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AN EVALUATION OF THE MICHIGAN DEPARTMENT OF NATURAL RESOURCES TRAFFIC SURVEY AND ALTERNATIVE PROPOSALS TO PROVIDE AN EARLY ESTIMATE OF THE FIREARM DEER SEASON HARVEST

By

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ABSTRACT

AN EVALUATION OF THE MICHIGAN DEPARTMENT OF NATURAL RESOURCES TRAFFIC SURVEY AND ALTERNATIVE PROPOSALS TO PROVIDE AN EARLY ESTIMATE OF THE FIREARM DEER SEASON HARVEST

By

Eric L. Heimerl

The Michigan Department of Natural Resources (MDNR) has used a Traffic Survey to provide an early estimate of the annual firearm deer season harvest since 1952. At the time of the survey's design hunter travel patterns in Michigan were well known and easily predicted, most of the hunting was done in the northern 2/3 of the state by hunters traveling from the south. Today, hunting patterns in Michigan are evenly distributed throughout the state. Given this change in hunter distribution, can the traffic survey still provide accurate estimates? Using stepwise regression procedures to derive estimates from the current traffic survey data produced total annual state kill estimates with a mean difference from the mail survey of 11.03% for the years 1987 to 1999. No data set manipulation or modification of the model selection methods produced estimates that were any closer to the mail survey for this same time period. No data set or model selection method met the level of precision desired for an initial estimate of the harvest set by the MDNR (within 5% of the mail survey, 95% of the time). If the current desired level of precision must be met, the traffic survey should be replaced with a survey that is capable of this. An evaluation of several alternative surveys including a telephone survey proposal, a survey of deer processors, and a mandatory check are also discussed.

To my parents
Jeffrey and Faye Heimerl

To my dad, the hardest working person I know,
And my mom, who taught me the value of finishing what you start.

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I would also like to thank the members of the MDNR who helped me to understand how the traffic survey works, and for providing information on the history of the survey. These people include Brian Frawley, John Urbain, and George Burgoyne.

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INTRODUCTION

White-tailed deer (*Odocoileus virginianus*) management in Michigan essentially began in 1895 when the Michigan legislature passed a law restricting the deer season to November 1 through 25 annually, set a bag limit of 5 deer, and required the purchase of a license. In 1921 the state legislature voted to create a State Department of Conservation and in 1928 the Game Division was established within that department. The creation of the Game Division allowed for the hiring of personnel trained in the field of wildlife biology. This, in turn, provided for the initial collection of scientific data on the deer herd in Michigan. Surveys concerning population numbers and age-sex ratios, studies to correlate antler diameter with age, and hunter surveys to help determine the annual harvest were all initiated. This was the birth of scientific deer management in Michigan (Langenau, 1994).

Today the Michigan Department of Natural Resources (MDNR), formerly the State Department of Conservation, conducts numerous annual field surveys in an effort to gather data on the white-tailed deer herd in Michigan. Field surveys are used to estimate the population size; predict changes in the population due to harvest, births, and deaths; and gather information on the composition and health of the deer herd. Various field survey techniques have been developed to satisfy each of these needs. Annual pellet group surveys and dead deer searches are used to estimate the size of the spring herd in the upper peninsula (UP) and northern lower peninsula (NLP). Deer-vehicle accidents are used to monitor non-harvest mortality and have also been shown to correlate with the annual buck harvest. Summer deer observations conducted by

MDNR wildlife personnel provide insight into fawn production and can also serve as an indicator of the potential magnitude of the upcoming hunting seasons. Data collected from voluntary check stations during the hunting seasons are used to help determine the physical condition of local deer populations and provide information on the sex and age composition of the herd (Cook, 2001).

Harvest estimates are derived from an annual mail survey that is sent to approximately 5% of those that purchase a deer license. Mail survey estimates are considered to be representative of the true harvest, and are the benchmark by which other harvest surveys (e.g., traffic survey) are measured. Hunting is the major source of population reduction and it is important to have an annual estimate of the number and type of deer taken each year, by location, to correctly identify changes in population size and composition. The annual mail survey results are generally reported by May of the following year. In addition to the mail survey, an annual traffic survey is conducted during the firearm deer season to provide a rapid estimate of the harvest within 7 days from the end of the rifle season. Hawn and Ryel (1969) compared a direct count survey and a sampling survey of the harvest and discovered that the sampling survey was more accurate and efficient than the direct count. Therefore, harvest estimates can be advantageous over a direct count in both results and effort. However, for a survey to be valid it is imperative that survey methods are conducted consistently and are statistically sound.

In 1952 MDNR survey personnel developed and implemented a traffic survey (see Chapter 1 for details) to provide an immediate assessment of the firearm deer season harvest. I evaluated the data collection and statistical procedures used in the traffic survey.

The specific objectives of the study were to:

A. Examine the traffic survey by:

1) evaluating the need for the survey and its value to wildlife managers;

2) evaluating the data collection procedures to determine if the most accurate data possible are being collected;

3) evaluating the statistical validity of the survey design;

4) evaluating the statistical validity of the analysis procedures; and

5) making recommendations on the improvement or modification of the current survey.

B. Examine alternative survey methods (see below) by:

1) providing information on each survey based on states where it is currently in use; and

2) providing information on the plausibility of using such a survey in Michigan.

By meeting these objectives, this evaluation of the rapid firearm deer season harvest estimate will insure a high quality survey producing accurate data. The results of these analyses will also help to provide for increased public support of the MDNR's deer management practices in general, as it is a highly publicized result. Meeting the objectives stated for the alternative surveys will provide MDNR wildlife managers information on the potential use of these surveys in Michigan.

Chapter 1 is the evaluation of the traffic survey. It involves an examination of the components of the traffic survey to determine if the survey can provide accurate estimates using the current methodology. Chapter 2 is an examination of alternative survey methods to the traffic survey. These methods include a survey of deer processors, mandatory check stations, the use of number of license's sold to predict harvest, the use of the number of deer checked at voluntary check stations to predict harvest, and a telephone survey. Chapter 3 is a synopsis of recommendations based on the findings from the previous chapters.

CHAPTER 1

THE TRAFFIC SURVEY EVALUATION

Introduction

The traffic survey in Michigan evolved from the need to provide an initial assessment of the magnitude of the firearm deer season harvest (Hayne and Eberhardt, 1956). Traditionally, the mail survey has been used to derive an estimate of the magnitude and composition of the deer kill for all seasons. The one major disadvantage to the mail survey is that the results are not available until approximately 6 months after the firearm season has ended, usually sometime in May of the following year. This time lag brought about the need to develop a new survey capable of providing an estimate of the firearm deer season kill within seven days from the end of the season.

The traffic survey was developed by Don W. Hayne and Lee Eberhardt and was first used during the firearm deer season in 1952. At the time of the survey's development, deer hunting patterns in Michigan were well known and easily predicted. The majority of the hunting in the state was done in the UP and the NLP by hunters who lived in the Southern Lower Peninsula (SLP) (Hayne and Eberhardt, 1956). Therefore, hunters returning from the hunt could easily be surveyed by an observer counting deer carcasses attached to vehicles traveling southbound along major highways.

Counts were done along nine major north-south highways as they intersect M20 from 1952-1969. Starting in 1970 the counts were restricted to three locations; Bay

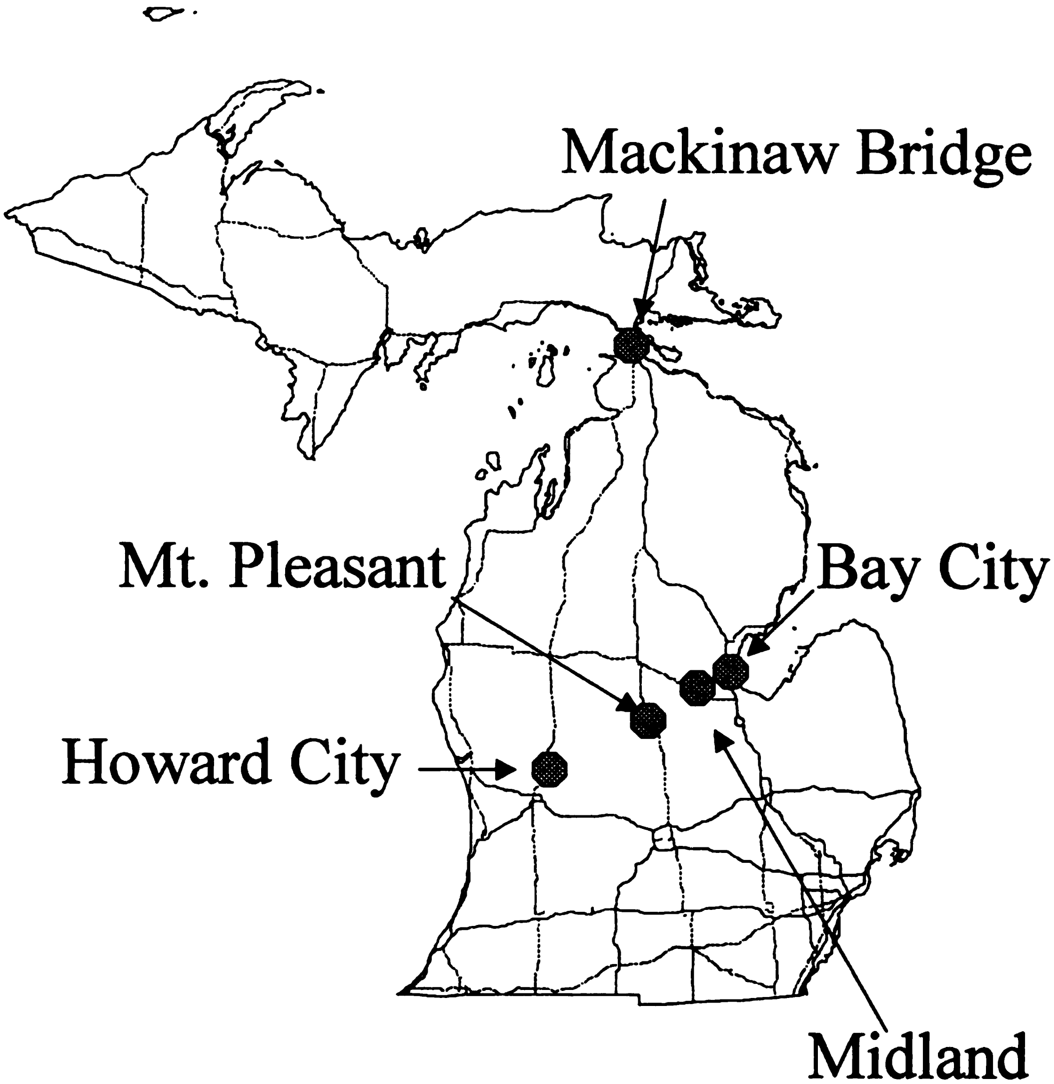


Figure 1. Location of the 2000 highway count locations.

City, Midland, and Mt. Pleasant (Figure 1). In 1988 an additional sampling location was added at Howard City, however, these data are not yet used in the regression equations due to inadequate sample size.

Hayne and Eberhardt (1956) described the strong features of the traffic survey as:

1) information is available quickly;
2) the basic information is easily understood (harvested deer traveling down a highway); and
3) the basic information does not depend on respondents in a poll, and thus may serve to evaluate the mail survey.

Weaker features of the survey noted were that:

1) important correction factors must be made in order to account for concealed deer; and
2) there is the risk of sudden and unrecognizable changes in hunter performance and patterns that the correction factors or the regression equations will not be able to predict.

A direct estimate of the harvest was computed up until 1956 based on the number of deer counted during the traffic survey corrected for the number of deer that highway observers were not able to count due to the deer being concealed (v/c ratio), and supplemented with additional information concerning the estimated number of harvested deer that did not travel down a major highway. Information on whether a deer was concealed or not is supplied by hunters voluntarily stopping at an MDNR highway check station and an MDNR employee noting whether or not the deer would have been visible to a highway observer. The estimated number of harvested deer that hunters did not remove from the immediate area of the kill (i.e., take home) is estimated from previous years' hunter reports. These three factors were used to compute an estimate of the harvest.

Starting in 1956 the kill was predicted using simple linear regression of the historical mail survey results on the count of visible deer seen throughout the firearm season. The Statistics Research Division, Research Triangle Institute (1966), conducted a review of the traffic survey and found the results to "agree very closely" with the mail survey results, although the traffic survey tended to underestimate the harvest. Since 1966 no outside evaluation of the traffic survey has been conducted.

At some point (date unknown) the v/c ratio method was incorporated into the regression method to form a hybrid survey that is used today. Additionally, the use of simple linear regression was eliminated in favor of stepwise regression procedures involving 18 independent variables, which are derived from the count locations. No record has been found pertaining to when the survey switched from simple linear regression to stepwise regression.

Current traffic survey procedures are as follows:

A. Data collection

1. Counts are taken daily from November 15th through 30th for ½ hour time periods starting at 10:00 a.m., 12:00 p.m., 2:00 p.m., 4:00 p.m., and 4:45 p.m. (data collected during the 4:45 count is for the 6 to 8 p.m. period) at four locations (Figure 1):

   a. Bay City

   b. Midland

c. Mt. Pleasant

d. Howard City (data collection began in 1988, these data are not used in the regression equations as of 2000)

2. Only visible deer are counted. Visible is defined as any deer that an observer would have been able to see if standing along the roadside. Today observers typically sit under an overpass and have an elevated view of passing traffic. Only deer that would have been seen from the roadside are counted, this is to keep current data consistent with historic data.

3. Visual / concealed ratios are recorded at three highway check point locations (Figure 2).

   a. Alma

   b. Big Rapids

   c. Birch Run

4. An independent count is done at the Mackinaw Bridge by Mackinaw Bridge employees.

B. Data Analysis

1. The number of visible deer counted at each location is adjusted for the time periods that counting did not take place. Each ½ hour block is multiplied by 4 to derive the total count for the two hour period. The 4:00 count is used to estimate 4 – 6 p.m., the 4:45 count is used to estimate 6 - 8 p.m. Nighttime counts are derived in the following manner:

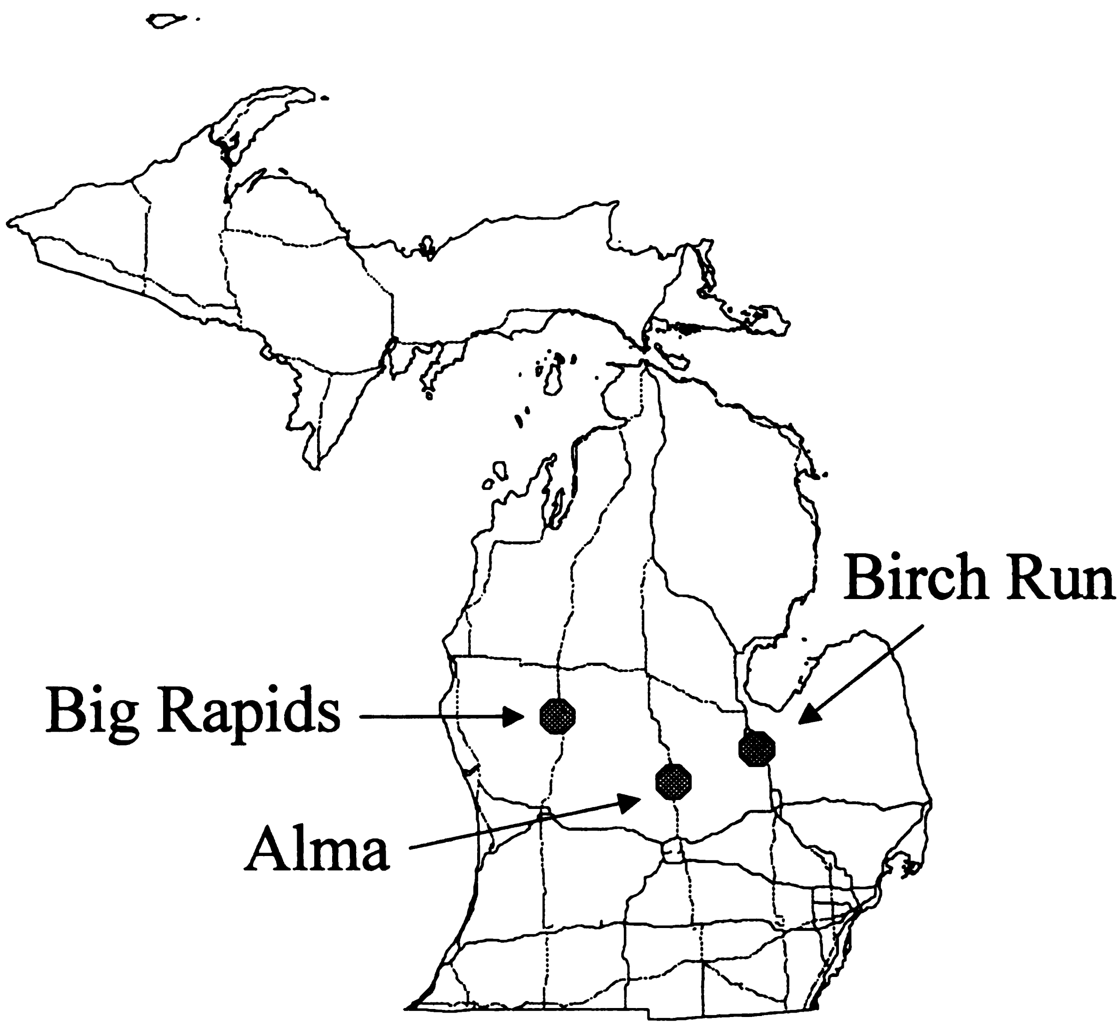


Figure 2. Location of the 2000 highway check stations. Alma was discontinued after the 2000 firearm deer season.

a. 8:00-10:00 a.m. counts are ½ of the 10:00-12:00 a.m. counts

b. 4:00-8:00 a.m. counts are ½ of the 8:00-10:00 a.m. counts

c. Midnight to 4:00 a.m. counts are ½ of the 4:00-8:00 a.m. counts

d. 8:00-10:00 p.m. counts are the same as 6:00-8:00 p.m. counts

e. 10:00-12:00 p.m. counts are ½ of the 6:00-8:00 p.m. counts

2. These daily components are then summed to form the daily count for each of the four locations. A sum for each location is calculated at the end of the season.

3. Each location is then adjusted for the number of concealed deer. This adjustment is done by multiplying the inverse of the appropriate visual / concealed ratio by the derived count for each location. The appropriate visual / concealed ratio for each location is as follows:

   a. Bay City – Birch Run

   b. Midland – Birch Run

   c. Mt. Pleasant – Alma

   d. Howard City – Big Rapids

4. After the v/c ratio adjustment, count data from Bay City are multiplied by a factor of 1.12. This correction factor is only applied to the Bay City data; it was developed when the sampling point located on M-13 was discontinued. The exact date when this occurred is unknown, but was probably sometime in the mid-1960's. The correction factor is based on a comparison of the counts on M-13 and US-23 (currently the I-75 location) previous to the closing of the M-13 location. The

correction was intended to compensate for the removal of the sampling location at M-13 (G. Burgoyne, MDNR, personal communication), and to provide historical continuity between data collected before and after this closing.

5. At this point 18 independent variables are developed from the count at the Mackinaw Bridge and the three highway count locations (Howard City is not yet included). These variables are entered into a stepwise regression process and are used to predict the total harvest and six other dependent variables as indicated in Table 1.
6. Due to the design of the traffic survey accurate estimates can only be derived for the UP and NLP. An estimate of the SLP deer harvest is based on information from wildlife management unit supervisors, who rely on employee/hunter contacts during the firearm season.
7. Before a final report is released the estimates provided by the stepwise regression models and wildlife management unit supervisors are further analyzed by MDNR wildlife personnel. Adjustments to the estimates may be made based on factors affecting the deer season that are not considered in the models. The effects of weather, hunter numbers, predicted hunter effort, and information from MDNR wildlife management unit supervisors are all considered before a final estimate is released.

Table 1. Traffic survey independent and dependent regression variables.

Variables	Description
Independent	
straits count	Count at the Mackinac Bridge-conducted independently by bridge toll booth employees
STRASQ	Mackinac Bridge count squared
baycity	Count at Bay City[a]
midland	Count at Midland[a]
mount pleasant	Count at Mt. Pleasant[a]
BCMI	Bay City + Midland Counts
BCMT	Bay City + Mt. Pleasant Counts
MIMT	Midland + Mt. Pleasant Counts
total deer	Bay City + Midland + Mt. Pleasant Counts
visible deer	Total visible deer from all three locations[b]
BCSQ	Bay City count squared
MIDSQ	Midland count squared
MTPSQ	Mt. Pleasant count squared
BCMISQ	Bay City + Midland count squared
BCMTSQ	Bay City + Mt. Pleasant count squared
MIMTSQ	Midland + Mt. Pleasant count squared
TOTSQ	Bay City + Midland + Mt. Pleasant count squared
VISSQ	Total visible deer from all three locations squared
R2 pellet count adjusted	Region 2 Pellet count--not used in all years
Dependent	
total kill	Total statewide kill, bucks and does
R12KILL	Region 1 and 2 combined total kill
upper peninsula kill	Upper peninsula total kill
n. lower peninsula kill	Northern lower peninsula total kill
R12BKILL	Region 1 and 2 combined total buck kill
upper pen. buck kill	Upper peninsula total buck kill
n. lower pen. buck kill	Northern lower peninsula total buck kill

[a]. Count includes correction for times not counted (nighttime), Bay City correction factor (1.12, only applied to Bay City data) and adjustment for visible/concealed ratio.

