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HARVEST OUTCOMES

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**PREFERENCES AND HARVEST INTENTIONS OF HUNTERS IN MICHIGAN
AND THEIR EFFECTS ON WHITE-TAILED DEER HARVEST OUTCOMES**

By

Elizabeth Lauren Ball

A THESIS

Submitted to
Michigan State University
In partial fulfillment of the requirements
For the degree of

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ABSTRACT

PREFERENCES AND HARVEST INTENTIONS OF HUNTERS IN MICHIGAN AND THEIR EFFECTS ON WHITE-TAILED DEER HARVEST OUTCOMES

By

Elizabeth Lauren Ball

The selective harvesting of Michigan's white-tailed deer (*Odocoileus virginianus*) represents a potential concern for deer hunting constituents and the state's management agency. This study investigated hunters' preferences for deer characteristics based on three conceptualized buck categories (ideal, preferred and least preferred) and the hunters' intentions to be selective based on 2,628 responses to a mail survey. Hunters surveyed preferred 7 to 10 antler points, 16 to 20" spread and 2 ½-year-old antlered deer. The majority (60%) of bucks that were harvested, however, were yearlings that did not exhibit those characteristics. Furthermore, 32% of respondents indicated that they intended to harvest any legal buck and not wait to harvest a buck of a specific category. I further examined how these hunters' preferences and intentions to be selective were linked to the outcome of their hunt by measuring eight morphological characteristics of 751 harvested antlered deer during the 2006 firearm season. Six antler dimensions and two body size measurements were collected to determine hunter selectiveness for them. The majority (61%) of the 751 bucks collected were harvested on opening day. Although hunters have harvest preferences, these preferences are seldom reflected in actual outcomes thereby reducing the potential for hunter-induced selection to occur.

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ORGANIZATION OF THESIS

This thesis is organized into five chapters. The first chapter presents a general introduction to my study including relevant background information and study objectives. Chapter 2 provides an outline of the general methodological procedures employed for this study. The third chapter summarizes the results obtained from a survey of firearm deer hunters in the Saginaw Bay region of Michigan. It quantifies harvest preferences and selectivity intentions and presents results from models explaining variation in hunter preferences and intentions. Chapter 4 presents data collected on harvested antlered white-tailed deer (*Odocoileus virginianus*) combined with survey data from each respective hunter. The aim of Chapter 4 was to determine whether hunters with different intentions to be selective in harvesting a buck have different harvest outcomes. The fifth chapter presents a general discussion of my research findings and implications of such research. Data collection instruments and research approval letters are provided as appendices.

CHAPTER 1

General Introduction

General Introduction

1.1 The rise of human dimensions of wildlife management

A utilitarian philosophy defined the way society viewed wildlife in the early 19th and 20th centuries in America (Petulla, 1987). The need for wildlife management and conservation in the early 20th century was a theme consistent with an increased awareness of wildlife by society. In 1933, Aldo Leopold published *Game Management* which further strengthened the utilitarian view of human-wildlife relationships integrated with an agricultural focus (Leopold, 1933). Despite being the keystone reference to scientific inquiry of wildlife management for over 40 years it neglected to consider the human aspect of wildlife management (Bath et al., 2001).

By 1960 little had changed. As pointed out by Mair in his critique of presentations at the 25th North American Wildlife Conference,

“I am disturbed too at the apparent complete lack of research into the social and cultural aspects of the wildlife conservation field. We are spending significant sums of money on wildlife now and plan to spend much more in the future, particularly with respect to the allied field of recreation. But there has been at this conference no mention of research into the mores of people, their motivation and their real needs (Mair, 1960)”.

It was not until the book *Wildlife Management* was published in 1978 by Robert Giles, Jr. that wildlife management included a human element (Bath et al., 2001). The human element, also referred to as the human dimension of wildlife management, has been defined as,

...an area of investigation which attempts to describe, predict, understand, and affect human thought and action toward natural environments and to acquire such understanding for the primary purpose of improving stewardship of natural resources (Zinn & Manfredo, 1992).