[b]. Visible deer are numbers from each location corrected for times not counted, but not adjusted with the visible / concealed ratio.

It is important to differentiate between the estimates derived from stepwise regression procedures and the estimates that are reported for the traffic survey. The reported estimates contain the professional opinion of MDNR wildlife division employees and are not purely a function of the traffic survey methodology or stepwise regression procedures. Over the past decade, traffic survey stepwise regression estimates have needed more of this adjustment to accurately estimate the harvest (H. Hill, MDNR, personal communication). Although the magnitude of this adjustment can be observed annually, there is no way to examine the methodology involved in this professional opinion, as it is a dynamic process. This evaluation of the traffic survey may serve to reduce, or eliminate, the need for these adjustments.

The purpose of this evaluation is to examine the traffic survey and determine if the survey is still providing an accurate early estimate of the firearm deer season harvest. In addition to the accuracy of the estimate, the evaluation will determine if the procedures being used to collect data are the best possible. The evaluation will also determine if the statistical procedures used to analyze the data are valid.

Methods

Examination of the traffic survey began by compiling the data from different sources. Daily traffic count data from each location (Bay City, Mt. Pleasant, Midland, and Howard City) for the years 1987 to 1999 were compiled in Microsoft Excel and organized by day, year, and location. Daily traffic count data include actual counts for each time period counted, and the extrapolated estimates for the periods not counted for each day of the season, at each count location. These count data, along with all of the mail survey kill data (1970-1999) and additional years of traffic survey data (1970-1986), serve as the basis for the evaluation. Mail survey kill data includes the following variables: total state kill, total Region I kill (UP), total Region II kill (NLP), total Region I and II combined kill, total Region I buck kill, total Region II buck kill, and total combined Region I and II buck kill. The additional years of traffic survey data (1970 – 1986) are the total for each location for each year, but are not divided into daily counts. Individual daily location counts for the years 1970 to 1986 are not known.

Data are also collected annually at the Mackinaw Bridge. Tollbooth employees record the number of harvested deer that pass through their toll station during the firearm deer season. Data are summed over the season and a total season count is used in the traffic survey estimates. These data were compiled and added to the data set containing the other variables.

Once all of these data were collected, an understanding of the survey's design, history, and current procedures was obtained through researching literature (Hayne and Eberhardt, 1956) and through discussions with current MDNR personnel. It was important to understand the history of the survey to identify areas where changes have occurred and to evaluate the necessity of these changes.

After a history of the survey had been completed, several general areas of the survey where changes had occurred were selected for evaluation. These areas are the nighttime count adjustments, the v/c ratio, the Bay City correction factor, and the model selection method.

Nighttime Count Adjustments

The nighttime count adjustments were evaluated by comparing the current adjustments (Table 2) with years when actual nighttime counts were performed. Night counts were performed at the Bay City count location during the years 1987 – 1998 for the 8-10 p.m. and 10-12 p.m. time periods, aided by the use of a light strung across the highway. Currently the 8 – 10 p.m. period is estimated as the same as the 6 – 8 p.m. count, for a ratio of 1.0. The 10 – 12 p.m. period is estimated to be ½ the 6 – 8 p.m. count for a ratio of 0.5. The mean count for each of these time periods (8 – 10 p.m. and 10 – 12 p.m.) taken at the Bay City location was compared to the mean count data for 6 – 8 p.m. at the Bay City location for the years 1987 – 1999, to produce new ratios based on the actual count data. These new ratios were evaluated against the current adjustments using a one sample t-test to determine if any differences existed.

Visible / Concealed Ratio

The next component of the traffic survey to be analyzed was the v/c ratio data. Data on whether or not a deer would have been visible to a highway observer are collected annually at highway check stations. As a vehicle pulls into a highway check station, workers record whether or not the deer would have been visible to a highway observer at roadside level. The v/c ratio is one of many variables collected at highway check stations during the firearm deer season. Additionally, information is collected on the age and sex of the deer, deer management unit of harvest, the beam diameter of the antlers if the deer is male, lactation status for females, whether the

Table 2. Traffic survey count periods and corresponding adjustments.

Period	Adjustment
Midnight – 4 a.m.	½ 4-8 a.m.
4-8 a.m.	½ 8-10 a.m.
8-10 a.m.	½ 10-12 a.m.
10-Noon	No adjustment
Noon-2 p.m.	No adjustment
2-4 p.m.	No adjustment
4-6 p.m.	No adjustment
6-8 p.m.	No adjustment (data from 4:45 count)
8-10 p.m.	Same as 6-8 p.m.
10-Midnight	½ 6-8 p.m.

deer was taken on public or private land, and a body cavity check for bovine tuberculosis. Collectively these data (all of the data collected at check stations throughout the firearm deer season) are known as the biophysical data and were compiled in the biophysical data work done by Cook (2001). The v/c ratio data were graphed for the years 1987-1999 to help determine any trends. V/C data were collected annually at three highway check stations through 2000, after the 2000 deer season the highway check station at Alma was discontinued. To find a replacement for the data lost at Alma, the v/c ratio's collected at each station were analyzed using ANOVA (F-tests were performed to test for equal variances) to determine if differences existed between the stations or between years.

Bay City Correction Factor

The correction factor that is applied to the Bay City count data was also examined to determine it's orgin and necessity. Sometime before 1970 (actual date is not known) counts on M-13, immediately to the east of I-75, were discontinued. To make up for this loss of data, a scaling factor was added to the Bay City count. This factor was determined to be 1.12 and is still in use today. A new data set was created by taking out this factor for all Bay City data from 1970 – 1999 and the stepwise regression procedures were run for 1987 – 1999 to determine if any changes occured.

Model Selection Methods

Stepwise regression procedures are currently used to select the appropriate model. Stepwise regression procedures have been in use since at least 1970. Over this 30-year period some relationships should have developed between the independent and dependent variables. In an effort to find the strongest linear

Table 3. List of independent and dependent variables used in simple linear and two variable multiple regressions. Description of the independent variables are located in Table 1.

Independent	Dependent
straits count	Total Kill
visible deer	Region I & II kill
total deer	U.P. kill
baycity	Region II kill
mount pleasant	Region I & II buck kill
midland	U.P. buck kill
BCMT	Region II buck kill
BCMI	
MIMT	

relationship between the independent and dependent variables and to simplify the regression procedures from stepwise regression to simple linear regression each of the nine independent variables listed in Table 3 were plotted against each dependent variable.

Several other data sets and model selection methods were also examined. The first of which was to transform the dependent variable each year by making it the average of the previous year, the current year and next year's kill. This makes each annual estimate a 3-year running average. This new data set was then entered into stepwise regression. This should have helped to eliminate any large flucuations in the annual estimates.

The next data set that was created used independent variables that did not contain the v/c ratio adjustment. Each independent variable was the number of deer counted adjusted for the nightime count and extrapolated to the full two hour counting block, but not adjusted for the v/c ratio. This data set was also entered into stepwise regression.

It was hypothesized that the v/c ratio collected at different locations throughout the state should be the same. There is no reason to suspect that hunters travelling in one part of the state are more inclined to conceal their deer than hunters in a different part of the state. Under current methodologies each count location adjusts the counts using the v/c ratio derived from the nearest highway check station. A new data set was created that used a state average v/c ratio. This data set was also entered into stepwise regression.

If the v/c ratio remains constant from year to year the number of deer counted by highway observers annually should reflect the total kill. This was tested by entering the number of deer counted (visdeer) into simple linear regression against the annual harvest.

One other model selection method was examined, aside from stepwise regression. This was the Schwarz's Bayesian Information Criterion (SBC). This model selection method differs from stepwise regression in that it considers all possible models that can be created using all of the independent and dependent variables in every combination. Stepwise regression procedures do not evaluate every possible model. For this reason it was hypothesized that SBC would provide a more thourough analysis of the data and possibly a more accurate model.

During the course of these examinations it was noticed that the estimates for the year 1995 were extremely high regardless of the data set or model selection method used to evaluate the data. For this reason a new data set was created that deleted all of the 1995 data. This data set was entered into stepwise regression. Also, the examination that used the visdeer variable in simple linear regression against the annual kill proved to be unreliable. It was noticed that the estimates seemed to lag behind by one year. To eliminate this time lag a data set was created with two variables, visdeer and last year's kill (lykill). These two variables were entered into multiple regression against the annual kill.

Based on all of the previous findings a final model was created that should be able to best predict the annual harvest. This model was based on the original data set modified in the following ways: 1) The v/c ratio was changed to a state average. 2)

Nighttime counts were adjusted using new adjustments. 3) The Bay City correction factor was taken out of the data. This data set was then entered into stepwise regression proceudres.

Results and Discussion

Daily traffic count data from each location (Bay City, Mt. Pleasant, Midland, and Howard City) for the years 1987 to 1999 were compiled in Microsoft Excel and organized by day, year, and location. A graph of these data shows that approximately 50% of the annual count is taken from the Bay City location; the other three locations equally contribute to the remaining 50 % of the data (Figure 3). These count data, along with all of the mail survey kill data (1970-1999) and additional years of traffic survey data (1970-1986), which were already in Excel, serve as the basis for the analysis.

Examination of the survey's history and discussions with current survey personnel uncovered inconsistencies that have developed in the survey over time. It is apparent that the current survey does not accurately reflect the original design. At the time of the survey's design, hunting patterns in Michigan were well known and easily recognized. Most of the hunting took place in the northern 2/3 of the state by hunters traveling from the south. Therefore, a survey of harvested deer attached to vehicles traveling southward during the deer season provided a logical basis for an estimate of the annual harvest. The design of the survey allowed for these data (counts of harvested deer) to be analyzed by two separate methods, each producing a harvest estimate.

The first method to estimate the kill is by making corrections to the number of deer counted traveling down the highway to account for the number of deer not seen (concealed) and the number of deer that were not removed from the immediate area of harvest. The number of concealed deer is estimated at highway check stations

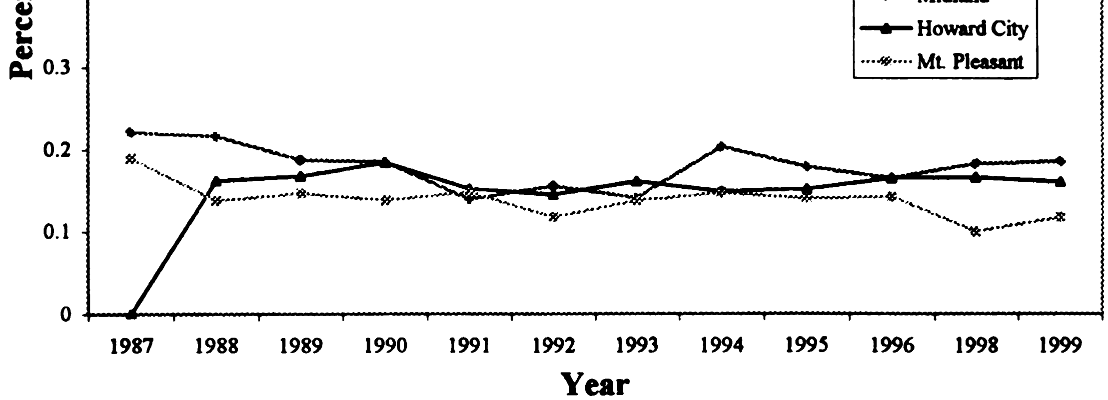


Figure 3. Percent of total annual traffic survey count by location, 1987 to 1999.

where check station workers record whether or not a deer would have been visible to a highway observer. These records are compiled at each highway check station to obtain the visible / concealed ratio (v/c ratio). The number of visible deer counted traveling down the highway is then divided by the percent visible deer from the check stations [v/(v+c)] to derive the total number of harvested deer traveling down the highway. To determine the complete harvest an additional correction must be made for deer that were not removed from the immediate area of harvest. This correction is obtained from previous years' hunter reports. Applying these two corrections to the count of visible deer results in a direct estimate of the harvest.

The second method for estimating the harvest involved the use of simple linear regression of the mail survey results upon the number of visible deer counted during the highway survey. Neither of the previously mentioned correction factors, the v/c ratio or the number of deer not removed from the immediate area of harvest, are used in this method. This method relies on past relationships between harvested deer seen attached to vehicles and the results of the mail survey. A 1956 Hayne and Eberhardt report indicated that the regression method seemed to be the more satisfactory of the two.

Today the traffic survey is a hybrid of the two methods and is conducted in two separate stages. The first stage involves counting visible deer at highway count locations and then adjusting this count for the number of concealed deer by the use of the v/c ratio. These data are combined in various forms to derive 18 independent variables as listed in Table 1. These independent variables are used to predict 7 dependent variables (Table 1) by the use of stepwise regression procedures. The resulting estimates serve only as a starting point for the second stage. At this point wildlife biologists apply their professional opinions regarding factors the regression procedures cannot predict such as hunter performance, weather, and the introduction of special seasons or restrictions to adjust the regression estimates. Thus, the final estimate is not a purely statistical one, but rather one that also incorporates professional opinion.

Studying the history of the survey has uncovered very little record of how the survey evolved into what it is today. The reason for incorporating the v/c ratio estimates into the regression procedures and the date when this occurred are not known. The basis for correction factors such as the nighttime count adjustment and the Bay City correction factor pre-date any of the current survey personnel and no written record can be found. Because of this lack of written records, the original idea behind and need for the changes that have occurred are not known, and thus the current necessity of these components is difficult to assess.

Nighttime Count Adjustments

The first part of the survey that was examined was the nighttime count adjustments. Counts are currently adjusted according to the schedule in Table 2. The accuracy of these adjustments was examined by comparing them to the years 1987-1998 when actual night counts were done.

Nighttime counts were conducted for a range of 2-5 days/season during the 8-10 p.m. and 10-12 p.m. time periods during the years 1987 – 1998 at the Bay City count location. Currently the 8-10 p.m. time period is estimated as the same as the 6-8 p.m. count producing a ratio of 1.0. Actual 8 -10 p.m. counts produce a mean ratio of 2.2

when compared to the 6-8 p.m. counts, which is significantly different from 1.0 (p=0.0114). The 10 –12 p.m. counts are estimated as ½ of the 6-8 p.m. counts. Actual count data produced a ratio of 1.1, which is significantly different from 0.5 (p=0.0024). This analysis indicates that the current adjustments underestimate the actual adjustment ratios for both the 8-10 p.m. time period and the 10-12 p.m. period.

A new variable was created using these new nighttime adjustments, which are based on the actual nighttime counts from the Bay City location. These new nighttime adjustments are 2.2 for the 8-10 p.m. period and 1.1 for the 10-12 p.m. period. This new variable is the number of visible deer counted (no v/c ratio adjustment) adjusted with the new nighttime adjustments. Data from each location, not just Bay City, were adjusted using the new nighttime adjustments. The number of visible deer counted is the sum of all deer counted at each location for the entire season. To evaluate which set of nighttime adjustments can best estimate the total statewide harvest, each of these variables, the visible deer count adjusted with the current nighttime adjustments and the visible deer count adjusted with the new nighttime adjustments, were entered separately into simple linear regression against the total statewide kill.

Simple linear regression using the current nighttime adjustments on the total kill produced an R^2 value of 0.295. Simple linear regression of the visible deer count using the nighttime adjustments actually collected at Bay City for the years 1987 – 1999 on the total kill produces an R^2 value of 0.323. This slight increase in model R^2 values indicates the new nighttime adjustments may provide more accurate estimates than the current adjustments.

Nighttime counts have not been performed at any other location. Additionally nighttime counts at Bay City have not been performed for any other nighttime periods. However, based on the data collected from the 8-10 and 10-12 p.m. periods, and the findings from the examination of those data, the adjustments made during all of the nighttime periods may need to be changed. To find out exactly if changes need to occur, nighttime counts need to be performed during the periods of Midnight to 4 a.m., 4 to 8 a.m., and 8 to 10 a.m. The count data collected during these periods can be used to determine if current adjustments are accurate. If current adjustments are not accurate, changes should be made based on the new data.

Visible / Concealed Ratio

The next component of the traffic survey to be analyzed was the v/c ratio data. As a vehicle pulls into a highway check station, check station workers record whether or not the harvested deer would have been visible to a highway observer at roadside level. The v/c ratio is derived by dividing the number of visible deer recorded at the check station by the total number of deer (visible and concealed) that passed through the station. What traffic survey personnel commonly call the v/c ratio is mathematically the percent visible deer that passed through the highway check station and not the ratio of visible to concealed deer. This is important to note, as the ratio of visible to concealed deer would not be equal to the percent visible deer. However, to keep this report consistent with traffic survey terminology the percent visible deer will be referred to as the v/c ratio.

Visible / concealed data collected from highway check stations were taken from the biophysical data compiled by Cook (2001) and separated into their own file.

Highway check stations are only open for the first 3-5 days of the season. The v/c ratio collected over that period is used to predict the true number of deer that passed in front of highway observers for the entire season. Visible / concealed data are collected at three highway check stations; Alma, Big Rapids, and Birch Run. Currently a separate v/c ratio is calculated for each highway check station location.

These v/c ratio data were graphed for the years 1987-1999 to help determine any trends. For the years 1987-1999 there is a decreasing trend, in 1987 approximately 59% of the deer were visible to a highway observer, by 1999 this number had dropped to about 47% of deer being visible (Figure 4). It should also be noted that in 1952 at the time of the survey's design it was estimated that approximately 90% of the deer were visible to a highway observer. This rapid increase in concealed deer is assumed to be the reason for incorporating the v/c ratio into the regression procedures. Counts of visible deer alone cannot accurately reflect total kill if the percentage of concealed deer changes each year. An MDNR report from the early 1970's (author and date are unknown) indicates that the regression equations were having problems adjusting fast enough to the changing v/c ratio. It attributes the changing ratio in part to an increase in enclosed vehicles, the new Interstate freeway system, and hunters' tendency to drive through the night.

Due to the closing of the Alma highway check station starting in 2001 some examination into a substitute v/c ratio recording location was also done. ANOVA for the three highway check stations (Alma, Big Rapids, Birch Run) showed that there was no statistical difference ($P = 0.1222$) between the v/c ratio collected at any of the stations across the years 1987 to 1999. Given this information any of the two

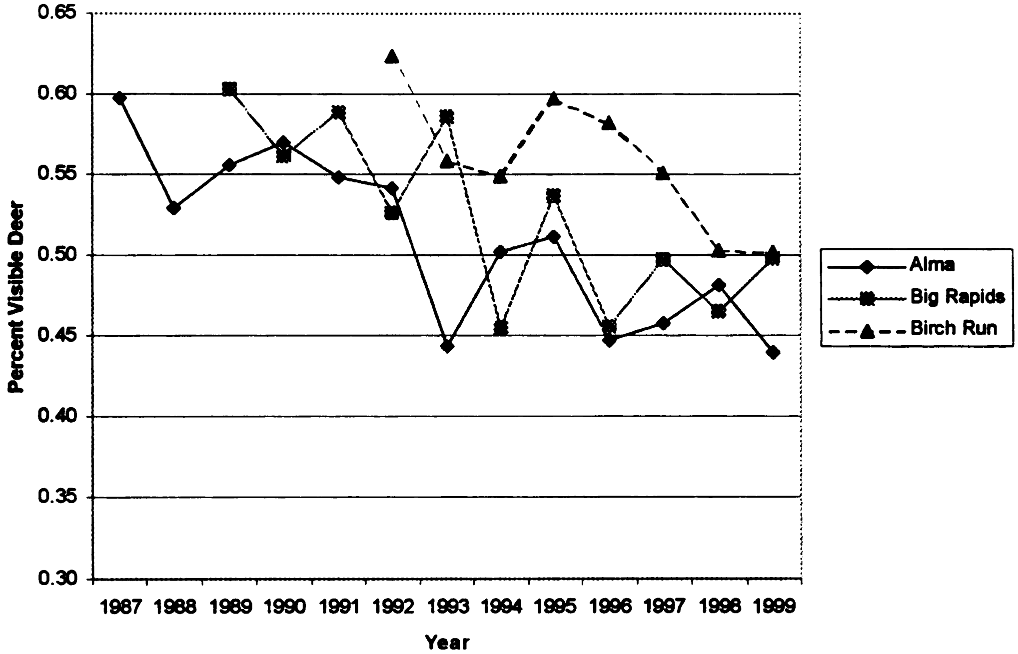


Figure 4. Percent visible deer at 3 highway check stations, 1987 to 1999.

remaining stations can be used in place of the v/c ratio data that were collected at Alma. This also suggests that in place of the current site specific method of assigning a v/c ratio to a count location, a statewide average v/c ratio can also be used. Currently counts done at Bay City and Midland are adjusted using the Birch Run v/c ratio, counts at Mt. Pleasant use the Alma ratio, and counts done in Howard City are adjusted using the v/c ratio collected in Big Rapids.

Bay City Correction Factor

The correction factor that is applied to the Bay City count data was examined to determine it's orgin and necessity. A new data set was created by taking this factor out of all Bay City data from 1970 to 1999. This new data set also used the statewide v/c ratio for the years 1987 to 1999.

Stepwise regression procedures were run for 1987 to 1999 using this new data set. Removal of this correction factor did not change the estimates. The average estimate for these years with the correction factor was 293,689. The average estimate using the data set without the correction factor was 293,608. Variances are equal ($p=0.4866$). These two average estimates are not statistically different from one another ($p=0.9979$). Because this correction is a constant, it's inclusion or removal is simply compensated for by the regression coefficient. These analyses indicate the correction factor is not necessary and should be removed from the data.

Model Selection Methods and Alternate Data Sets

Simple Linear Regression

Traffic survey estimates have been derived using stepwise regression procedures since at least 1970. The data set used in these examinations contains variables for 30 years, 1970 to 1999. The use of stepwise regression is recommended when the relationships between the sets of dependent and independent variables are not known, or cannot be accurately hypothesized (Neter et al., 1996). Since 1970, relationships between the dependent and independent variables used in the traffic survey may have developed, and stepwise regression procedures may no longer be needed to determine the best model every year.

To find the strongest linear relationship between the independent and dependent variables and to simplify the regression procedures from stepwise to simple linear regression each of the 9 independent variables listed in Table 3 were plotted against each dependent variable. The plots were examined visually. Simple linear regression was used to analyze the two independent variables that showed the strongest linear relationship with each dependent variable. The two strongest relationships for each dependent variable are listed in Table 4.

Multiple regression was used to evaluate both of the two strongest independent variables in a single model against each dependent variable. These results are also in Table 4.

For each of the seven dependent variables a fairly strong linear relationship was found with at least one of the independent variables. The strongest linear relationship between a dependent variable and an independent variable is the relationship between the U.P. kill (Upkill) and the straits count (straits) which had an R^2 value of 0.9079. The weakest relationship was between the total state kill (totkill) and Bay City + Mt. Pleasant (bcmt) with an R^2 of 0.7616.

Table 4. Two best predictors for each dependent variable (R^2 value) using simple linear regression, and R^2 value for multiple regression using two best predictors.

Dependent	Independent		
Total kill	BCMT (0.7616)	total deer (0.7313)	(0.7634)[a]
Region I & II kill	BCMT (0.8587)	total deer (0.8327)	(0.8590)
U.P. kill	straits count (0.9079)	mt. Pleasant (0.6042)	(0.9287)
Region II kill	total deer (0.8660)	bay city (0.8632)	(0.8735)
Region I & II buck kill	BCMT (0.8663)	total deer (0.8198)	(0.8741)
U.P. buck kill	straits count (0.8197)	mt. Pleasant (0.6375)	(0.8689)
Region II buck kill	BCMT (0.8581)	total deer (0.8264)	(0.8595)

[a]. Last value is R^2 for multiple regression with the two variables listed

Only three of the nine different independent variables tested were found to have the stronges relationships with the seven dependent variables. Of these independent variables, Bay City + Mt. Pleasant (bcmt) was the best predictor for four of the dependent variables, including total state kill (totkill), region I and II kill (R12kill), region I and II buck kill (R12bkill), and the region II buck kill (R2bkill). The Mackinaw bridge count (straits) was the best predictor for the U.P. kill (Upkill) and for the U.P. buck kill (Upbkill). Total deer (totdeer) was found to be the best predictor of the region II kill (R2kill).

The independent variable Midland did not end up being selected by itself or in conjunction with any other independent variable, aside from it being a part of the total deer variable. The independent variable visible deer was not selected either, although it is the basis for the total deer variable.

Stepwise Regression Using a Statewide Average V/C Ratio

Examination of the v/c ratio data indicated that the use of a statewide v/c ratio might provide more accurate data than the current way the v/c ratio is used. Currently, data from each highway count location is adjusted using v/c ratio data from the nearest highway check station where a v/c ratio is collected. A new data set was created that used the annual statewide average v/c ratio to adjust count data.

An average v/c ratio could be determined for the years 1987 to 1999. No data on the v/c ratio are available for the years 1970 to 1986. For the years when a statewide average v/c ratio could be determined, the number of deer counted at each location (Bay City, Midland, and Mt.Pleasant) was adjusted with this new v/c ratio. This resulted in new totals for each of these locations and a new statewide total (totdeer) for the years 1987 to 1999. The years 1970 to 1986 were not changed.

Stepwise regression was run using this data set to estimate total state kill. Estimates using these data may be slightly more accurate than the current site specific v/c ratio data. Estimates produced from stepwise regression procedures using this state average v/c data set were closer to the mail survey results than the site specific v/c ratio data set in 7 of the 13 years from 1987 to1999 and closer for the most recent four years (1996-1999). R^2 values for the models using the state average v/c ratio are 0.9578 versus 0.9599 for the models using the standard data set. These R^2 values are based on the model that uses the full data set (1970 – 1999) in both cases.

Other Models

Several other data sets and model selection methods were also explored. The method and the corresponding R^2 values produced using the full data set (1970-1999, unless otherwise noted) are listed in Table 5. The percent difference from the mail survey for each method is graphed in Figure 5. The following paragraphs will explain the rationale behind exploring each data set and model selection method. For each data set the R^2 values and the estimates obtained for each dependent variable will be compared to R^2 values and estimates derived from the standard data set analyzed using stepwise regression to determine if any of the modifications provide an improvement over what is currently done.

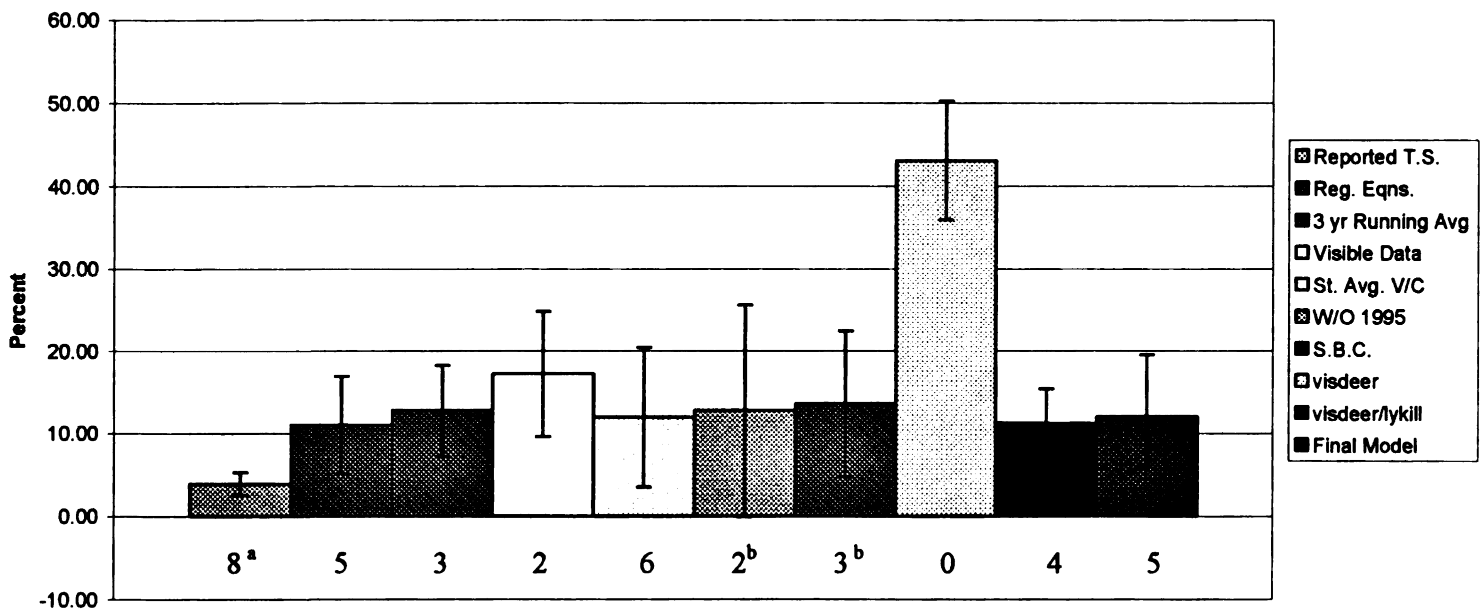
Table 5. List of R^2 values for several estimate methods (see text for details).

Dependent Variable	Method								
	Stepwise Reg. [b]	S.B.C	St.Avg.V/C	Visible Data	w/o 1995	visdeer	visdeer/lykill	3-Year Run. Avg.	Final Model
Totkill [a]	0.9599	0.9612	0.9578	0.9149	0.9593	0.2160	0.9138	0.9221	0.9580
R12kill	0.9650	0.9666	0.9532	0.9271	0.9605	0.3577	0.8656	0.8985	0.9690
Upkill	0.9388	0.9728	0.9426	0.9471	0.9268	0.1784	0.7523	0.8952	0.9410
R2kill	0.9096	0.9419	0.9600	0.8367	0.9410	0.4237	0.8325	0.8895	0.9500
R12bkill	0.9488	0.9488	0.9508	0.8959	0.9546	0.3880	0.8154	0.9093	0.9620
Upbkill	0.9222	0.9222	0.9097	0.9215	0.9164	0.2126	0.7931	0.8995	0.9250
R2bkill	0.9092	0.9388	0.9216	0.7932	0.9034	0.4751	0.7559	0.9194	0.9210
Mean	0.9362	0.9503	0.9422	0.8909	0.9374	0.3216	0.8184	0.9048	0.9466

[a]. Totkill – total state kill, R12kill – region I and II combined total kill, Upkill – total UP kill, R2kill – total region II kill, R12bkill – region I and II combined total buck kill, Upbkill – total UP buck kill, R2bkill – total region II buck kill.

[b]. Stepwise Reg. – original data set examined using stepwise regression procedures, S.B.C. – original data set analyzed using Schwarz's Bayesian Information Criterion, St.Avg.V/C – use of a state average v/c ratio on the original data set, Visible Data – data set without any v/c ratio correction, w/o 1995 – original data set without data from 1995, visdeer – simple linear regression using visdeer variable as the predictor, visdeer/lykill – multiple regression using visdeer and the last years kill as predictors, 3-year Run. Avg. – data set transforms the dependent variable into the mean of the current, previous, and next year, Final Model – incorporates a state average v/c ratio, no Bay City correction factor, and new nighttime adjustments. All data sets examined using stepwise regression procedures except the SBC model.

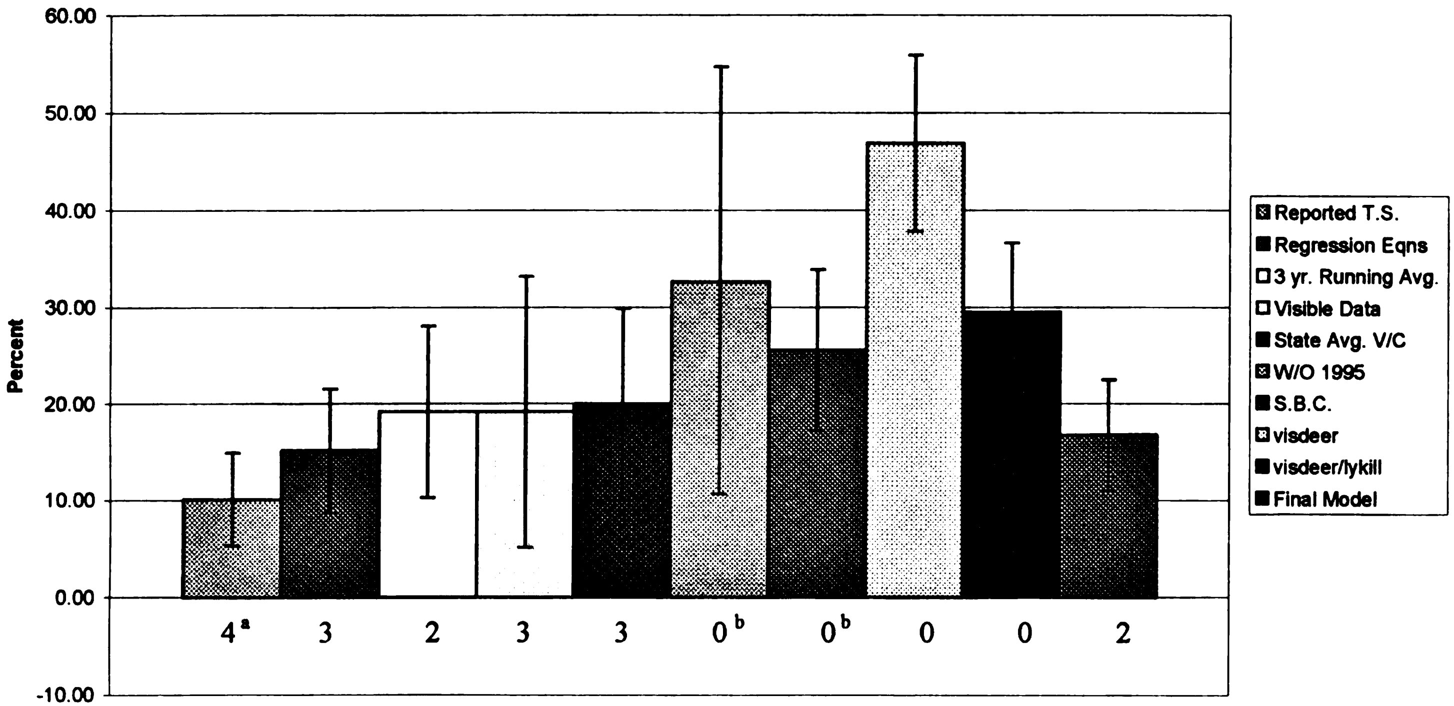
(a) Total Kill



[a]. Indicates the number of years out of 13 the prediction was +/- 5% from the mail survey
[b]. 2 of 4 years, 3 of 11 years

Figure 5. Average percent difference from the mail survey and the number of years the estimates met the desired precision for several data sets and estimate methods, 1987-1999. Error bars represent the 95% confidence interval. Reported T.S. is the reported value for the traffic survey, it includes the stepwise regression estimates adjusted for variables not considered in the traffic survey, see Table 5 for a description of the other methods.

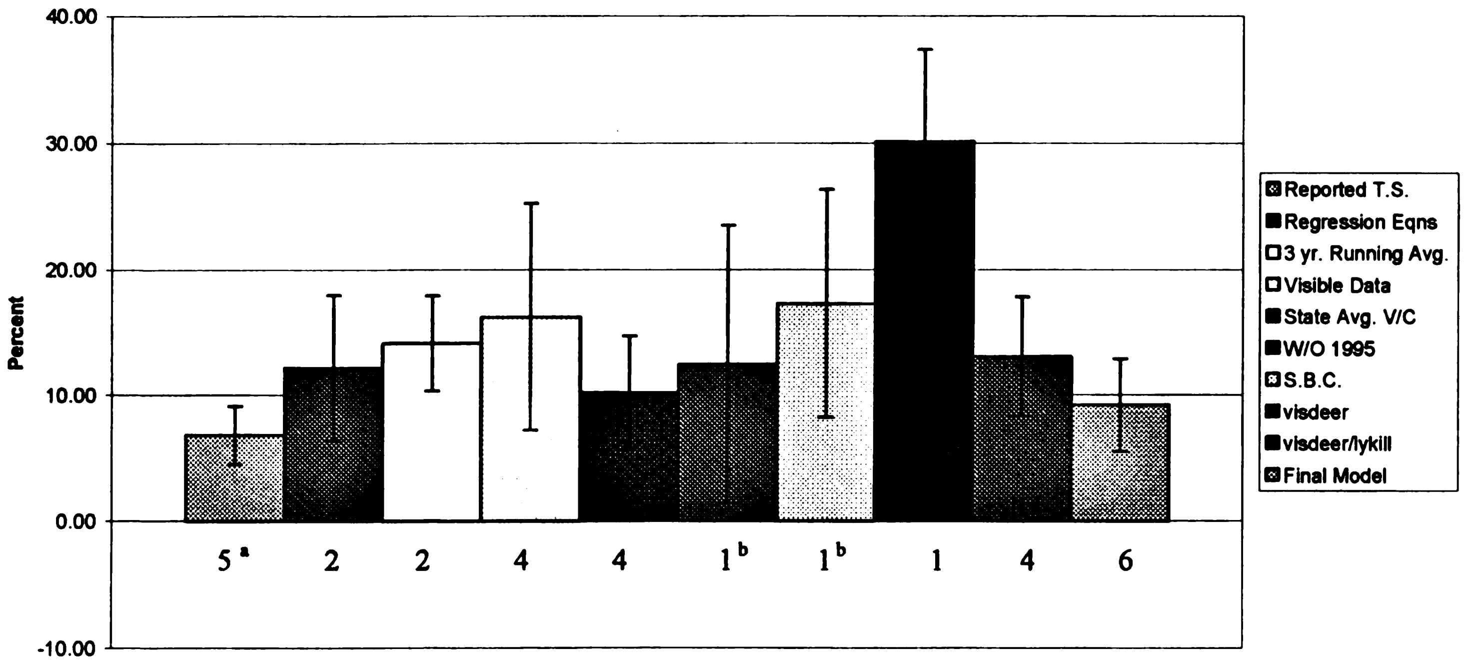
(b) U.P. Kill



[a] Indicates the number of years out of 13 the prediction was +/- 5% from the mail survey
[b] 0 of 4 years, 0 of 11 years

Figure 5 (cont'd).

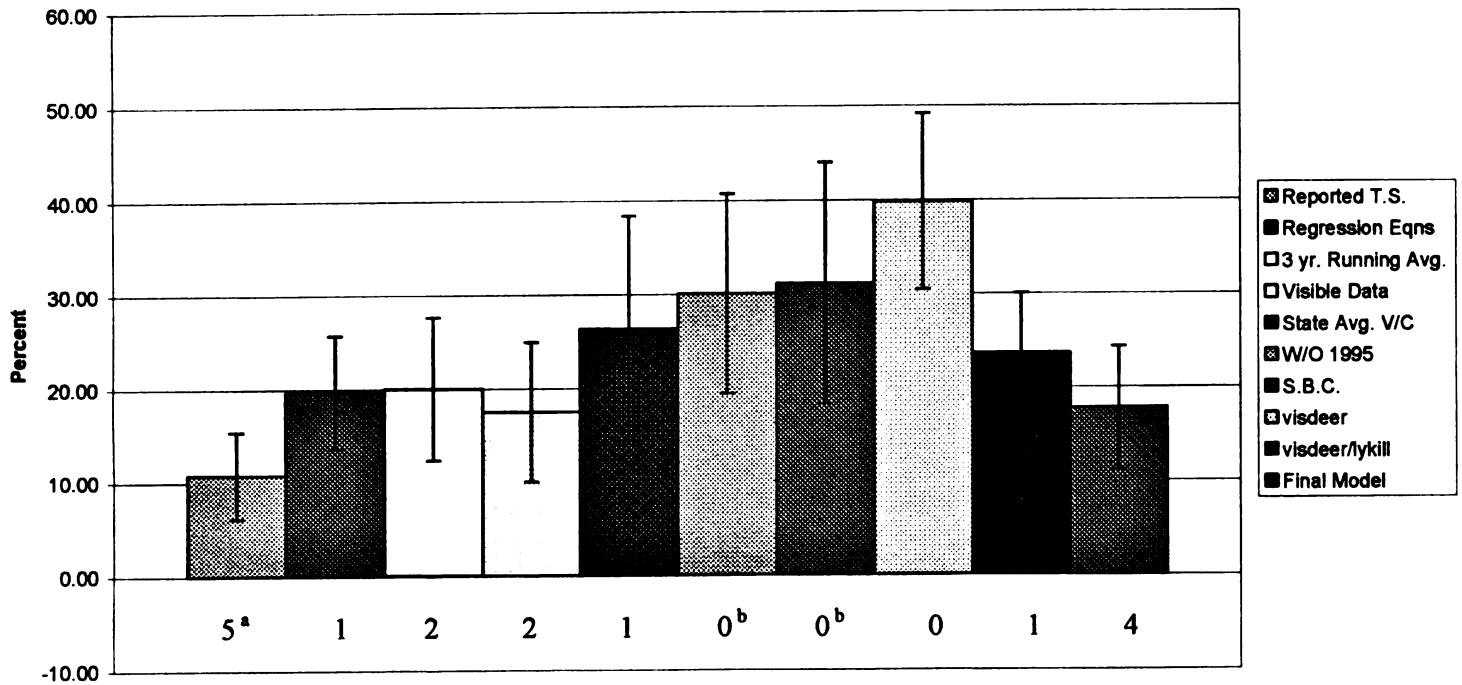
(c) Region II Kill



[a] Indicates the number of years out of 13 the prediction was +/- 5% from the mail survey
[b] 1 of 4 years, 1 of 11 years

Figure 5 (cont'd).