The importance of human dimensions stems from consumptive wildlife resource users (e.g., hunters) playing an increasingly pivotal role in the management process. Consumptive resource users can affect exploitable populations by reducing overall numbers or reducing the number of certain types of animals (e.g., those meeting minimum size requirements). Such harvesting practices are behavioral acts of hunters; the human dimension aspect of wildlife management seeks to understand human behavior and determine factors related to harvest outcomes.

1.2 Hunter-induced Selection

Harvest decisions can have important consequences for not only the size of game populations, but also for the composition (i.e., sex ratio, abundance of specific trait attributes) of populations (Fenberg & Roy, 2007). Previous concerns about harvest-induced changes in herd composition have considered either skewed adult sex ratios (Harris et al., 2002; Whitman et al., 2004) or skewed population age distributions (Strickland et al., 2001). The effect of preferential harvesting of animals with specific attributes, however, has not been as thoroughly explored except on certain species like bighorn sheep (Coltman, 2008).

Hunter-induced selection is the result of selective (i.e., non-random) harvesting of prey with certain characteristics from within a population. In some cases selection is focused on the size of one particular sex whereas, size-selective harvesting in other systems is independent of sex (Fenberg & Roy, 2007). Recreational hunters, like natural predators, have the ability to differentiate the individuals they harvest from the population (Kunkel, Ruth, Pletscher, & Hornocker, 1999), but might select for very different attributes in prey.

1.3 Natural Selection & Evolution

Ample empirical evidence exists supporting natural selection in the wild (Endler, 1986; Kingsolver et al., 2001). Natural selection often occurs as a distinct episode (e.g., drought, flood, winter storm) of selection where individuals possessing a specific morphological trait(s) have a survival advantage over the rest of the population (Arnold & Wade, 1984; Conner & Hartl, 2004). Greater than 80% of estimates of natural selection in the wild have resulted from measurements of morphological traits (Kingsolver et al., 2001), including selection of overall body size and specific morphological characteristics (Fox, 1975; Price et al., 1984).

Despite a growing body of work supporting the process of natural selection acting on morphological traits in natural environments, there remains a gap in the literature linking proposed anthropogenic influences to natural selection. Recreational hunters might impose natural selection on their prey if only individuals with specific attributes in the prey population are selectively harvested (i.e., hunter-induced selection). For example, a study conducted on bighorn sheep rams (*Ovis canadensis*) in Alberta, Canada highlighted a system where hunters targeted specific individuals from the population because of minimum harvest size regulations. The hunter-induced selection imposed on the population from 1971 to 2002 resulted in an evolutionary decline in the number of ‘trophy’ game animals available for harvest (Coltman et al., 2003). Hunters were found to be selectively harvesting males with higher body weight and horn size, which caused a decline in the trait means and reduced reproductive potential of rams. This particular study provided rare evidence of direct evolutionary consequences resulting from harvest outcomes mandated by minimum horn size harvest regulations.

Evolutionary effects resulting from harvest biases have also been documented in marine fisheries experiencing excessive anthropogenic size-selective harvesting pressures (for a review see Browman, 2000; Conover & Munch, 2002; Festa-Bianchet, 2003; Stokes & Law, 2000). Documented size-selective harvesting has been shown to select for traits that are economically desirable such as large size. Excessive harvest of individuals with these traits can result in the evolution of less desirable traits such as reduced size at maturity and reduced fecundity (Browman, 2000).

1.4 Social Psychology Aspect of Human Dimensions

1.4.1 Understanding Hunting Behavior

In order to understand the potential effect of non-random harvest decisions on wildlife populations we need to better understand how hunters make their harvest decisions. The Theory of Planned Behavior (Ajzen & Fishbein, 1980) has been used in a variety of contexts to gain a clearer understanding of wildlife resource users' behavior. It has been hypothesized that behavioral acts occur in a manner that is likely to confer a preferred outcome, such that personal preferences can often serve as strong indicators of behavioral intentions (Lichtenstein & Slovic, 2006). In a wildlife management context, preferences for wildlife population sizes have been found to differ among stakeholder groups (i.e., farmers, hunters and the general public; Curtis & Lynch, 2001). Also, different user groups (e.g., Indian and colonist communities) have been investigated and their harvesting preferences of specific game taxa (e.g., mammals, birds, reptiles) quantified in terms of the species hunted and the number harvested (Redford & Robinson, 1987). The relationships between total numbers harvested and user groups (Redford & Robinson, 1987; Vickers, 1984), animal body mass (Bodmer, 1995) and preferences for

alternative fishing management scenarios characterized by minimum and maximum total length (Oh, Ditton, Gentner, & Riechers, 2005) have also been explored. None of the aforementioned studies considered preferences for particular attributes other than body mass or total length of the harvested individuals. Harvest preferences for specific desirable attributes (e.g., body size, antler size or configuration) of a multi-attribute individual such as an antlered white-tailed deer, is potentially important for determining the influence of attributes on a hunters' harvest outcome.

1.4.2 Behavioral Intentions

Given a behavior under volitional control, intentions are thought to be the direct predecessors of behavior (Ajzen, 1991). The Theory of Planned Behavior provides one theoretical framework that helps to understand and predict volitional behavior by identifying determinants of a person's intentions (Ajzen, 1991; Ajzen & Fishbein, 1980). One determinant of intentions are attitudes (Homer & Kahle, 1988); empirical relationships between attitudes and intentions, however, are inconsistent (Homer & Kahle, 1988). Aspects of personality other than attitudes, such as motivation and situational variables, might also affect the attitude-intention relationship (Ajzen & Fishbein, 1974). Holsman & Petchenick (2006) found that attitudes about deer population reduction goals did not affect the behavioral outcome of the number of deer harvested. The degree to which attitudes accurately predict intentions and harvest outcomes (i.e., behavior) is unclear.

1.5 White-Tailed Deer Harvesting in Michigan

In 2006 the annual harvest of white-tailed deer (*Odocoileus virginianus*) in the southern lower peninsula of Michigan exceeded 450,000 (Clute, 2006), representing

roughly 53% of the estimated population for that area. As a result, selection pressures from hunters could be strong enough to result in observable changes of deer attributes towards less desirable forms. In order to determine this selection potential, I examined hunter preferences for deer attributes and hunter harvest intentions. To establish a region of Michigan that would have the highest likelihood for selection to occur, I quantified the opportunity for hunter-induced selection on bucks for each deer management unit (DMU) in the state of Michigan. The opportunity for selection (I) was calculated as the variance in relative fitness of bucks based on existing population (2000-2005) and harvest estimates (2000-2004) for each DMU in Michigan (see Figure 1.1; refer to the General Methods section). In this case, I is based on the proportion of individuals harvested from the total population and sets an upper limit to the strength of hunter-induced selection. Typical harvest levels of antlered deer represent an extremely high opportunity for selection during the firearm deer hunting season. Seventy-seven of ninety-six DMUs typically experience an opportunity for selection on antlered deer that could fall within the strongest 5% of previously recorded selection events in the wild (Kingsolver et al., 2001). The majority of DMUs with the “strongest” ($I = 5$ to 11) opportunity for selection were located in the Saginaw Bay Wildlife Management Unit (SBWMU) and all DMUs located within SBWMU had “very strong” ($I = 0.75$ to 5) or “strongest” ($I = 5$ to 11) opportunity for selection values. Values for antlerless deer were also calculated but these were generally very low indicating that too few antlerless deer are harvested for hunter-induced selection on antlerless deer to be a problem.

The proportion of antlered white-tailed deer harvested in most DMUs in Michigan, and in the SBWMU in particular, suggest that hunter-induced selection has the

potential to be very strong. As a first step toward quantifying hunter-induced selection, this study investigated white-tailed deer hunters' preferences, intentions and harvest outcomes. White-tailed deer represent an optimal study subject due to their popularity as a harvestable big game species, high annual harvest rates, and abundance within the state of Michigan. In this system, prominent traits (i.e., large antlers) have the potential to confer a fitness disadvantage during the hunting season because individuals with these trait attributes might be disproportionately removed from the population via hunter harvest. By understanding hunter preferences, intentions, and harvest outcome, it will be possible to determine the potential targets of selection and the potential fitness disadvantages incurred from selective harvesting of these individuals from the population.