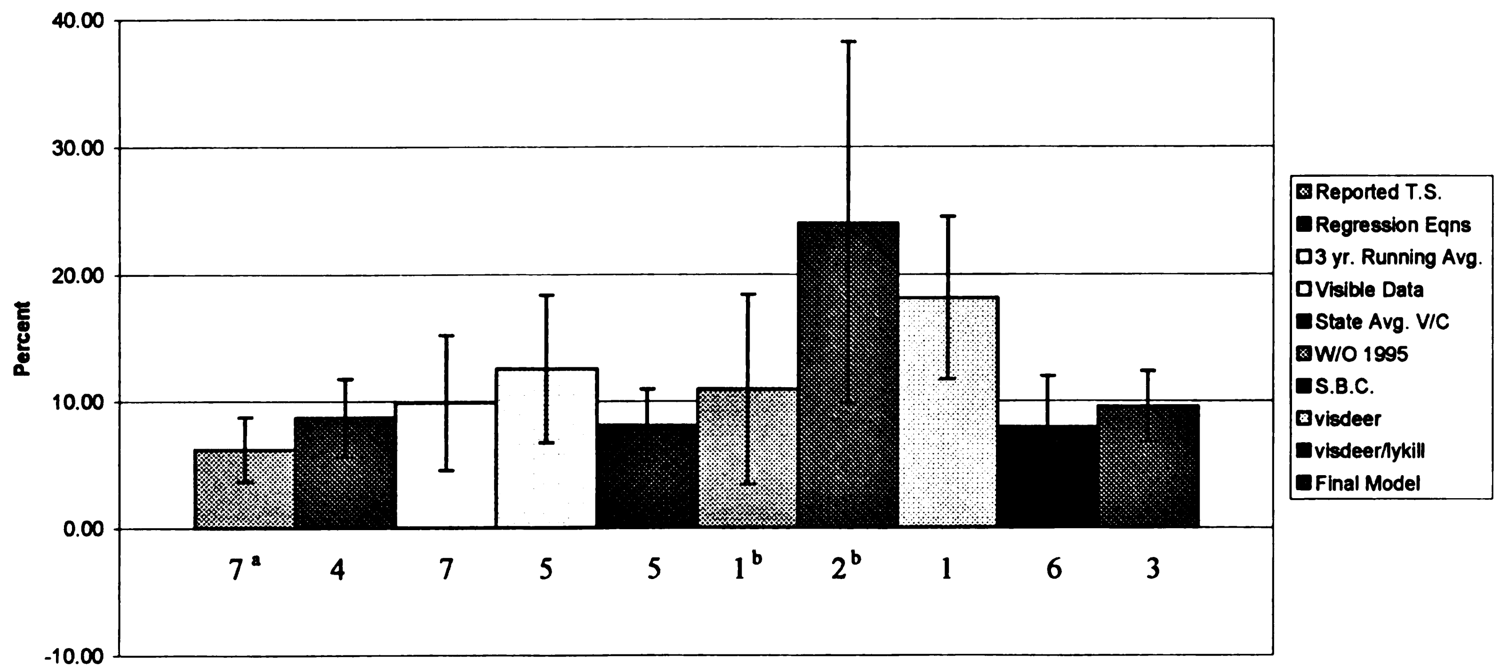
(d) U.P. Buck Kill



[a] Indicates the number of years out of 13 the prediction was +/- 5% from the mail survey
[b] 0 of 4 years, 0 of 11 years

Figure 5 (cont'd).

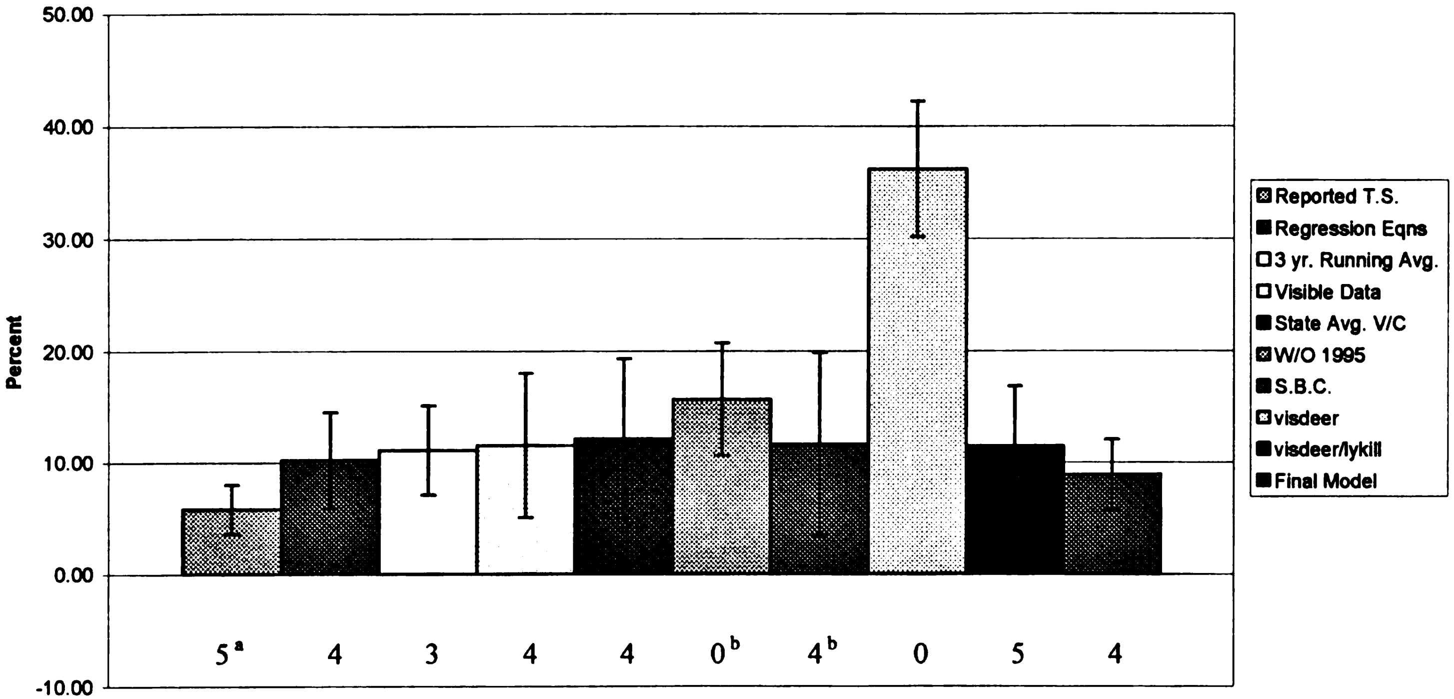
(e) Region II Buck Kill



[a] Indicates the number of years out of 13 the prediction was +/- 5% from the mail survey
[b] 1 of 4 years, 2 of 11 years

Figure 5 (cont'd).

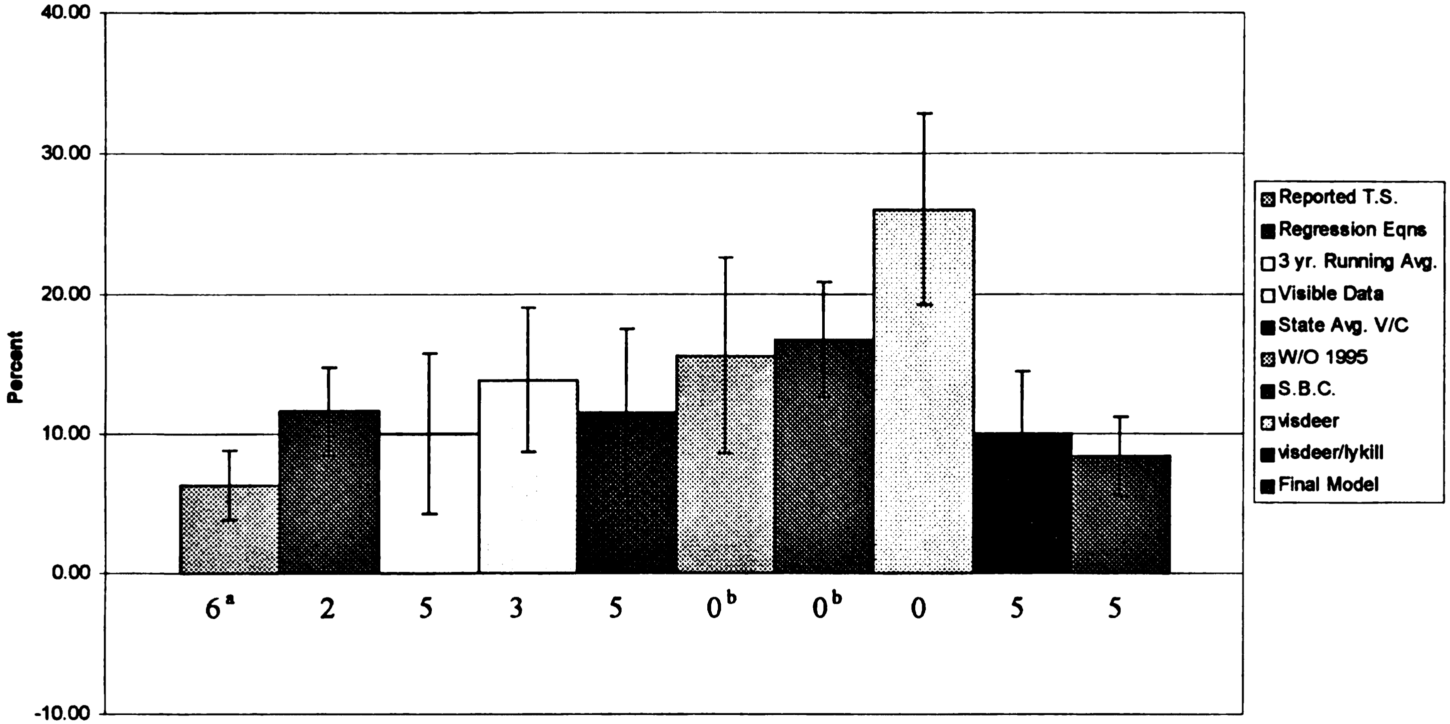
(f) Region I and II Kill



[a] Indicates the number of years out of 13 the prediction was +/- 5% from the mail survey
[b] 0 of 4 years, 4 of 11 years

Figure 5 (cont'd).

(g) Region I and II Buck Kill



[a] Indicates the number of years out of 13 the prediction was +/- 5% from the mail survey
[b] 0 of 4 years, 0 of 11 years

Figure 5 (cont'd).

3-year Running Average Data Set

Estimates derived from the current data set using stepwise regression procedures began to fluctuate starting in the early 1990's. In 1995 the estimate overshot the mail survey by almost 100,000 deer, and in 1997 the traffic survey estimate was more than 100,000 deer below the mail survey estimate. To stabilize this fluctuation each dependent variable was transformed by making it the 3- year running average of the current, previous, and following year's estimate. This was done for each dependent variable (total state kill, U.P. kill, Region II kill, U.P. buck kill, Region II buck kill, Region I and II kill, and Region I and II buck kill) for the years 1970 – 1999. This new data set was then entered into stepwise regression procedures to produce new estimates.

The models produced for each dependent variable had an average R^2 of 0.905. This is compared to an average R^2 of 0.936 for models produced with the original data set using stepwise regression procedures. The models produced using the 3-year running average data set had lower R^2 values for each dependent variable than the original data set, except for the Region II buck kill which had an R^2 value of 0.919 compared to an R^2 value of 0.909 when the original data set was used. Overall the 3-year running average data produced models with lower R^2 values than the current data set and stepwise procedures.

Additionally, the use of the 3-year running average data set did not stop the fluctuations in the estimates (Figure 5). For the years 1995 and 1997, when the estimates for total state kill using the standard data set analyzed with stepwise regression differed from the mail survey estimates by 100,000 deer, the estimates using the 3-year running average data set also were approximately 100,000 deer over in 1995, and below the mail survey estimate in 1997.

The mean estimates produced for the years 1987 – 1999 using the 3-year running average data set differed from the mail survey by a higher percentage than did the standard data set estimates for every dependent variable except Region I and II buck kill which was closer to the mail survey (10.03% difference) than the standard data set mean estimate (11.61% difference). None of the estimates produced a mean percent difference from the mail survey that was statistically different from the standard data set estimates, at a 95% confidence level.

Visible Data Only

This data set is the original data set with the v/c ratio correction taken out of the count data. Count data from each location is then just the number of deer actually counted corrected with the nighttime adjustments. For the years 1987 to 1999 the actual number of deer counted at each location can be found in the traffic survey data kept by the MDNR. To take out the v/c ratio prior to 1987, mean v/c ratio's for the years 1970 to 1986 were derived by dividing the total number of deer counted at each location (totdeer- data contains the v/c ratio) by the amount of visible deer counted at each location (visdeer – data does not contain the v/c ratio). Count data from each location were then multiplied by this mean v/c ratio (percent visible deer), to estimate the number of visible deer at each location. Data from Bay City contain the Bay City correction factor. Estimates were produced using stepwise regression procedures.

Models produced using only visible data had a mean R^2 value of 0.891 across all dependent variables, this is compared to a mean R^2 of 0.936 for models produced using the original data set. Model R^2 values produced using the visible data only data set were lower for each of the dependent variables except for the U.P. kill model which produced a higher R^2 value (0.947 compared to 0.939 for the original data set).

Estimates for the dependent variables produced using the visible data only data set were farther away from mail survey estimates than estimates produced using the original data set for every dependent variable except for the U.P. buck kill. The U.P. buck kill estimates produced with the visible data set averaged a 17.49% difference from the mail survey, compared to an average 19.65% difference for estimates produced from the original data set. None of the differences are significant at the 95% confidence level.

Schwarz's Bayesian Information Criterion

Schwarz's Bayesian Information Criterion (SBC) is a model selection method that differs from stepwise regression in that SBC considers every possible model that can be made with every combination of the independent variables (Ramsey and Schafer, 1997). Variables entered into stepwise regression procedures at a previous step can be deleted from the model in subsequent steps if the set level of significance is no longer met. This does not happen with SBC, as all possible models are considered. The model ultimately selected by stepwise regression procedures would also have been examined by SBC, the advantage SBC provides is that all models are considered and, therefore, a model not considered by stepwise regression may prove to better represent the data. For these reasons, SBC should provide a more thorough examination of the data.

Schwarz's Bayesian Information Criterion produced models with the highest mean R^2 values across all of the dependent variables, with a mean R^2 value of 0.950. The original data set analyzed with stepwise regression produced a mean R^2 of 0.936. SBC models produced the same or higher R^2 values for every dependent variable. Stepwise regression procedures and SBC chose the same model for Region I and II buck kill (R^2 0.949) and U.P. buck kill (R^2 0.922).

Although SBC models produced higher R^2 values than stepwise regression procedures for every dependent variable, predictions were unreliable in the early years (1987, 1988) because SBC was choosing models that contained 16 of the 18 independent variables available. Estimates for the years 1987 and 1988 are not included in the percent difference from the mail survey results. Mean estimates produced using SBC were not closer to the mail survey results than estimates derived using stepwise regression for any dependent variable for the years 1989 - 1997.

Visible deer variable (visdeer) and visible deer with last years kill

The number of deer counted every year should be related to the total kill. If the number of deer counted at highway count locations increases or decreases in any year, the total kill should be expected to reflect that. The visdeer variable is the sum of deer counted across all count locations over the entire firearm season. This variable includes the nighttime adjustments, but not the v/c ratio. This variable (visdeer) was entered into simple linear regression against each dependent variable. This differs from the visible data only evaluation described earlier in that this uses simple linear regression of one variable (visdeer) against the total kill for each dependent variable. The visible data only evaluation used stepwise regression to analyze the full data set (18 independent variables) whose variables only contained information on the number of deer counted (no v/c ratio).

Mean R^2 values for this method proved to be the lowest of any method, with a mean of 0.322. Model R^2 values were not better for any dependent variable when compared with the original data set analyzed with stepwise regression. These low model R^2 values prompted the idea of adding last years kill (lykill) as an independent variable and running multiple regression with visdeer and lykill against the total kill. This idea implies that the kill for each region is not independent across any two concurrent years.

R^2 values for these models improved almost three-fold with a mean value of 0.818. However, no model R^2 for any dependent variable was better than the original data set analyzed with stepwise regression.

Estimates differed from the mail survey estimates for total kill by an average of 11.20% over the years 1987 – 1999. This difference is compared to an 11.03% difference when the original data set is analyzed using stepwise regression. Estimates for Region II kill (13.07% difference) proved to be just as accurate as the original data set estimates (12.17% difference). Region II buck kill (7.92% difference) estimates proved to be the most accurate of any method. This is logical as all of the count locations are located in Region II and most of the harvest is composed of bucks.

Original Data Set Without 1995

Throughout the course of this evaluation estimates for 1995 were extremely high for all of the dependent variables, regardless of the data set or method of evaluation used. For this reason, a data set was created that removed all of the data from 1995.

This should provide estimates that more closely reflect the mail survey estimates from 1996 on. Additionally, the model R^2 values produced starting in 1996 should show an improvement.

R^2 values produced using the data set without 1995 analyzed with stepwise regression were essentially the same as model R^2 values produced from the original data set. The mean R^2 value across all dependent variables was 0.937 for the data set without data from 1995 and 0.936 with the 1995 data. The largest difference in R^2 value between the two data sets was for the Region II kill models which produced an R^2 value of 0.941 for models without the 1995 data, and an R^2 value of 0.910 for models with the 1995 data.

Estimates from models without data from 1995 will only produce different estimates for the years 1996 – 1999. Of these years the data set without 1995 produced total kill estimates that were closer to the mail survey than the original data set for every year. The Region I and II buck kill prediction was closer for 3 of the 4 years, the Region II kill was closer for one of four years, for every other dependent variable (U.P. kill, U.P. buck kill, Region I and II kill, and Region II buck kill) the data set without 1995 did not produce estimates that were closer to the mail survey than the original data set in any year.

Final Model

Based on all the previous findings a final model was created. This model was based on the original data set modified in the following ways: 1) The v/c ratio was changed to a state average. 2) Nighttime counts were adjusted using the new adjustments. 3) The Bay City correction factor was taken out of the data. This data set was then entered into stepwise regression procedures. Figure 5 is a representation of the percent difference from the mail survey for each dependent variable and each model.

Based on percent difference from the mail survey the final model was the best predictor for five of the seven dependent variables, including U.P. kill, U.P. buck kill, region II kill, region I and II kill, and region I and II buck kill. The best predictor for total state kill is the current data set using stepwise regression. The best predictor for region II buck kill was multiple regression using the variables visdeer and lykill.

Mean R^2 values for the final model were 0.947, which is better than the original data set analyzed with stepwise regression (R^2 0.936), but it is not the highest model R^2 value achieved. SBC models had the highest mean R^2 (0.950). However, the final model did produce estimates that were closer to the mail survey than any of the other methods for 5 of the 7 dependent variables.

It is the goal of the traffic survey to annually predict the harvest to within +/- 5% of the mail survey. Figure 5 also contains data that indicate how many years each method was within +/- 5% of the mail survey for each dependent variable.

Conclusion

Examination of the traffic survey indicates that the current traffic survey results are accurate due only in part to the regression procedures used, as the resulting regression estimate only serves as a starting point from which to apply factors such as weather during the hunting season, preseason harvest forecast and the professional opinion of wildlife biologists to obtain the final harvest estimate. No purely statistical method has been found that consistently matches the mail survey estimates. Further recommendations are discussed in Chapter 3.

CHAPTER 2

ALTERNATIVE SURVEY METHODS

Chapter 2 is an examination of alternative survey methods to the traffic survey. These methods include a survey of deer processors, mandatory check stations, the use of number of license's sold to predict harvest, the use of the number of deer checked at voluntary check stations to predict harvest, and a telephone survey.

Telephone Survey Proposal

Introduction

The Michigan Department of Natural Resources (MDNR) has used a mail survey to estimate the annual harvest of white-tailed deer across all deer seasons since 1931. Mail survey results are generally not available until May or June of the following year. In an effort to eliminate this time lag, MDNR survey personnel designed and implemented a traffic survey in 1952 to provide an estimate of the firearm deer season harvest within 7 days from the end of the season.

At the time of the surveys design in 1952 hunter distribution and traffic patterns were well known and easily recognized, almost all of the hunting was done in the northern 2/3 of the state, predominantly by hunters who traveled there from the south. Therefore, a survey of harvested deer attached to these hunters vehicles as they returned home provided a logical basis for an estimate. Since 1952 changes have occurred in the distribution of deer, and therefore the distribution of deer hunting in Michigan may no longer facilitate the use of a traffic survey.

A recent examination of the traffic survey has found that traffic survey stepwise regression estimates have been diverging from mail survey estimates over the last 15 years (Figure 6). Key aspects of the traffic survey have been unable to adapt quickly enough to changes in hunter distribution, travel times, and types of vehicles used to transport harvested deer. Due to this recent divergence of the two estimates and the traffic surveys inability to adapt to changes, alternative survey ideas are being

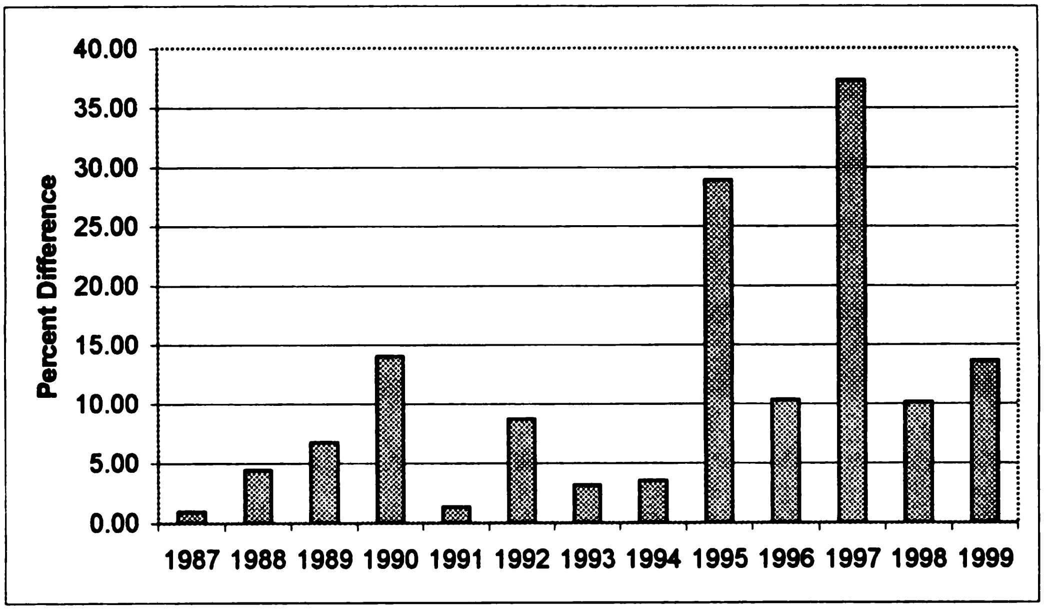


Figure 6. Percent difference from the mail survey for the stepwise regression estimates for firearm deer season total state kill, 1987 to 1999.

proposed. Among these alternative survey choices a telephone survey is being proposed to provide an initial assessment of the firearm deer season in Michigan.

Telephone surveys are often a tool used by wildlife management agencies to estimate annual harvests and have proved to be reliable and accurate (Steinart, et al 1994). Currently in the United States, six states use a telephone survey to estimate annual white-tailed deer harvests. Of these six states, a telephone survey is the only harvest survey technique used in four of the states (Colorado, Idaho, Montana, and Oregon). California and Kentucky use a telephone survey with other harvest surveys such as mail surveys (CA) and check stations (KY) (Rupp, et al 2000). The following proposal is an outline indicating what will be necessary to implement a telephone survey in Michigan.

The goal of the proposed telephone survey is to predict the firearm deer season harvest to within +/- 5% of the mail survey 95% of the time, and to do this within seven days from the end of the firearm season. This goal will be met by addressing the following objectives:

1. Assign firearm deer season hunters to strata based on type of license purchased.
2. Determine sample sizes that will allow for the desired level of precision within each stratum.
3. Develop a sampling frame (based on available phone numbers).
4. Develop a set of questions to be used in the survey.
5. Provide formulas necessary for estimating within strata total kill and the associated variances.

Stratification

Stratified sampling is recommended in the case where possible subgroups of a larger total population may have different mean values for the characteristic in question. Strata do not overlap, and therefore each sampling unit in the population can belong to only one stratum. If strata are designed correctly variances within strata will be lower than variances among strata. Once population members are assigned to strata a simple random sample is drawn from each stratum, and the results are pooled across all strata to obtain population estimates (Lohr, 1999).

Stratification of firearm season hunters in Michigan is recommended due to the varying types of licenses a single hunter can purchase. If a simple random sample of Michigan deer hunters were to take place, there is the possibility that certain groups of license holders could be excluded or underrepresented. Additionally, differences in the number and type of deer that can be taken with each license type will create a large variance in per hunter harvest. Stratification, based on license type will provide estimates with lower variances.

Firearm season deer hunters in Michigan can be assigned to one of four mutually exclusive strata based on the type(s) of license they purchase. There are two types of license that allow the harvesting of antlered deer; they are the firearm license and the combination license. The firearm license allows the hunter to harvest one antlered deer in the firearm season. The combination license allows a hunter to harvest two antlered deer in any combination of the archery and firearm season. One of the antlered deer taken with the combination license may be subject to size restrictions. Antlerless permits are allocated according to whether they will be used on private or public land. Additionally, each county in the state is subject to antlerless restrictions ranging from zero antlered deer, to an unlimited amount per hunter per season.

A hunter may not purchase a firearm and combination license, only one or the other. However, antlerless permits may be purchased in conjunction with either of those licenses. Based on these three license types, hunters can be assigned to one of four strata: firearm, firearm/antlerless, combination, and combination/antlerless. It is not possible for a hunter in one stratum to be a part of another.

Sample Size

Among the states that currently use a telephone survey several sample size determinations are used. California varies its effort to achieve a 95% confidence interval and is the only state that uses a statistical sample size determination. Other states that use a telephone survey allocate sample size as a percentage of the total number of licenses sold. This percentage ranges from a low of 0.5% in Kentucky to a high of 47% in Montana. Idaho contacts 10% of license buyers.

It is the goal of this survey to be able to predict the firearm deer season harvest in Michigan to within 5% of the mail survey, 95% of the time. The following formula is used to determine sample size:

$$n = \frac{z_{\alpha/2}^{2}\, CV^2}{D^2}$$

Where n is the desired sample size, z is the value from the standard normal distribution, CV is the coefficient of variation (standard deviation / mean), and D is the allowable error expressed as a percentage of the total (Lohr, 1999). Filling in the values needed to make estimations at the desired confidence level gives:

$$n = \frac{1.96^2 \, CV^2}{0.05^2}$$

The CV has to be estimated. There are several ways to do this. If the distribution of the mean number of deer harvested / hunter (or total number of deer harvested / hunter) can be assumed to take a right triangle shape with all values falling between two endpoints (a,b) than the variance on this mean can be estimated by the formula;

$$S^2 = (b-a)^2/18$$

This right triangle distribution can be assumed because the largest percent of hunters do not harvest a deer, a smaller percent harvest one deer, and an even smaller percent harvest two deer, continuing until the smallest percentage of hunters is reached (those that harvested the most deer). Values for the endpoints (a,b) need to estimated. The lower bound (a) must be equal to zero. Values for the upper bound (b) are based on the highest number of deer any single hunter harvested. No data are available for this estimate. There are data available on the highest number of harvest tags issued to any one hunter. It can be assumed that no one hunter harvested more deer than the number of harvest tags issued. Data for 2000 indicate that no hunter purchased more than 8 harvest tags (in a combination of firearm and antlerless tags, or combination and antlerless tags) (Frawley, 2000). Substituting in (0,8) for (a,b) provides a variance estimate of 3.556 and a standard deviation of 1.886.

The mean number of deer harvested per hunter must also be estimated to calculate the CV. This value can be derived by dividing the total number of firearm deer season hunters by the total number of deer harvested during this season.

Averaging the number of hunters and harvest for the years 1999 and 2000 provides a mean number of deer harvested per hunter of 0.476 deer / hunter. This results in a CV of 3.962. Table 6 provides sample size estimates at different confidence levels, acceptable errors, and different endpoint values (a,b).

There are several methods that could have been used to estimate the mean and standard deviation necessary in calculating required sample size. A standard deviation can be calculated for the mean (versus being estimated based on a right triangle data distribution), however, if this is to be done reliably, several ($n > 30$) years of data are necessary. Additionally, the distribution of data may take several forms, aside from the right triangle. Other possible distributions, such as the Poisson distribution should be examined by the MDNR, before sample size determinations are calculated.

This determined sample size must be further allocated into the four strata. This should be done proportional to stratum size. At this point there are no data available pertaining to the size of each stratum, as the sampling frame has not been compiled. Once the sampling frame is composed and the size of each stratum is known, proportional allocation of the total sample size should be used to determine the sample size from each stratum. This will ensure the weight of any response from any stratum is equal. A hunter will have the same chance of being selected regardless of which strata they are assigned to.

Nonresponse, or the failure to obtain responses from everyone selected to be in the sample, increases the number of people that need to be contacted to ensure the sample size is met. A recent telephone survey conducted by the MDNR (Frawley,

1999) indicates there are several reasons contact could not be made with everyone selected to be in the survey. Some of the most common reasons include, reaching an answering machine (23.2%), person selected for the survey is not home (18.3%), no answer (10.0%), and wrong number reached (7.4%). Of all the calls made during this survey only 29.2% resulted in a completed questionnaire. Table 7 is a representation

Table 6. Number of samples necessary to meet the desired error (D) and confidence levels (alpha), using two estimates of variance based on the range of data values (a,b).

	(a,b)	
	(0,5)	(0,8)
alpha = 0.05		
D = 5%	9427	24124
D = 10%	2357	6030
alpha = 0.10		
D = 5%	6681	17095
D = 10%	1670	4274

Table 7. Number of calls necessary to meet sample size requirements at a 30% call success rate, with different levels of allowable error (D), confidence levels (alpha), and estimated variances based on the range of data values (a,b).

(a,b)

	(0,5)		(0,8)	
alpha = 0.05	Sample Size	No. of Calls	Sample Size	No. of Calls
D = 5%	9427	31423	24124	80413
D = 10%	2357	7857	6030	20100
alpha = 0.10				
D = 5%	6681	22270	17095	56983
D = 10%	1670	5567	4274	14247

of the number of calls necessary to meet the required sample size if only 30% of call attempts are successful.

Calls during this survey were only conducted for one day from 6:00 to 8:30 p.m. No attempts were made to reach people who were not contacted after the first attempt. If a predetermined amount of repeat attempts were made to contact initial nonrespondents, this 30% call success rate should be expected to rise. Sending a postcard to hunters selected to be in the survey indicating that the MDNR will be attempting to contact them during a certain time frame may also increase response. Therefore, the number of calls needed to reach a certain sample size as listed in Table 7 can be treated as a worst-case scenario.

Sampling Frame (Available phone numbers)

The sampling frame is defined as the list of all possible sampling units from which a sample is drawn (Lohr, 1999). In this case the sampling frame would include all people who purchased a deer-hunting license of any type, and for whom a telephone number is available. Currently, information collected when a hunter buys a license includes the hunters name, address, and the type of license they purchased. Phone numbers are not collected or included in the database. Attempts to locate telephone numbers by MDNR survey personnel in the past were made by searching telephone directories on the Internet (www.peoplesearch.net). Telephone numbers were located for 61.1% of the people in the original sampling frame (Frawley, 1999) during a 1999 opening day preference survey. If a telephone survey were to be implemented it is recommended that telephone numbers be collected from hunters as they purchase a license.

Formulas for estimates and variances

The total firearm season harvest will be estimated using the formula:

$$\hat{t}_{str} = \Sigma \hat{t}_h$$

Where t_{str} is the population total estimate, and t_h is the total estimate from each stratum. Furthermore, t_h is estimated by the formula:

$$\hat{t}_h = N_h \overline{y}_h$$

Where N_h is the total number of hunters in the h^{th} stratum, and $\overline{y}_h$ is the mean number of deer harvested per hunter, derived from the sample. An unbiased estimate of the population total variance is obtained using:

$$\hat{V}(\hat{t}_{str}) = \sum_{h=1}^{4} \left(1 - \frac{n_h}{N_h}\right) N^2_h \left(\frac{s_h^2}{n_h}\right)$$

s_h^2 is the within stratum variance and is estimated by the formula:

$$s_h^2 = \sum_{j \in S_h} \frac{(y_{hj} - \overline{y}_h)^2}{(n_h - 1)}$$

Where y_{hj} is the observation from the j^{th} unit in stratum h, $\overline{y}_h$ is the sample mean of all the observations from stratum h, and n_h is the number of samples from stratum h. The standard error ($SE(\hat{t}_{str})$) used to calculate confidence intervals is the square root of the variance estimate ($\hat{V}(\hat{t}_{str})$) (Lohr, 1999).

Information on the sex and location of harvest will be collected from each respondent in the survey. The population total estimate can then be broken down into antlered and antlerless, and also into region of harvest.

Questionnaire

The questionnaire needs to be designed to collect accurate information on the total state harvest, total state antlered and antlerless harvest, and harvest by region. The first three questions are designed to ensure that the hunter has been assigned to the correct stratum and did actually hunt. The remaining questions collect information on the number, sex, and location of each deer harvested by the hunter. The following sample questionnaire can be used as a guideline.

Firearm and Firearm / Antlerless Strata

1) Did you purchase a firearm deer season license?

2) Did you purchase any antlerless permits? How many?

3) Did you hunt deer during the firearm season (Nov. 15 – Nov. 30)?

4) How many deer did you harvest during the firearm season?

5) Of the deer that you harvested how many were tagged with an antlered permit?

6) In which county was the first antlered deer harvested? Second?

7) Of the deer that you harvested how many were tagged with an antlerless permit?

8) In which county was the first antlerless deer harvested? Second? Etc…

Combination and Combination / Antlerless Strata

1) Did you purchase a combination deer license?

2) Did you purchase any antlerless permits? How many?

3) Did you hunt during the firearm season (Nov. 15 – Nov. 30)?

4) How many deer did you harvest during the firearm season?

5) Of the deer that you harvested how many were tagged with an antlered permit?

6) In which county was the first antlered deer harvested? Second?

7) Of the deer that you harvested how many were tagged with an antlerless permit?

8) In which county was the first antlerless deer harvested? Second? Etc…

In addition to the questionnaire an introduction needs to be written as a way for survey workers to identify themselves to the respondents in the most effective way possible. In other words an introduction has to keep respondents on the line and interested in completing the survey, and also explain what the survey information is used for and who is collecting the information. The MDNR may currently have a standard introduction used for telephone surveys. If not, an introduction needs to be written for this survey.

Conclusion

This proposal has addressed five areas necessary to design and complete a telephone survey; stratification, sample size, sampling frame, survey questionnaire, and estimate formulas. Given that the estimate that is desired is a preliminary estimate and must be provided within seven days from the end of the firearm deer season, a survey time-table must also be established. The sample size, stratification of hunters, sampling frame, questionnaire, and mean and variance estimate formulas will all be known before the survey begins. At this point the implementation of the survey begins.

The absolute highest number of phone calls that would have to be made was determined to be approximately 80,000 calls. At a 30% call success rate this will provide 24,000 responses, which meets the required sample size at a 95% confidence interval and 5% error. The survey will have to be completed in 4 or 5 days to provide an estimate within 7 days from the end of the firearm season. Factors that can be adjusted include the number of employees making calls, the number of days calls are made, and the length of the time period calls are made each day. Figure 7 is an illustration of the manpower necessary to complete a varying number of telephone calls over different time periods.

It becomes evident from studying Figure 7 that due to the lack of time allotted to complete the survey, the manpower necessary becomes large very quickly. Even at

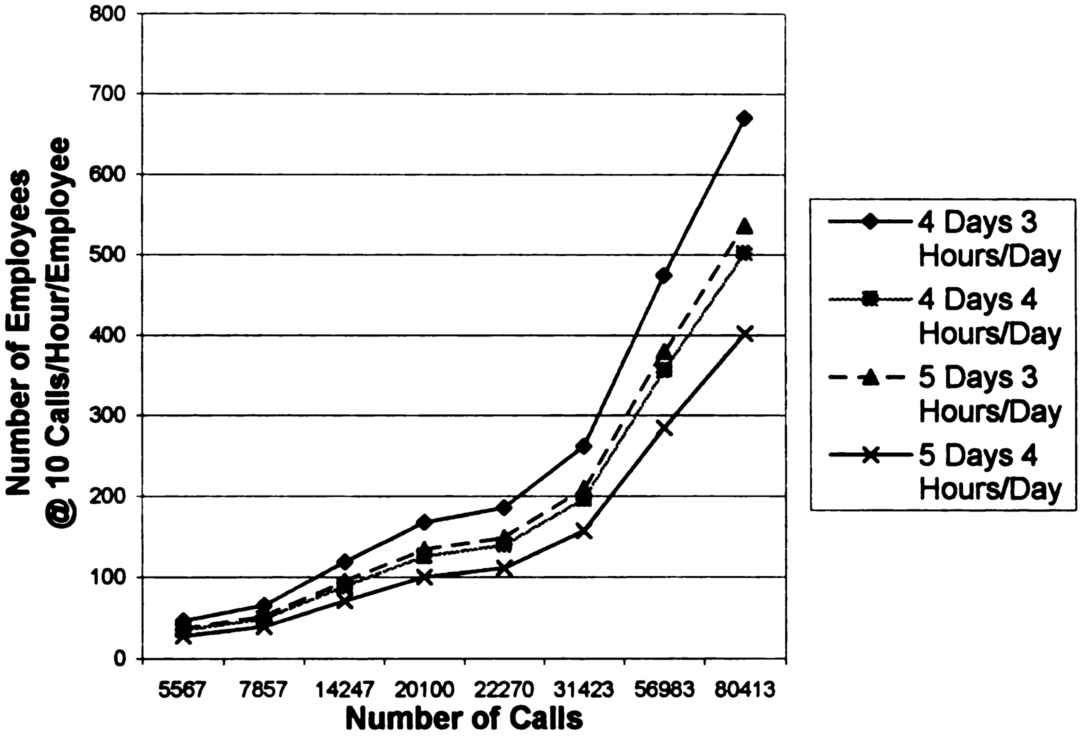


Figure 7. Number of employees and time needed to complete a varying number of phone calls.

its smallest, approximately 50 employees are needed to complete the telephone calls. The number of employees needed to complete the maximum amount of calls (estimate with the highest precision, 5% Error, 95% confidence) ranges between 400 and 650 depending on the time allotted. It is unrealistic to recommend this number of employees for a survey designed to provide a preliminary estimate. Even 50 employees may be unrealistic. The short time allotted to complete this survey and the subsequent high number of employees necessary to do so, may be its major drawback. A complete discussion of recommendations is in Chapter 3.

Estimating the Harvest by the Number of Licenses Sold

Introduction

It can be assumed that if the success rate of hunters is constant, than the number of deer harvested annually can be a function of the number of licenses sold. The number of harvest tags allowed per hunter in Michigan can change annually. Starting in 1998 a combination license was available to hunters. With this license two antlered deer can be harvested in any season or combination of seasons (archery, firearm, and muzzleloader), one of the animals taken may be subject to antler restrictions (ie…4 or more points on one antler). Prior to 1998 Michigan hunters purchased a firearm tag to harvest an antlered deer during the firearm season. The number of firearm tags allowed per hunter, per season, fluctuates annually according to deer population numbers and the deer population goals of the MDNR.

Methods

Information on the number of firearm deer season licenses sold annually was compiled from data collected by Dunifon (1993), and made available by the MDNR wildlife division. The data file contains the number of firearm deer licenses sold from 1970 to 1997; data for 1998 to 2000 contains the number of firearm deer licenses plus the number of combination deer licenses sold. No information on the number of antlerless permits was available for 1970 to 1997, and therefore, this information is not used in the analysis.

Models were generated for each traffic survey dependent variable using simple linear regression of the total number of harvest tags against each dependent variable. Model R^2 values are reported for each dependent variable.

Results and Discussion

Model R^2 values for each dependent variable are listed in Table 8. The highest model R^2 value was for the total kill prediction (R^2 0.682). Figure 8 is a plot of the data for total kill versus total harvest tags sold. The plot indicates that up until the incorporation of the combination license in 1998, using the total number of harvest tags sold to predict harvest may have been reliable. With the combination license information is not available on the number of harvest tags used during the archery, firearm, or muzzleloader season. There is no way of knowing how many hunters used their combination license during only the firearm season.

Figure 8 also indicates that at some point (approximately 700,000 harvest tags) the number of harvest tags sold begins to have a decreasing effect on the number of

Table 8. Model R^2 values for simple linear regression of the number of harvest tags sold versus total kill by region and sex.