1.6 Study objectives

The overall goal of this research was to explore the potential evolutionary consequences from non-random harvesting of antlered white-tailed deer by firearm deer hunters in Michigan. As a first step towards quantifying hunter-induced selection, I set out to measure the preferences and intentions of white-tailed deer firearm hunters and their harvest outcomes. This goal was accomplished through the following objectives:

1. Quantify Michigan firearm deer hunters' preferences for total number of antler points, G2 tine length, antler spread and age of antlered deer.
2. Determine the intention of Michigan firearm deer hunters to be selective.
3. Examine the importance of context-independent factors (i.e., intention to be persistent, expectations, importance of selectivity) and hunter attributes (i.e. age, centrality to lifestyle) to their selectivity intentions.

4. Examine the morphological characteristics of antlered deer harvested during the 2006 firearm season and determine the relationship between context-independent factors (i.e., self-reported persistence, selectivity intentions), hunter attributes (i.e., centrality to lifestyle, age, years of hunting experience) and context-dependent factors (i.e., hunting pressure, land-type hunted, day of season started hunting) and the characteristics of hunters' harvested antlered deer.

1.7 Research implications

This project investigated the potential for selective harvesting to result in the evolution of wild, free-ranging populations of antlered white-tailed deer in ten counties in the east-central Lower Peninsula of Michigan. It serves as a first step toward understanding the degree of selective harvesting in this area of Michigan by exploring hunter preferences and selectivity intentions.

Figure 1.1. Map of Michigan designating Deer Management Units and their respective opportunity for selection values. The study area is outlined in yellow (Saginaw Bay Wildlife Management Unit). **This image is presented in color.**

[illegible]

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CHAPTER 2

Data Collection Methodology

Data Collection Methodology

2.1 Study area

2.1.1 Selection of study area

The study area for this project was chosen based on calculated values of the opportunity for selection (denoted by I) (see General Introduction; see Figure 1.1). The opportunity for hunter-induced selection was quantified based on existing population (2000-2005) and annual harvest estimates (2000-2004) for each Deer Management Unit (DMU) in Michigan taken from Frawley (2007). Information from Michigan Department of Natural Resources (MDNR) harvest surveys, deer check stations, deer pellet group surveys, reports of deer-vehicle collisions and population modeling were used to estimate deer population levels statewide (Frawley, 2007).

The Saginaw Bay Wildlife Management Unit (SBWMU) is located in a region of Michigan that is dominated by agricultural and forested landscapes. Huron, Sanilac and Tuscola counties are characterized by a long growing season (130 – 160 days), annual precipitation of approximately 31 inches with below average winter temperatures (-28 °F to -24 °F) and minimal snowfall during the winter months (Comer et al., 1995).

Saginaw, Bay, Midland, Gladwin, Arenac and the eastern areas of Clare and Isabella counties are characterized by a long growing season (153 days), with minimum winter temperatures of approximately 14 °F (Comer et al., 1995).

2.2 Survey methods

2.2.1 Pre-survey focus groups

Two focus groups were utilized to facilitate the design of a mail questionnaire to evaluate hunters' attitude toward white-tailed deer harvest and to provide a qualitative

description of resident firearm deer hunters in the SBWMU of Michigan. Both meetings were conducted by following a scripted set of questions (Appendix A). Names of potential focus group participants were elicited from a sampling frame produced by the MDNR in which individuals meeting the following criteria were included: 1) Michigan residents, 2) 18 years of age or older as of January 1, 2006, and 3) had purchased a license in 2006 to hunt white-tailed deer. All participants (n = 29) indicated a willingness to participate in a focus group discussion by returning a postcard indicating their availability (Appendix B). Participants of each focus group meeting also provided their consent to participate in the meetings (Appendix C) and completed a brief survey (Appendix D). Focus group meetings were held with SBWMU firearm deer hunter stakeholders in March of 2006 in Bay City, Michigan. These meetings were conducted to achieve the following objectives:

- 1) Identify external variables that may impede a hunter's ability to exercise intended harvest actions.
- 2) Identify potential antlered deer traits that would allow later categorization of these trait preferences among deer hunters.
- 3) Identify the perceptions of the stakeholders' own harvest selectivity and the reason(s) for their perceptions.