	Model R^2
Total kill	0.682
UP kill	0.387
UP buck kill	0.408
Region II kill	0.527
Region II buck kill	0.311
Region I and II kill	0.528
Region I and II buck kill	0.399

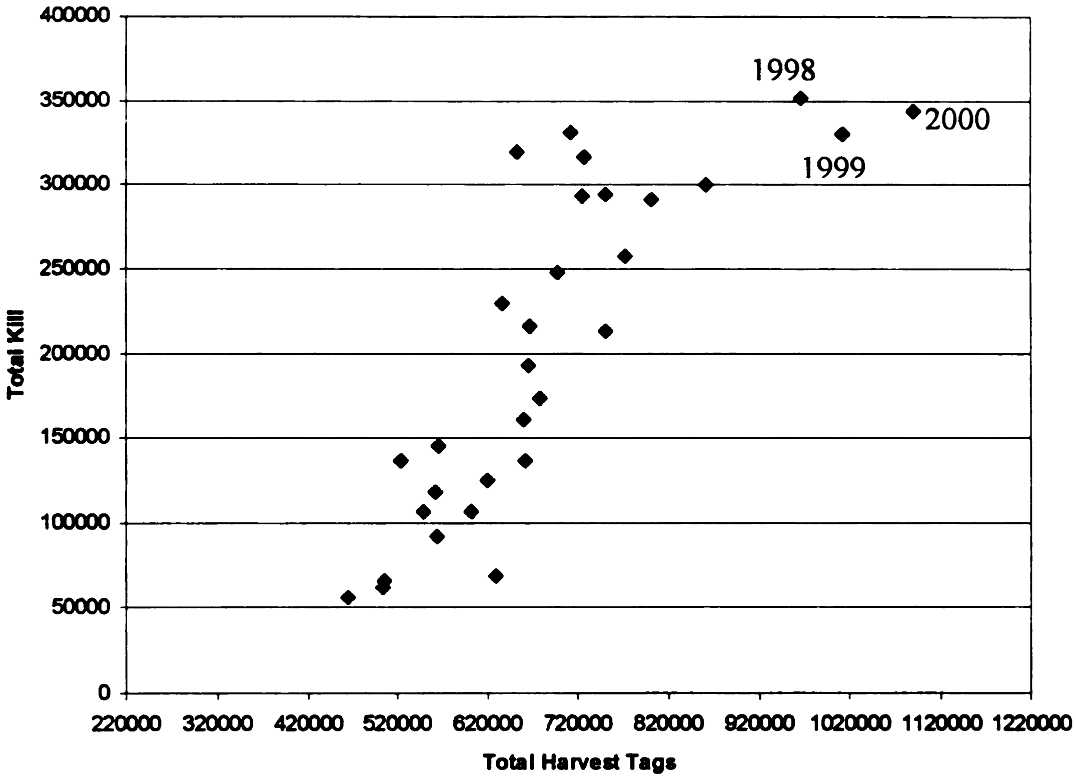


Figure 8. Graph of the total number of harvest tags issued versus the total state kill for 1979 to 2000. 1998, 1999, 2000 show the incorporation of the combination license.

deer harvested. At a certain point adding more hunters will not increase the number of animals harvested, the market becomes saturated with hunters. This hunter saturation is currently what is happening in Michigan. For these reasons, and due to the annual changes in the types and amounts of harvest tags available to hunters, using the number of harvest tags sold to estimate the harvest may not be a reliable method.

Estimating the Harvest by the Number of Deer Checked

Introduction

The MDNR annually collects biophysical data at selected check stations throughout the firearm deer season. Checking in a deer in Michigan is voluntary. The goal of the voluntary check system is not to generate a harvest estimate, but to collect information on the composition of the harvest and the biological characteristics of the harvested deer. In 1999, the MDNR operated 4 highway check stations and 75 field check stations during the firearm deer season.

Biases have been shown in the types of deer Michigan hunters bring to check stations (Cook, 2001). Although biases may exist in the types of deer checked, if these biases remain the same every year, the number of deer checked annually may be used to provide an initial estimate of the harvest. For example, hunters may be more likely to check bucks with larger antler sizes, and less likely to check does, but if this trend remains the same annually, then the number of these types of deer checked should be a reflection of the total harvest.

Methods

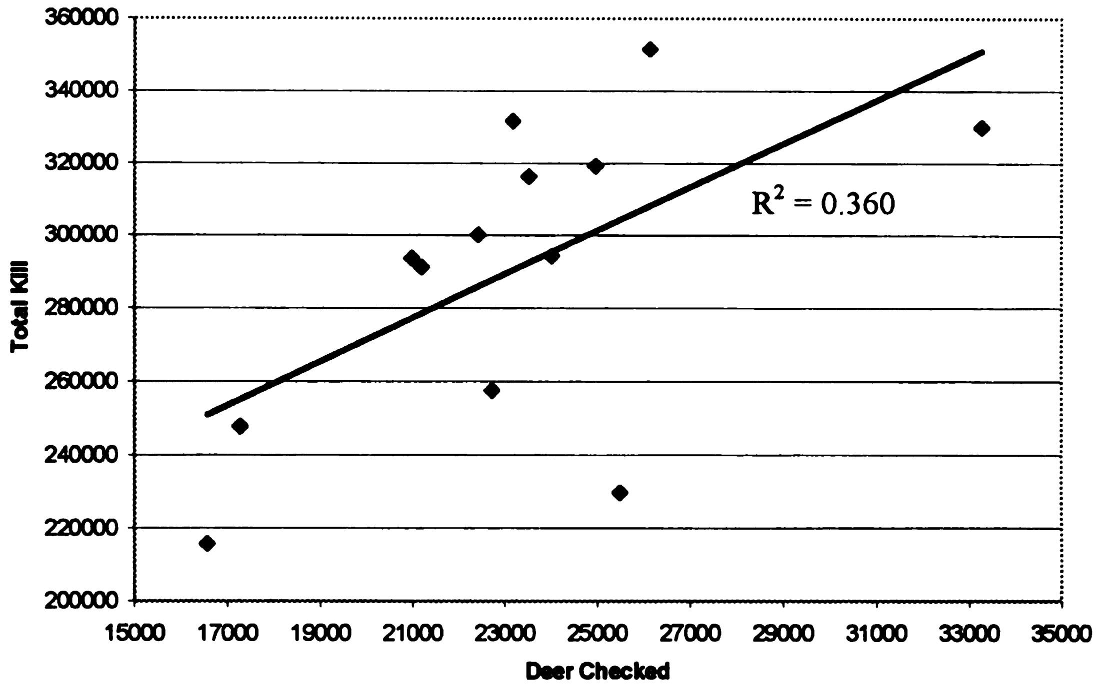
Information on the number of deer checked annually from 1987 to 1999 was collected from the MDNR. These data were compared to annual harvest estimates from the mail survey for these years to determine if any relationships existed. The number of deer checked annually was plotted against each dependent variable from the traffic survey (Table 1), additionally simple linear regression of the number of deer checked annually against each dependent variable was performed to determine if the number of deer checked annually could provide accurate harvest estimates.

Results and Discussion

As a percent of the total state harvest the number of deer check annually for the years 1987 to 1999 ranged from a low of 6.97% in 1992, to a high of 11.10% in 1994, with a mean of 8.03%. The results for simple linear regression of the number of deer checked versus each dependent variable are graphed in Figure 9.

The highest R^2 value was for total state kill (R^2 0.360). The model R^2 values for every other dependent variable were under 0.113. Using the total number of deer checked annually probably will not provide accurate harvest estimates. For example in 1993 and 1994 the total state harvests differed by 6.1%, yet the number of deer checked in those years differed by 35.0%. Additionally, with the increased checking of deer in the northeast lower peninsula due to a recent outbreak of bovine tuberculosis (TB) in the deer herd, current check station numbers will not be consistent with historical data, as the biases against checking certain types of deer no longer exist to the extent they did in these areas.

(a) Total Kill



(b) U.P. Kill

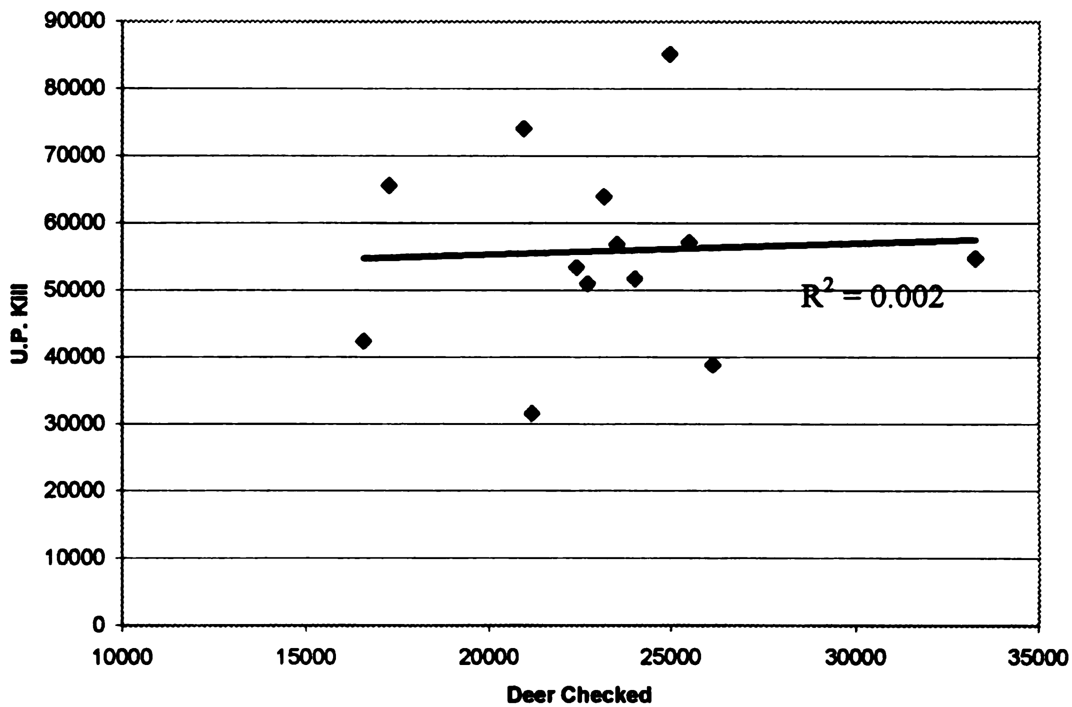
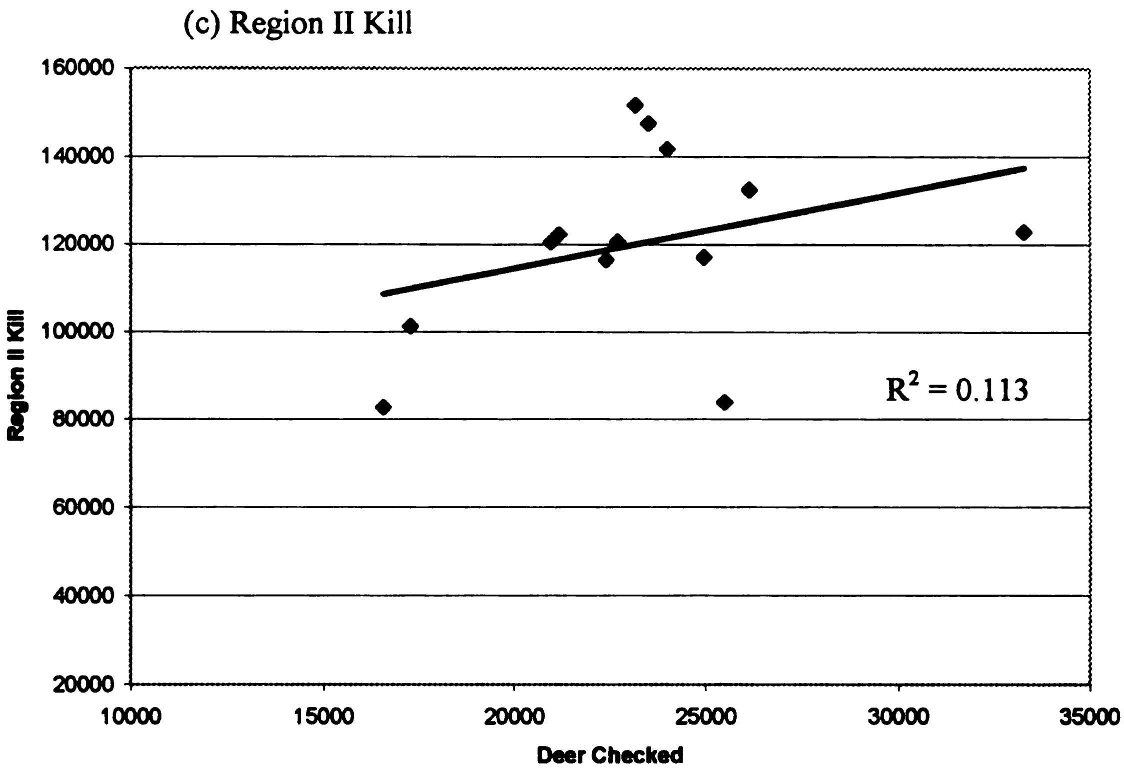


Figure 9. Plot of the number of deer checked versus each traffic survey dependent variable, including line of best fit and model R^2 value, 1987 to 1999.



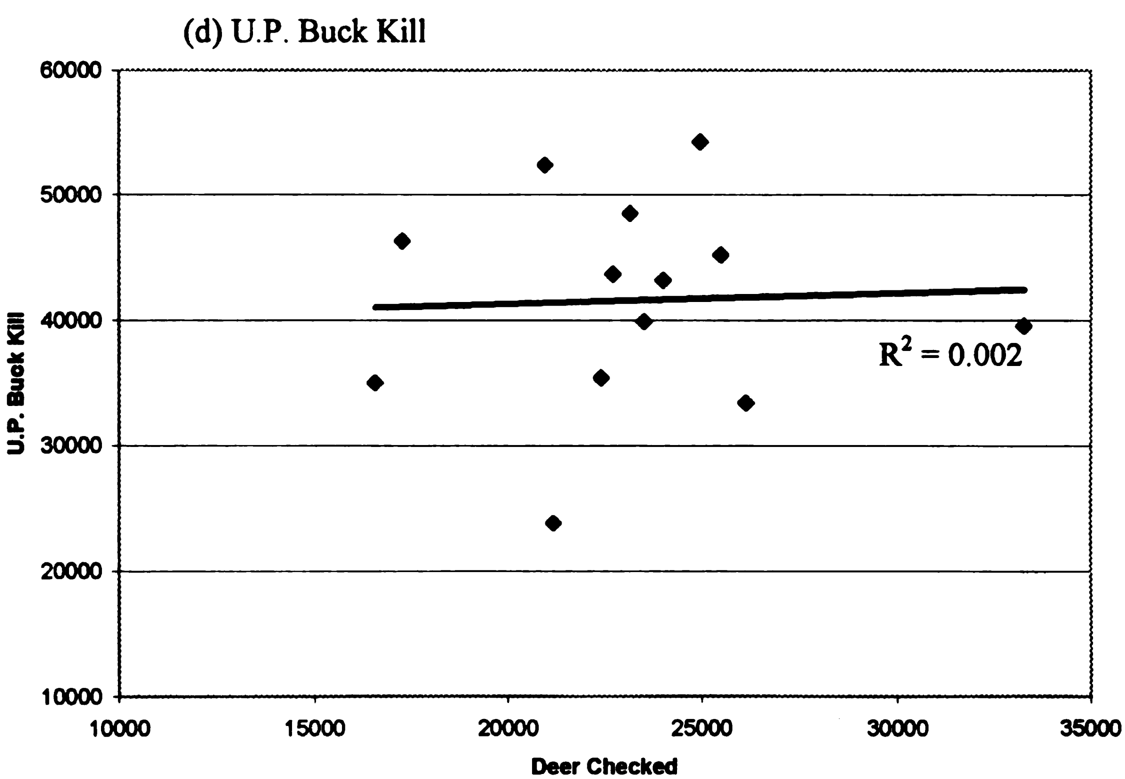
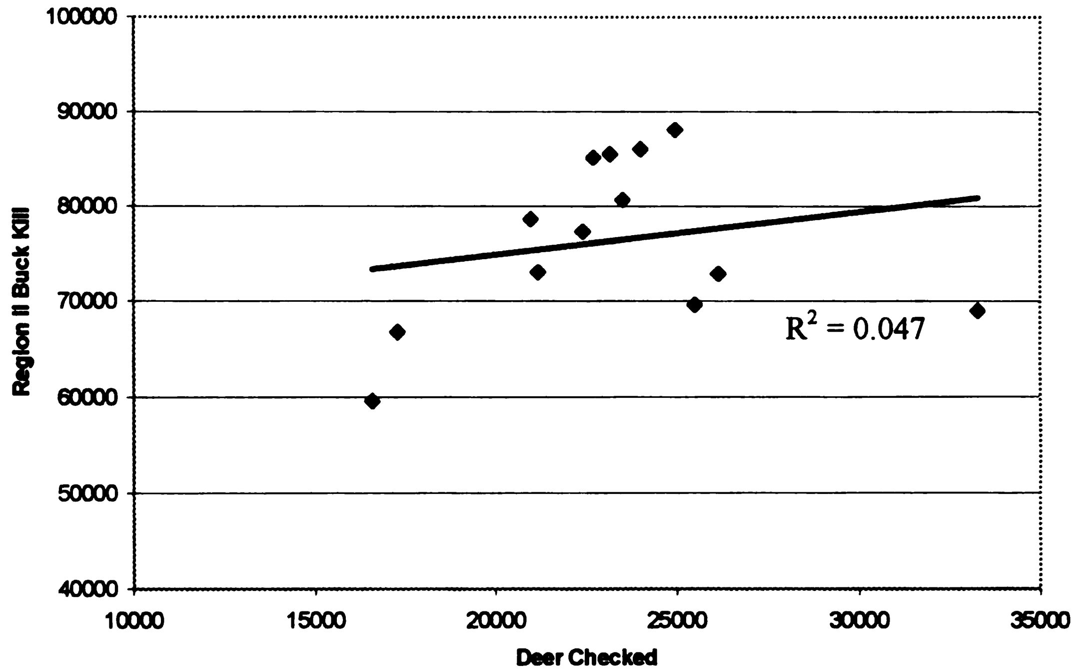


Figure 9 (cont'd).

(e) Region II Buck Kill



(f) Region I and II Kill

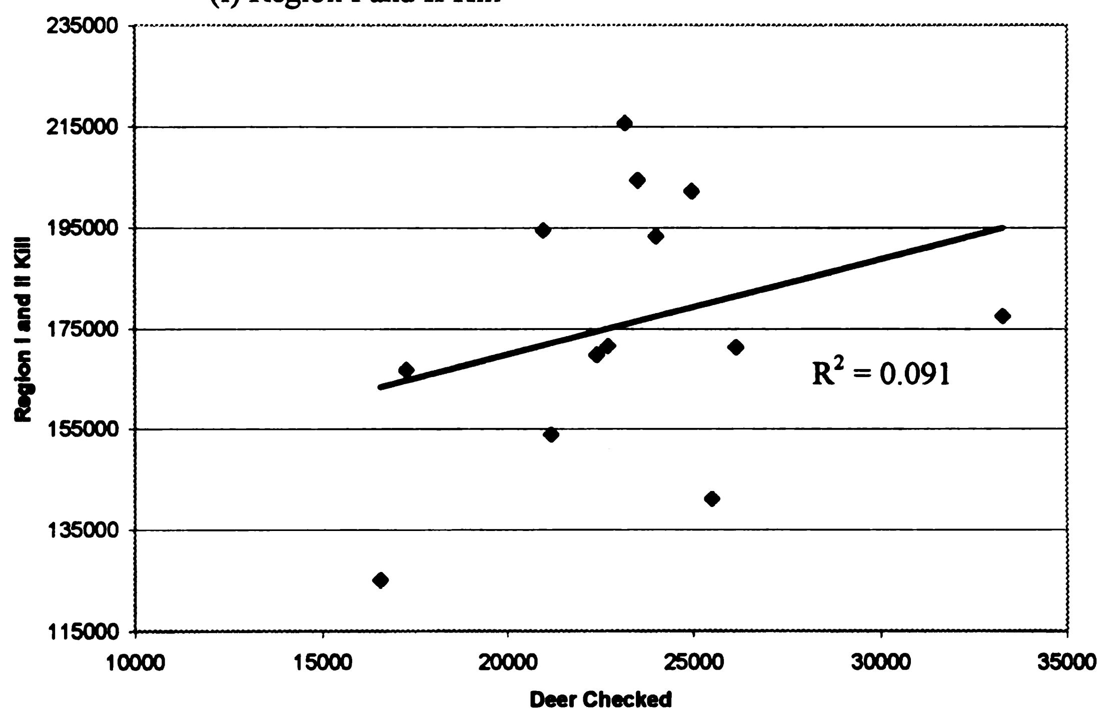


Figure 9 (cont'd).

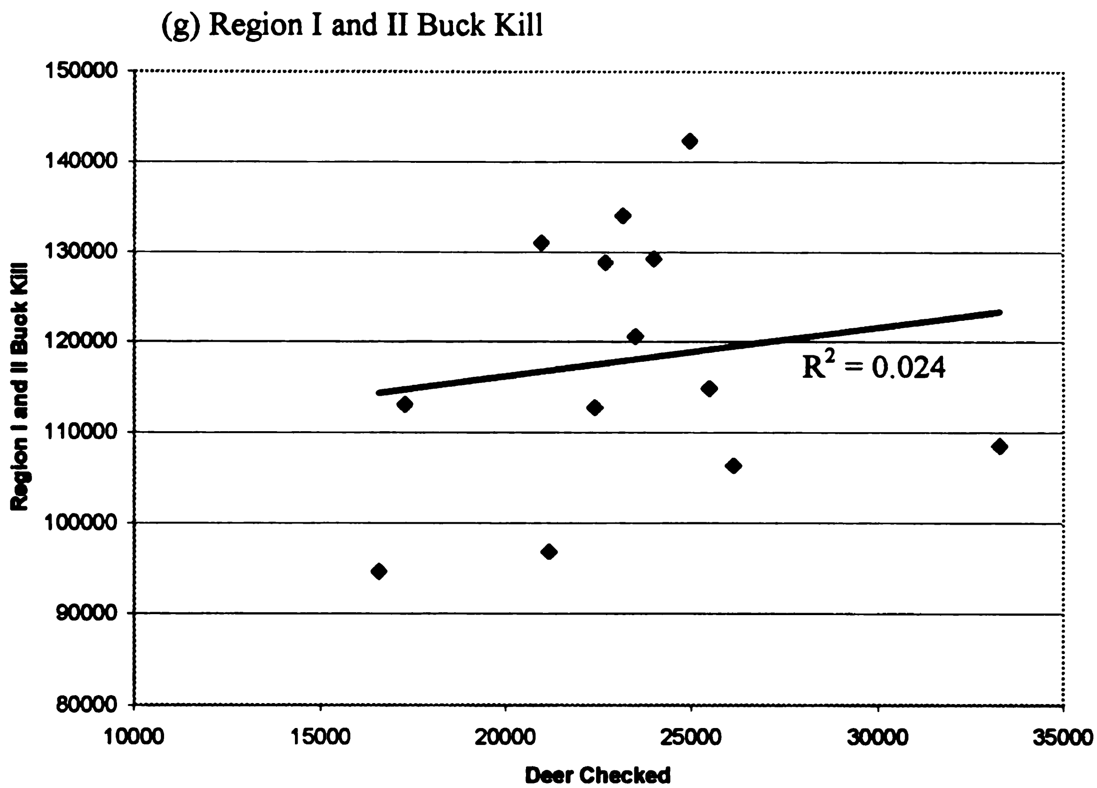


Figure 9 (cont'd).

Using only deer checked in a region to predict that regions harvest for total harvest and bucks increases the model R^2's slightly. Model R^2 values for each region are as follows; UP (0.455), NLP (0.326), SLP (0.640), UP buck (0.524), and NLP buck (0.038). None of the model R^2 values are nearly as high as models produced in the traffic survey. Once again, model R^2 values for the NLP are especially low due to the increased in the number of deer checked due to TB.

Using the number of deer checked to predict the harvest, whether it's statewide or by region, does not appear as if it will be a reliable method. This could be for several reasons. Up until 1998 and the increase in checked deer in the NLP, the number of deer checked annually remained fairly constant, while the harvest fluctuated. This would indicate that it is essentially the same groups of people who check their deer every year. Some Michigan hunters check their deer regardless of sex, age, or antler size, as the Michigan successful deer hunter patches given out at check stations are a collectors item. Additionally, hunters who harvest a large buck are likely to have it checked in. A final category of hunters are those who do not check their deer, regardless of what sex, age, or antler size it is.

The risk of disease outbreak in the deer herd also increases the number of deer checked, as is currently happening in Michigan with TB. The additional threat of chronic wasting disease ensures that the number of deer the MDNR hopes to collect for testing will increase, as well as a hunters desire to have their deer checked. Chronic wasting disease will likely increase the number of deer checked from the UP, as the disease was recently discovered in Wisconsin. This will likely have the same effects on the predictive power of using the number of deer checked as TB did in the NLP.

Survey of Deer Processors

Once a deer is harvested, it must be processed. Processing a deer involves skinning the animal and having the meat cut into usable portions. Although no information is available on the number of hunters who process the deer themselves and the number who bring the deer to a processor, it is assumed the large majority of hunters bring the deer to a processor. Therefore, a survey of these deer processors may serve to provide an annual harvest estimate, or at least provide an index of the annual harvest.

I explored the feasibility of such a survey by contacting MDNR wildlife mangers in each of Michigan's 8 management units. Managers in all eight units currently visit local processors on an informal level to get a feel for the number of deer being harvested. I also contacted one deer processor in Michigan for an opinion on the use of such a survey.

No hard data are available concerning whether a survey of deer processors would provide accurate harvest estimates. However, it was the opinion of wildlife division mangers and deer processors that there is too much variability in the factors that make up the number of deer any one processor handles annually. Factors such as competition and cost of processing effect the number of deer any one processor handles in a season. Many of these processors are unlicensed and are run out of a garage or home. A comprehensive list of processors would not be readily available, or easily compiled. Although large, licensed processors do exist, simply surveying them would not provide accurate harvest estimates. Weather also can play a factor in where a deer is processed. Colder weather allows hunters to travel with their deer and have it processed nearer there home. Warm weather would increase the number of deer processed near where it was harvested, as hunters would not want the meat to spoil.

One advantage a survey of this type has, is in its public relations value. Having MDNR wildlife mangers actively engaged in a public setting provides a forum for informal communication between hunters, processors, and wildlife mangers. The public will see MDNR employees actively engaged in open lines of communication. This may help to increase public confidence in MDNR procedures in general and MDNR harvest estimates. Annually surveying processors will also serve as an index of the harvest. Estimates may not be available, but general trends may be noted.

In conclusion surveying deer processors in Michigan will probably not provide accurate harvest estimates, as there is too much variability in the factors that hunters use to decide where to process their deer. A survey of this type does have good public relations value, as it actively engages MDNR wildlife mangers with the public in an informal setting. This type of survey may also serve as an index of the harvest, as general trends can be noted annually.

Mandatory Check

Introduction

All of the states surrounding Michigan (Illinois, Indiana, Ohio, Minnesota, and Wisconsin) have mandatory check policies in place for deer harvested during any of their respective deer seasons. Generally, a harvested deer must be checked in at a registered check station with 24 to 48 hours after harvest. Biophysical data are not collected at every station, only those stations staffed by state wildlife employees. For a more complete discussion of how each of these states operates there mandatory check stations, see Appendix 1.

Currently, Michigan has a system of check stations in place. However, checking a deer in Michigan is not mandatory. Biophysical data are currently collected at all of Michigan's check stations. The major difference between the deer harvest in Michigan and its' neighboring states is that hunters in Michigan harvest a higher number of deer. Hunters in Illinois, Indiana, Ohio, and Minnesota harvest approximately 100,000 deer annually, in each state. Wisconsin's average deer harvest is 400,000 animals across all seasons. Hunters in Michigan have harvested over 500,000 deer annually since 1998. This increased number of harvested deer, versus other states, translates into higher staffing needs for Michigan to effectively run a mandatory check.

In 1999 Wisconsin had over 600 field check stations where hunters could bring a deer to be registered, this is compared to 75 field check stations and 4 highway check stations in Michigan during that same year. Wisconsin collects biophysical data on approximately 5% of the deer harvest annually, or about 20,000 deer. Michigan has collected biophysical data on an average of 8% of the harvest for the years 1987 to 1999.

The following paragraphs will be a discussion on the advantages and disadvantages of implementing a mandatory deer check in Michigan, versus the methods currently used in Michigan to derive harvest estimates, and collect biophysical data on the harvest.

Advantages

The one advantage of having a mandatory check is that it would reduce the bias in the types of deer that are checked. Under the voluntary check system currently in place there is a bias for hunters to check larger and older deer, as well as a bias towards checking antlered deer versus antlerless (Bull and Peyton, 2000). Requiring that all deer be checked should improve the reliability of the data that is collected. The biophysical data collected at check stations should more accurately reflect the true population characteristics.

Another possible advantage is in the public relations aspects. Many hunters, and the general public, feel that the only way to accurately predict the harvest is with a complete census. In theory a mandatory check will provide a complete census. In practice, it is likely that not all deer will be checked, and there is no way of accurately knowing how many deer were not checked. Mandatory check will increase interactions between the MDNR and hunters, which should help to open lines of communication, and provide a forum in which hunters can express their beliefs and values towards deer hunting, in an unofficial setting. This communication will also allow MDNR wildlife division employees to answer questions, and provide accurate information on topics hunters may be interested in, but otherwise would not inquire about.

Disadvantages

The advantages a mandatory check will provide come at a cost. The largest disadvantage to having a mandatory check system in Michigan is the costs that will be incurred to set up and run such a system. The number of check stations will have to be increased from the approximately 80 currently run to nearly 500, to allow for adequate coverage. Not all of these stations need to be staffed by MDNR wildlife division employees, or be located at a MDNR office. Stations that are not located at a MDNR office will likely have to be financially reimbursed for their efforts. Along with increased cost to set up the infrastructure of the system, increase costs will be needed for enforcement.

Due to the increase in staffing needs, costs, and time needed to run a mandatory check, there is the potential that less biophysical information will be collected than at the current voluntary check stations. For example, in Wisconsin most deer are aged either as adult doe, adult buck, buck fawn, or doe fawn. Wisconsin DNR wildlife division employees only work at 100 of approximately 600 check stations aging deer to the year, using toothwear and replacement criteria. Aging is only done for the first 2-3 days of the firearm season. Compare this to Michigan where approximately 8% of the harvest are aged to the year, and aging takes place everyday during the firearm season. Additional information collected in Michigan not collected by states with a mandatory check include average beam diameter for bucks and lactation status for does, as well as whether the deer was harvested on public or private land.

No additional data would be collected under a mandatory check. Harvest estimates are currently derived using a mail survey, and biological data of harvested deer are collected at voluntary check stations. Having a mandatory check would not improve the accuracy of either of these, and it would also come at an additional cost. Specifically, harvest estimates would not be as reliable, as there would be no way to assign a variance to the estimate. Under a mandatory check a census of deer would be taken, however, it would not be a complete census, as there is no way of knowing who did or did not check their deer. Mail survey harvest estimates do have a variance associated with them, which provides information on the precision of the prediction.

Conclusion

The list of advantages and disadvantages proposed above is not inclusive. There are more advantages and disadvantages that will become apparent if a system of this type is initiated in Michigan. At this point, the disadvantages outnumber the advantages a mandatory check would provide. Specifically, the information that would be made available to MDNR wildlife division employees under a mandatory check will not help to manage deer hunting any more than the data that is currently collected, and it will come at an additional cost. More information on how Michigan's neighboring states operate their mandatory check systems is available in Appendix 1. Should Michigan decide to implement a mandatory check system this will provide a readily available source of information on how similar systems are run.

CHAPTER 3

GENERAL DISCUSSION AND RECOMMENDATIONS

Traffic Survey

At the time of the traffic survey's design (1952), hunting patterns in Michigan were well known and easily recognized. Most of the harvest was in the UP and NLP (Figure 10). This pattern held true until the early 1970's. Since the early 1970's the SLP harvest has begun to rise at a higher rate than the harvest in both the UP and the NLP (Figure 11), and beginning in 1995 the harvest in the SLP has exceeded the UP and the NLP. Under current traffic survey methodologies estimates cannot be derived for the SLP. Data are collected from southbound vehicles in Region I (Mackinaw Bridge) and in the northern most counties of Region III (SLP). This increase in the SLP harvest over the years and the traffic survey's inability to accurately account for this is a potential reason that traffic survey estimates have begun to diverge from mail survey estimates (Figure 6).

In addition to the increase in SLP harvest, the v/c ratio has also been changing. In 1952 it was estimated that approximately 90% of the deer that passed in front of a highway observer would have been seen. By 1987 this figure had dropped to 60% and in 1999 it was below 50%. This decline in the v/c ratio may also be a factor in the declining accuracy of the estimates. With this decline in the percent of deer visible to highway observers, each observation holds more weight. This causes potential measurement errors on the part of highway observers to be magnified in the final estimates. The decline in the percent of visible deer is probably due to a change in vehicle body styles (SUV's, campers, trucks with toppers), which allow hunters to

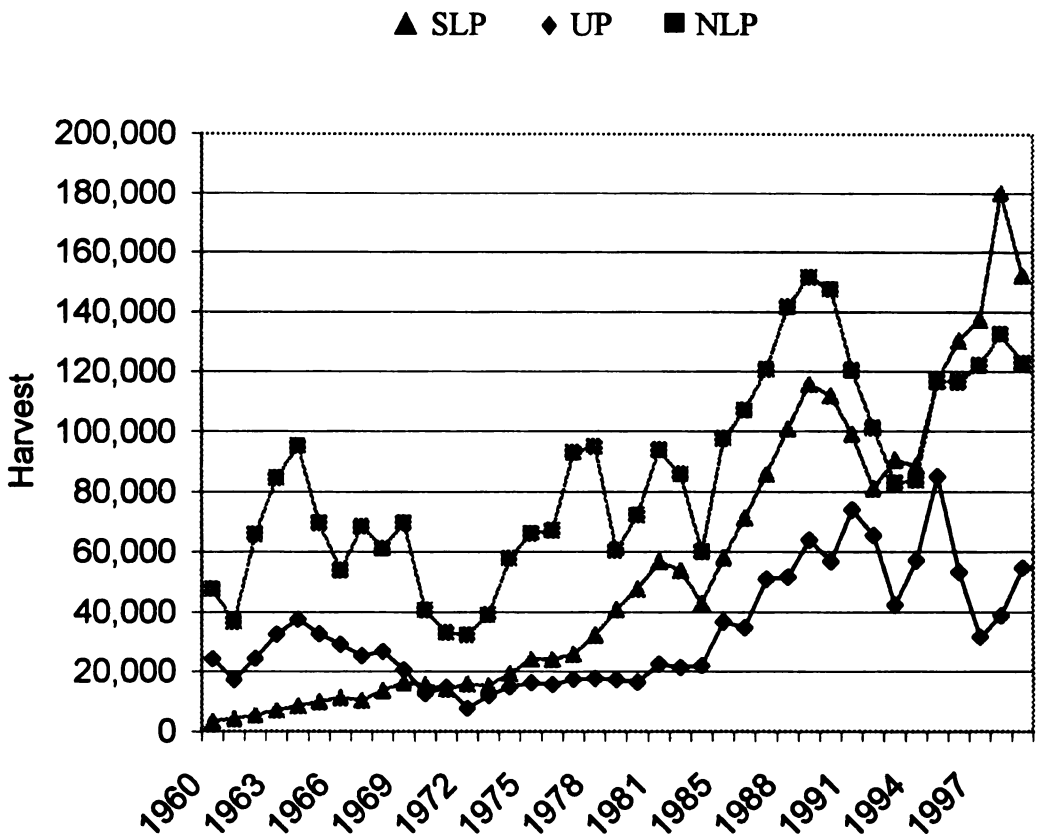


Figure 10. Total state firearm deer season harvest by region, 1960 to 1999.

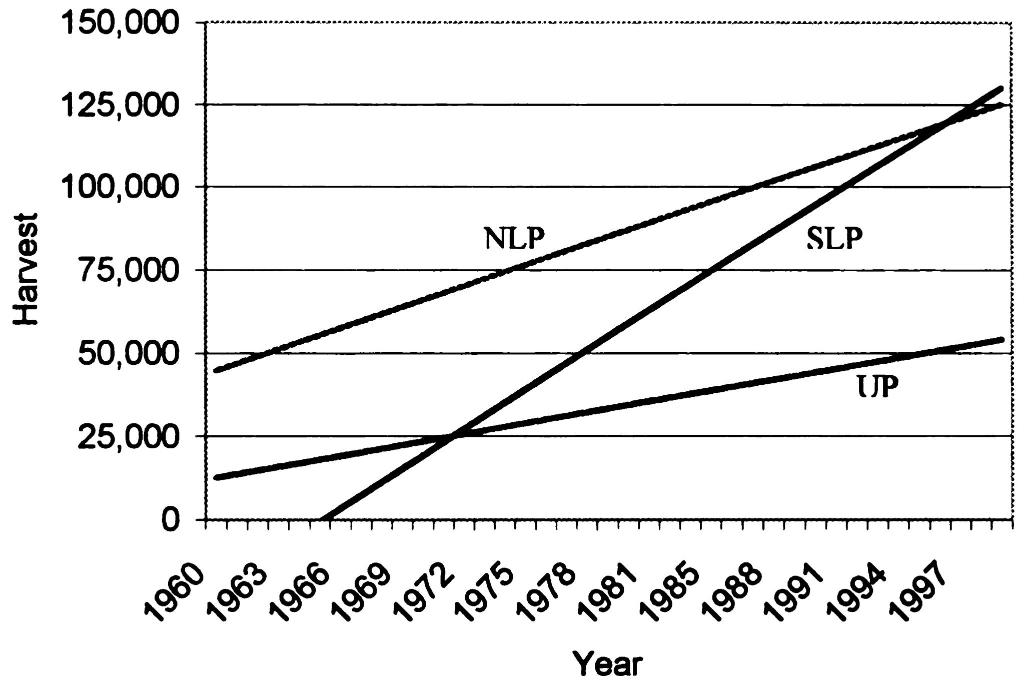


Figure 11. Total state firearm deer season harvest trends for each region, 1960 to 1999.

store deer inside the vehicle while traveling. It may also not be as socially acceptable to carry harvested deer on the outside of vehicles, attached to the bumper, as it was at the time of the surveys design.

Potential Actions

Eliminate the Traffic Survey

It is the goal of the traffic survey to predict the harvest within 5% of the mail survey 95% of the time (H. Hill, MDNR, personal communication). Under current traffic survey methodologies this does not seem possible. Stepwise regression estimates (unmodified, before being reported) for total state kill averaged an 11.03% difference from the mail survey for the years 1987 to 1999, and were only within 5% of the mail survey for five of those years (38.5%). The most accurate predictions for any of the dependent variables using stepwise regression procedures was for the Region II buck kill, which had a mean difference from the mail survey of 8.69% and was within 5% of the mail survey 4 of the 13 years from 1987 to 1999 (30.8%).

Stepwise regression estimates are generally adjusted before they are officially reported. The estimates serve as a starting point from which to apply factors such as weather during the hunting season, preseason harvest forecast and the professional opinion of wildlife biologists to obtain the final harvest estimates. These reported estimates averaged a 3.89% difference from the mail survey for 1987 to 1999. However, the estimates were only within 5% of the mail survey for 8 of those 13 years (61.5%).

Traffic survey reported estimates have remained close to the mail survey, even though stepwise regression estimates have become unreliable (Figure 12). This is

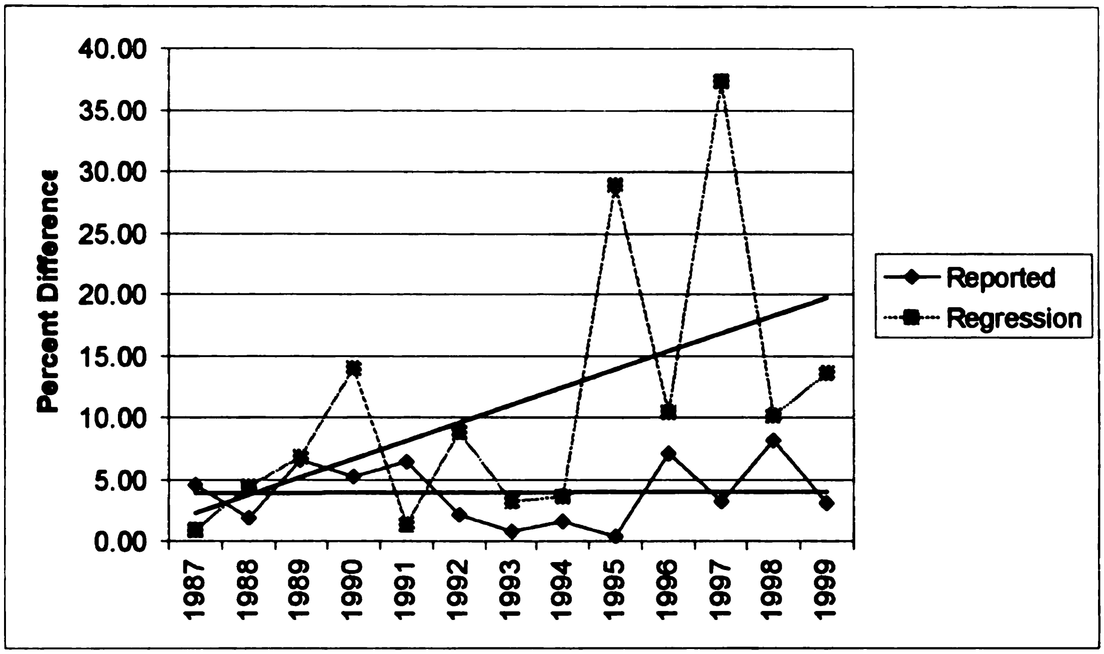


Figure 12. Reported traffic survey results and stepwise regression estimates for total state firearm deer season harvest, with trendlines, 1987 to 1999.

because the reported estimates are the stepwise regression estimates that have been adjusted using the professional opinion of experienced biologists. These adjustments are based largely on professional opinion, which is highly subjective. The quality of these adjustments will change with the changing of personnel. The MDNR is currently looking to lose a large number of its senior employees due to an early retirement option offered by the state of Michigan. Some of these employees who will retire are associated with the annual running of the traffic survey. This loss will undoubtedly have an effect on the quality of the professional opinion adjustment, and could result in a decrease in the reliability of the traffic survey reported estimate.