Focus group input helped to guide the development of hypotheses and the selection of variables for modeling purposes.

2.2.2 Sampling criteria & sampling frame

The sampling frame for the mail questionnaire was determined by the following criteria: 1) Michigan residents, 2) 18 years of age or older as of January 1, 2006, 3) had purchased a license in 2006 to hunt white-tailed deer, and 4) had completed and returned a 2003, 2004 or 2005 MDNR harvest questionnaire stating they had harvested a white-

tailed deer (antlered or antlerless) from within the research study area (SBWMU). Only deer hunters possessing a combination license, an archery only license, and a firearm only license qualified for this study. The sample group for the survey was derived from a portion of the total number of firearm deer hunters who had previously hunted or hunt within the SBWMU; it was not a statewide sample.

2.2.3 Mailing sequence dates & sample sizes

The self-administered mail questionnaire (Appendix E) with repeat mailings was conducted following methods described by Dillman (2000). A cover letter (Appendix F) was included in each initial mailing to introduce the questionnaire and inform recipients that filling out the survey indicated their voluntary participation. A total of 3,954 names and addresses were used in the initial mailing of the questionnaire on January 12th, 2007 followed 15 days later with a reminder postcard (Appendix G). Non-respondents received a second questionnaire 15 days later accompanied by a modified cover letter (Appendix H). Non-respondents of the second questionnaire were sent a third and final mailing of the questionnaire with the same modified cover letter 15 days after the second mailing was delivered. All questionnaires were mailed from and returned to the MDNR headquarters in Lansing, Michigan. A deadline of May 23rd, 2007 was established, after which time no returned mail questionnaires were included in the study. Questionnaire responses were coded and transferred to a database using a MDNR program designed for survey data entry purposes.

2.2.4 Study variables

The mail questionnaire was designed to assess hunter preferences for deer related attributes (e.g. number of points, spread) and to determine the influence of non-deer

related factors (e.g., hunter persistence, landownership) on hunter preferences and intentions for harvest outcomes. In addition, several other factors that potentially affected harvest outcome were measured including selective harvest intentions, self-reported persistence, experience (e.g., age, number of years hunting), centrality of hunting to one's lifestyle, hunting pressure, number of days hunted, the day hunting began and land-type hunted (i.e., public vs. private). Although behavior was not explicitly measured, the intentions for harvest and the actual harvest outcome were. Some standard demographic questions typically asked on surveys (i.e., employment status, education level and income) were not measured in this case.

Three categories of bucks that hunters would be willing to harvest as their first buck of the firearm deer season were presented to respondents under the heading of: ideal, preferred and least preferred. To reduce subjectivity and ambiguity among responses, each category was described. **Ideal bucks** were defined as "Those that you would not hesitate to take if the opportunity presented itself. You might be willing to pass up shots at other bucks for part or all of the November firearm season to wait for this buck". A **preferred buck** was defined as "A buck that you would harvest when you were not willing to wait any longer for your ideal buck. You might be willing to pass up shots at other legal bucks for part or all of the November firearm season to wait for a buck of at least this standard". Finally, **least preferred bucks** were defined as "Those you would harvest only after you gave up waiting for your ideal and preferred bucks. You might decide to harvest your least preferred buck for venison or because you would rather not risk ending your November firearm season without harvesting a buck at all". These three categories of bucks were further defined as deer that the respondent was

reasonably certain existed in their hunting area within the Saginaw Bay Wildlife Management Unit.

Variables used in the data analysis stages were operationalized by the survey as follows:

Selectivity intention: This was the hunter's intention to be selective when harvesting their first buck at the beginning of the 2006 November firearm deer season. Intentions were measured using the options of: "I intended to shoot only a buck that met my ideal buck standards, even if it meant not getting a buck during the 2006 November firearm deer season", "I intended to try and harvest my ideal buck for a while, but would not have settled for anything less than my preferred buck standard, even if it meant not getting a buck during the 2006 November firearm deer season", "I intended to wait awhile to harvest either an ideal or preferred buck, but intended to harvest a least preferred buck, if necessary, to avoid going home without venison during the 2006 November firearm deer season", and "I intended to take any legal buck that presented an opportunity during the 2006 November firearm deer season."

Preferences: Preferences for attributes of antlered deer were assessed by qualitative descriptions of antler tine length, antler beam spread, total number of antler points and age. For each buck category and for each trait attribute, a preference was qualitatively described.

Harvest experience: Harvest experience was measured as whether a hunter harvested one or two antlered deer during each of the past three November firearm deer seasons (2004, 2005, and 2006).

Years of hunting experience: The years of firearm deer hunting experience was measured by how many of the past three years (2003, 2004, and 2005) that a respondent hunted in the SBWMU during the November firearm deer season.

Importance of selectivity: The importance of selectivity was measured as how important select whitetail deer attributes were in helping hunters decide whether to harvest a buck. Response options included “Extremely Important”, “Moderately Important”, “Slightly Important”, “Not at all Important”, and “I am Unsure”. Responses of “I am unsure” were treated as missing data as no direction of importance could be gathered from such a response. “Extremely Important” was scored as the highest value of importance whereas “Not at all Important” received the lowest value. Reported responses were then averaged across the seven whitetail deer attributes for a final overall importance of selectivity score for each hunter. Larger scores meant that the hunter placed a high importance on these traits when making harvest decisions.

Expected harvest opportunity: Expected harvest opportunity (i.e., “Extremely likely”, “Highly likely”, “Somewhat likely”, “Not at all likely”) was measured as the respondents perceived likelihood of having the opportunity to harvest each category of bucks.

Intention to be persistent: Two values for the intention to be persistent were calculated. Responses from the survey enabled scores to be computed for the intention to be persistent for an ideal buck category before switching to a preferred buck and the intention to be persistent for an ideal *or* preferred buck before switching to a least preferred buck. Respondents indicating that they intended to wait for at least part of their season to try and harvest an ideal buck were asked when they would most likely stop

waiting for a particular category of buck and take another if the opportunity was presented. The response options were when “75% of my opportunity to hunt remains”, “50% of my opportunity to hunt remains”, “25% of my opportunity to hunt remains” or “I wouldn’t shoot anything less than a buck of my ideal or preferred standards.”

Centrality of lifestyle: The centrality of deer hunting to one’s lifestyle was assessed by the importance of deer hunting as a recreational activity compared to other recreational activities. This question has been used extensively in the past (Hunt, Haider, & Armstrong, 2002; Sutton, 2003) and serves as an indicator of the level of specialization of a hunter. Possible responses to the question included: “My most important recreational activity”, “One of my more important recreational activities”, “No more important than any other recreational activity”, “Less important than most of my other recreational activities”, and “Not at all important to me as a recreational activity”. Due to the low number of responses to options “No more important than any other recreational activity” (n = 328), “Less important than most of my other recreational activities” (n = 46), and “Not at all important to me as a recreational activity” (n = 26) these three categories were combined into one category for analysis purposes.

Land-type: The land ownership type that was primarily hunted on during the past three November firearm deer seasons (2004, 2005, and 2006) was recorded as either public or private.

Self-reported persistence: Self-reported persistence was calculated as the number of days hunted before harvesting their first buck divided by the total number of days available to hunt. A value of 1 indicated that the hunter harvested their first buck on their last available hunting day.

Hunting pressure: Hunting pressure was measured as the perceived hunting pressure within a mile of the respondents' primary hunting area, and was categorized as: "Very light", "Light", "Moderate", "Heavy", and "Very Heavy."