Current traffic survey methodologies cannot meet the annual goal of having estimates within 5% of the mail survey 95% of the time, regardless of whether the estimate is taken directly from stepwise regression, or if this estimate is adjusted. No method for predicting the harvest evaluated in this study met those restrictions for any of the dependent variables. It is likely that the traffic survey estimates will not become more accurate in the future, as the survey cannot deal with the factors that caused the decline in the accuracy of the estimates, such as the rising SLP harvest and the changing v/c ratio.

Currently, estimates for the SLP harvest are based on a system of communication between traffic survey personnel and MDNR SLP area unit supervisors. If estimates for the SLP can be based on the knowledge of area unit supervisors, it should be possible to derive an estimate for the entire state. Area unit supervisors for management units in the NLP and UP can be contacted during the season for information of the number of deer harvested in there respective units. The accuracy of these predictions should serve to be high enough for an initial prediction of the harvest, and it comes at little or no cost to the MDNR.

Keep the Traffic Survey

Traffic survey predictions serve only as an initial estimate of the harvest and are not used for any policy making decisions (H. Hill, MDNR, personal communication). The estimates are a public relations tool, as many Michigan hunters and residents have become accustomed to the MDNR releasing harvest estimates within a few days after the end of the firearm season. Additionally, the traffic survey is relatively inexpensive to carry out, at an annual cost of approximately $20,000 (includes costs of employees, hotel rooms, travel, and traffic survey materials) (H. Hill, MDNR, personal communication). It is important that these estimates be accurate though, because for many people it is the only estimate they see. The traffic survey is capable of producing estimates that are accurate enough for an initial estimate of the harvest.

If the traffic survey is going to be continued, the following changes are recommended based on the findings of this study:

1) Change the v/c ratio to a state average.
2) Delete the Bay City correction factor.
3) Use the new nighttime adjustments.

These changes were evaluated (see Chapter 1) and the results were reported under the name *final model*. Although the mean percent difference (1987 to 1999) from the mail survey was greater than for the stepwise regression estimates (12.01% versus 11.03%), the final model produced total state kill estimates that were closer to the mail survey for every year from 1994 to 1999. In addition to these changes the 1995 data should be removed from the data set.

In 1966 the Research Triangle Insititute performed an evaluation of the traffic survey. Since 1966 no outside evaluations of the traffic survey have been performed. If traffic survey methodolgies are to keep current with the changes that are occuring to some of the traffic survey components (v/c ratio and nighttime adjustments) periodic internal evaluations need to occur. An evaluation of all traffic survey methodologies every 3-5 years will help to ensure the traffic survey is producing the most accurate estimates possible. In addition to internal evaluations, independent evaluations, conducted outside of the MDNR should also be done as often as possible, every ten years at most.

Incorporating these changes into the traffic survey will provide more accurate estimates than the current methodologies. However, if the goal of having estimates within 5% of the mail survey 95% of the time must be met for an initial prediction, the traffic survey should be replaced with a survey that is capable of meeting those restrictions.

Alternative Methods

Telephone Survey

Telephone survey methodology can be designed to meet the precision standards the MDNR desires for its initial harvest estimates (5% of the mail survey, 95% of the time). Required sample sizes necessary for the desired precision are large, however. The drawback with using a telephone survey is the large number of respondents it would be necessary to contact in a short period of time, 4 to 5 days. The amount of manpower needed to complete this survey would be large; at the very least, 50 employees would be needed to complete the minimum amount of calls to meet the lowest allowable precision.

The costs associated with this type of survey would also be high. The state of Oregon currently uses a telephone survey to estimates its annual white-tailed deer harvest, and estimates that it costs $0.70 per completed phone call (J. Hurtado, Oregon Department of Natural Resources, personal communication), not including the costs of employees or necessary materials to complete the survey. In Michigan this would translate into costs as high as $16,000 to complete the amount of phone calls necessary for the highest level of precision (5% allowable error, 95% confidence). This cost is in addition to employee salaries and materials necessary for the survey.

Using a telephone survey as an initial estimate of the harvest does not appear feasible. There is not enough time available to make the necessary number of calls. Additionally, if this level of precision is met using a telephone survey, the mail survey becomes redundant, as nearly the same information would be collected. If a telephone survey is used in Michigan it is recommended that more time be allotted to complete the survey, and that it does not replace just the traffic survey as an initial estimate of the harvest, but that it also replaces the mail survey, and serves as the final "true" estimate.

Mandatory check

Implementing a mandatory check in Michigan has many more disadvantages than advantages over the current voluntary check system and current harvest estimators (mail survey and traffic survey). In theory, a mandatory check will provide a complete census of the harvest, and therefore would replace the mail survey as the harvest estimator, as it would be redundant and unnecessary to have two estimates of the harvest. The disadvantage to a mandatory check is that there is no way of knowing the percent of hunters who did not check their deer. Under the mail survey methodologies, variances can be derived and confidence intervals can be placed around harvest estimates to gain an idea of how precise they are. This is not possible using a mandatory check. Additionally, this complete census of deer would potentially come at a cost higher than that of the voluntary check system and the mail survey.

The two possible advantages a mandatory check system provides are decreased bias in the types of deer that are checked, as all deer would be checked, and a possible increase in public relations value. Many hunters assume the only way for the MDNR to collect accurate data on the deer harvest is to look at every deer. By implementing a mandatory check, and collecting data on "every" deer, the public may gain more confidence in MDNR deer management strategies. However, in practice, due to the large number of deer that will be checked, it is unlikely that the MDNR will be able to collect biophysical information on every deer that is checked. It is possible that less biophysical information may be collected under a mandatory check than currently is under the voluntary check.

Implementing a mandatory check system strictly as a replacement of the traffic survey is not recommended. The costs necessary to create the infrastructure for a mandatory check system in a state the size of Michigan, with a deer harvest as large as Michigan's outweigh the benefits a mandatory check system can provide. No additional information would be collected, compared to what is currently collected. Additionally, the validity of harvest estimates would be in doubt, as there is no way to measure their precision.

Deer Processors

A survey of deer processors to provide an estimate of the firearm deer season harvest does not appear feasible. There is too much variation in the factors that determine when and where a hunter will have their deer processed. In addition to this variation, the number and location of deer processors changes annually, as many are small businesses, often run out of a home.

A positive aspect of a survey of deer processors is an increased opportunity for hunters and deer processors to interact with MDNR wildlife division personnel. Having MDNR personnel at deer processors allows for communication between wildlife managers, hunters, and the general public in an informal setting. This increase in communication could provide an increase in the confidence the public has in MDNR policies and management practices, as questions could be answered and management practices explained.

Additionally, this type of survey may provide an index to the annual harvest. It does not appear that an estimate can be derived, but if the same processors are surveyed annually, an index to the harvest can be observed. Each year, fluctuations in the number of deer processors handle should reflect the number of deer that were actually harvested. This may help managers gain some insight into annual harvest trends.

Estimating the harvest by the number of licenses sold

Prior to 1998 a firearm deer season hunter only had the choice of purchasing a firearm license and a certain number of antlerless permits, depending on the location of the hunt. Each firearm deer season license purchased allowed the hunter to harvest one antlered deer. In certain years, hunters were allowed to purchase two firearm licenses, the second after a successful harvest with the first license. Under this system the number of licenses sold would have been a fairly accurate estimator of the total state harvest.

Starting in 1998 a combination license was introduced. This combination license allowed a hunter to harvest two antlered animals, during any season (archery or firearm), one of the antlered animals may be subject to antler restrictions (i.e., 4 or more points on one side). There are no data kept on the number of hunters who use this combination license in each season. This prevents the total number of combination licenses sold from being allocated into archery and firearm season. The firearm license is still sold to hunters who only plan to harvest one deer, during the firearm deer season. This increase in the types of licenses available, and the inclusion of some strictly archery season hunters into the total number of licenses sold for use during the firearm season, makes using the total number of licenses sold to predict the firearm deer season harvest an unreliable method.

Estimating the harvest by the number of deer checked

Under a voluntary check system the same groups of hunters annually check their deer (Bull and Peyton, 2000). In general, these groups include those hunters who harvested either a large antlered deer or an older antlerless deer, and those hunters who check their deer every year regardless of its size or sex. One final group of hunters is those that do not check their deer regardless of its size, sex, or age. Due to this suspected grouping of hunters, the number of deer check annually tends to remain constant.

Recently, certain parts of Michigan have seen an increase in the number of deer checked due to bovine tuberculosis (TB), which has been detected in Michigan's deer herd. This increase in the number of checked deer is due to mandatory check policies in the core TB area, and an increase in the number of hunters who voluntarily check their deer to have it tested for the disease in areas immediately surrounding the core TB area.

Using the number of deer checked annually to estimate the harvest does not seem to be a reliable method for the following reasons. (1) The number of deer checked annually remains fairly constant and appears to be independent of the actual harvest number, due to the groups of hunters who annually check their deer. (2) Unforeseen occurrences, such as TB in Michigan, increases the number of deer checked, whether due to regulations or hunter desire, and artificially increases the number of deer checked. "Artificially", because this increase in the number of deer checked may not reflect an actual increase in the harvest. Although, in the core TB area, unlimited antlerless permits have been issued and there has been a subsequent increase in the number of antlerless deer harvested in that area (Bull and Peyton 2000, Cook 2001).

Appendix 1. Summary of the mandatory deer check procedures and policies used in Michigan's neighboring states (Illinois, Indiana, Ohio, Minnesota, and Wisconsin).

Illinois

A. Background

Illinois has four separate white-tailed deer hunting seasons; archery (early and late), firearm (1st and 2nd season), muzzleloader, and handgun. Early archery season begins October 1st and runs until the start of the 1st firearm season in early November. Late archery season begins at the end of the muzzleloader season in early December and runs until mid January. Firearm season is divided between a 1st and 2nd season. First season begins in mid November and runs for 3 days. Second season occurs at the end of November. Muzzleloader season begins at the end of the 2nd firearm season and runs for approximately one week, ending in mid December. The handgun season occurs in mid January in specific counties where deer are determined to be overpopulated. The firearm season harvest is about 100,000 animals annually. No information could be found on the harvest numbers for the other seasons.

B. Data

Firearm deer hunters must take their deer either whole or field-dressed to the check station in the county in which it was killed, or the closest check station, on the same day it was taken. Firearm deer hunters may not quarter their deer prior to checking it in. Daily check station hours are 8 a.m. to 8 p.m. If a hunter is not able to locate a harvested deer in sufficient time to enable checking the deer by 8:00 p.m., the

Appendix 1 (cont'd).

hunter must take the deer to the appropriate check station upon its opening (8:00 a.m.) the following morning, or immediately upon retrieving it if that occurs later than the opening of the check station. Hunters during all other seasons (archery, muzzleloader, and handgun) must check their deer in the county from which it was harvested within 48 hours from the time of kill.

All information obtained from:
http://www.dnr.state.il.us/admin/systems/index.htm

Indiana

A. Background

Indiana has four separate white-tailed deer seasons; archery (early and late), firearm, and muzzleloader. Early archery season generally runs from October 1 through November and does not stop for the firearm season, which occurs in the last half of November. Muzzleloader season typically occurs for two weeks in mid-December. Later archery season starts about one week after the early archery season ends, and runs into early January. All deer taken in all seasons must be registered at an official deer check station. In 1999 approximately 99,618 deer were harvested across all seasons. The firearm season harvest comprised about 71% of the total harvest, or 70,907 deer. About 50% of the firearm season harvest is made up of antlered deer.

Appendix 1 (cont'd).

B. Data

Immediately upon harvesting a deer, the temporary transportation tag must be notched indicating the sex of the deer, and the month and day of the kill. The hunter who harvested the deer must present the deer at an official deer registration station within 24 hours of the kill. Upon arriving at a deer registration station the temporary tag will be replaced with a permanent seal attached between the tendon and bone of any leg on the carcass. The head of the animal must remain attached until the deer is registered at a check station and this permanent seal is attached.

All information obtained from:

http://www.in.gov/dnr/fishwild/huntguide1/deerhnt.htm#deer

Ohio

A. Background

Ohio has four distinct deer hunting seasons; archery season, special area primitive weapons season, firearm season (shotgun only), and the statewide primitive weapons season. All deer taken during any deer season must be checked at a certified check station. In 1999 there were approximately 126,000 deer taken in all seasons. The firearm season is six days long (Monday – Saturday after Thanksgiving) and in 1999 there were approximately 85,000 deer taken during this season. Each of Ohio's 88 counties has between 2-14 check stations, which are voluntary and are usually convenience stores, sporting goods stores, and gas stations. All harvested deer must be immediately tagged and brought in to a check station in the county, or an adjacent

Appendix 1 (cont'd).

county, from which it was harvested by 8:00 p.m. of the day after it was taken. Deer harvested on the final day of any season must be reported by 8:00 p.m. of that day.

B. Data

Once a deer is presented at a designated check station the hunter and station operator must complete the Deer Harvest Record form. Information included on the form that must be filled out by the hunter includes name and address of hunter, county of harvest, date of harvest, type of weapon used, and the present number of deer taken in Ohio by the hunter that year. Additional information on the form must be filled out by the station operator and includes the station number, permit type, and the age and sex of the animal. Age and sex data are separated into two categories, either antlers longer than 5 inches or antlers less than 5 inches. Deer assigned to the less than 5 inch category are further separated into either doe, button buck, or buck with antlers shed.

Division of Wildlife employees age approximately 6-8% of the deer harvested annually during the firearm season. These age data are immediately forwarded to the Waterloo Wildlife Research station for entry into a database. Age and sex data entry for the firearm season is completed by January 1st of each year. These data are then extrapolated to fit the entire harvest. Age and sex data from the firearm season are entered into a sex-age-kill model and the population size for all 88 counties is derived. Management decisions concerning season length and bag limit for the following year are based on this model, as well as landowner attitude

Appendix 1 (cont'd).

surveys and car deer accident data. Recommendations for changing a season or bag limit are made no later than the first week in February.

At the conclusion of each season harvest record forms are collected by county wildlife officers. These data are entered and analyzed by biologists in order to help determine next year's hunting seasons and bag limits. The entire process takes about 2 ½ months. In the future Ohio hopes to move to an electronic data entry system, which will provide instantaneous results available for immediate analysis.

All information obtained from:

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New Marshfield, OH 45766

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New Marshfield, OH 45766

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Minnesota

A. Background

Minnesota has three distinct deer hunting seasons: archery, general firearms, and muzzleloader. Archery season generally runs from mid-September through December annually. Firearm season generally starts on the first Saturday in November and lasts for approximately two weeks, ending on various days according to zone. Muzzleloader season starts on the last Saturday in November and runs for 15

Appendix 1 (cont'd).

days. Hunters in Minnesota generally harvest 125,000 deer throughout all seasons. All deer taken during any season must be registered at one of over 800 registration stations located throughout the state. These stations are voluntary and are typically stores, gas stations, etc. Stations are paid $0.25 per registered deer.

B. Data

Upon purchasing a license hunters are issued a registration tag. When an animal is taken the tag is to be immediately completed by the hunter. Information on the tag includes license type (firearm, archery, etc...), date of kill, deer management unit of kill, and the sex and age (fawn, adult) of deer. This tag is then turned into the registration station in exchange for a possession tag. In order to receive this possession tag, the person whose name is on the registration tag must personally present the tag and deer at the registration station. Possession tags must be obtained within 24 hours after the close of the season in which the deer was taken and before the deer is processed. Station operators are not required to verify the information presented by the hunter. It is the hunter's responsibility to accurately record all of the data on the registration tag. Minnesota DNR Wildlife personnel record information and check hunter recorded information for accuracy at several of the stations annually in order to check for, and if necessary, develop bias factors. Recent reports suggest hunters are biased against aging their kill as a fawn. Additional information collected by biologists includes age data, which is recorded to the year. DNR personnel collect information on less than 10% of the total harvest annually.

Appendix 1 (cont'd).

Registration tags are either sent to, or picked up, by area wildlife managers at the end of the season. The numbers are compiled and a final tally is reported within 2 weeks. In the future Minnesota hopes to move to an electronic registration system. Currently there are over 1700 electronic licensing agents across the state. The same regulations would apply, with the only difference being the instantaneous entry of data into a central data handling system. This is likely to increase the current cost to the state of $0.25 per deer due to the need to employ a central data system management company to handle the electronic data compiling systems.

All information obtained from:

http://www.dnr.state.mn.us/hunting/deer.html

Wisconsin

A. Background

Wisconsin has three separate deer hunting seasons: archery, firearm, and muzzleloader. Archery season begins in mid-September and continues until the opening of the firearm season. Archery season opens again at the conclusion of the firearm season and runs until the end of December. Firearm deer season in Wisconsin is a 9-day season generally starting on the third Saturday in November and running through the following Sunday. Muzzleloader season opens at the conclusion of the firearm season and lasts for one week. In 1999 Wisconsin harvested a total of 503,000 white-tailed deer during all seasons. Wisconsin uses a mandatory check

Appendix 1 (cont'd).

station system that was put into place in 1953. All deer taken during all seasons must be checked.

Currently there are over 600 cooperative registration stations distributed throughout the state. Three criteria are used when selecting a registration station; they include need, location, and station specifics. Need for a station is based on the following: 1) attrition – when an existing station closes another station in the same location should be considered first; 2) requests for a station – these are kept on file and given consideration when the criteria are met; 3) the number of deer being registered by nearby stations – this works both ways, if nearby stations are overburdened additional stations will be considered, however, if stations are registering less than 50 deer consideration will be given to dropping them; 4) customer feedback – feedback from the public is considered before any decision is made on a registration station.

Location of a station is based on a number of factors. How many people the station will serve and the proximity to other stations are the two most important factors. Additionally, thought must be given to the impact a new station may have on existing stations and finally consideration is given to the location of a station in order to maintain current traffic laws and transportation requirements.

Station specifics include information that is pertinent to each individual station. Information such as the type of establishment must be noted. Taverns and bars are used only if there are no other options in an area. The hours of a business, parking

Appendix 1 (cont'd).

availability, and the general reliability of the business are all considered before any business can become a registration station.

All current registration stations are contacted in July to confirm that they are still participating in the check station program, it is a voluntary program and businesses can decide not to participate if they choose. A list of all participating registration stations is then compiled and released by the Bureau of Wildlife Management in September. Materials needed for the data collection are then forwarded to the stations sometime in the first week of September. Materials arrive this early in the fall because these stations also register information on bear and turkey harvested in the fall. In 1997 stations were paid $0.35 per deer registered.

B. Data

Data collected at the stations includes the date, county and deer management unit in which the animal was taken, and whether the animal was antlered or antlerless. Additional information on the season (archery, firearm) and the age and sex (adult buck, adult doe, buck fawn, doe fawn) of the deer are also collected. Wildlife personnel work at selected stations and collect age information on about 5% of the deer harvested each year.

Aging of deer is only done at stations that have historically received a high volume of registrations during the opening weekend, generally aging occurs at less than 100 of the approximately 600 statewide stations. Aging of deer only takes place on the first 2 or 3 days of the firearm season. Deer are aged using toothwear and

Appendix 1 (cont'd).

replacement criteria. Agers are either Wildlife personnel or volunteers and they must annually complete certification, which includes a review of field aging procedures. Ages are recorded as whole numbers in the categories 2, 3, 4-5, 6-8, 9-12, or 12+. All deer not registered at specified aging stations are recorded as adult buck, adult doe, buck fawn, or doe fawn.

Upon arrival at the registration station hunters fill out a harvest card. Information on the card includes hunter name, address, date of kill, sex of deer, and deer management unit (DMU) of kill. Cards are separated into DMU of kill by registration station workers. Each wildlife manager in the state is in charge of several DMU's. Data from registration stations are collected either in person by Department of Wildlife personnel or by mailing to the appropriate wildlife manager. Mailed data are sent bi-weekly during the archery season and daily during the firearm season. Once received by the Wisconsin DNR several steps occur. First, a record of the number of stubs sent in from each station is kept, in order to pay the stations. Secondly, the data are sorted by county, deer management unit of kill, type of deer, and type of license. When information for each DMU has been tallied, the results are sent to the Regional Wildlife Biologist. There are five regions in the state. When results for each region have been finalized they are reported to the state statistician. The final step is to enter the data into the DNR VAX computer system. Interim reports are generated following the firearm season and the final report appears in the Big Game Harvest Report sometime in early February.

Appendix 1 (cont'd).

All information obtained from:

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