Start of the hunting season: Possible responses describing the start of the hunting season included: "I began hunting on the first day the season opened (Wednesday, Nov. 15)", "I began hunting on the second day of the season (Thursday, Nov. 16)", "I began hunting on the third day of the season (Friday, Nov. 17)", "I began hunting during the first weekend (Saturday and Sunday, Nov. 18 and 19)", and "I began hunting during the second week (Monday thru Friday, Nov. 20 to 25)". Very few hunters began hunting on days other than the first day of the season; therefore, these four categories were combined into one category (i.e., "Any day after the first day").

Harvest date: The date that an antlered deer was harvested. This date may have been different from the date the deer was checked in at a check station.

To reduce the variability of situational factors contributing to harvest outcomes, a sex-specific and site-specific approach was used throughout the survey. Specifically, respondents were cautioned that although people hunt in more than one location and may have different harvest intentions for those areas, the questions on the survey were to be answered as they would apply to the respondents' primary hunting area during the 2006 November firearm deer season in the Saginaw Bay Wildlife Management Unit. Drafts of the questionnaire were reviewed by the researcher's committee, fellow colleagues, MDNR biologists and personnel, and firearm deer hunters. The questionnaire was then piloted to hunters (N =10) and Michigan State University graduate and undergraduate students (N =10). Necessary revisions were completed and a final version of the mail

questionnaire was approved by the University Committee Involving Research on Human Subjects and the Institutional Review Board (IRB #05-1028, see Appendix J).

2.3 Data Collection on Harvested Deer

Measurements of harvested, antlered, white-tailed deer attributes were collected from hunters during the 2006 firearm deer season, November 15-30th, 2006 in ten DMUs that geographically comprise the SBWMU (See Figure 1.1) (ESRI, 1999).

Attribute measurements were taken at ten check stations that checked a high proportion of antlered deer harvested within the study area and that were open throughout the 16-day firearm deer season. The numbers of antlered deer processed for attribute measurements at each check station were as follows: Bay City: 23, Cass City: 121, Chipp-A-Waters: 66, Gladwin: 74, Maurer's Meat: 68, Mr. Chips: 52, Sanford: 74, St. Charles: 95, Standish: 92, Wilson State Park: 85, and one unknown. During the collection of morphological attribute measurements of harvested deer, reminder postcards (Appendix I) were handed out to successful hunters informing them that they would be receiving a survey in the mail starting in January 2007. Hunting license or driver license numbers were also collected to facilitate the mailing of a survey to each hunter.

Deer were measured if they were legally harvested by a Michigan resident within any county of the 10-county SBWMU during the November firearm deer season and were considered an antlered white-tailed deer by the MDNR (i.e., > 3" antler points). Morphometric attribute data collection consisted of the measurements of six traits including ear length, hindfoot length, G2 tine length and spread (see Figure 2.1). Two further measurements (total number of antler points and antler beam diameter) were obtained from the MDNR as part of their annual routine data collection procedures (see

Figure 2.1). Beam diameters were collected to the nearest tenth of one millimeter. All other trait measurements were collected to the nearest tenth of one centimeter. Measurements were collected using a cloth measurement tape following standardized procedures:

Ear length: Measured from the base of the notch below the ear opening to the most distant point on the margin of the pinna (external ear), excluding ear hair that extends beyond this point (Lundrigan, 1996).

Hindfoot length: Measured from the calcaneum (heel or hock) to the base of the hoof (Lundrigan, 1996).

G2 tine length: Measured from the baseline of the G2 tine (i.e. where the bottom of the G2 tine intersects with the top edge of the main antler beam) to the tip of the tine, following the centerline of the tine; both left and right antler G2 tines were measured.

Spread: Measured as the widest distance between the left and right main antler beams or points.

Total number of antler points: All points greater than 1" in length were enumerated.

Beam diameter: Measured the main antler beam 1" from the antler burr; two measurements were taken perpendicular to one another and then averaged for the final main antler beam diameter. Both left and right sides of the main antler beam were measured.

Figure

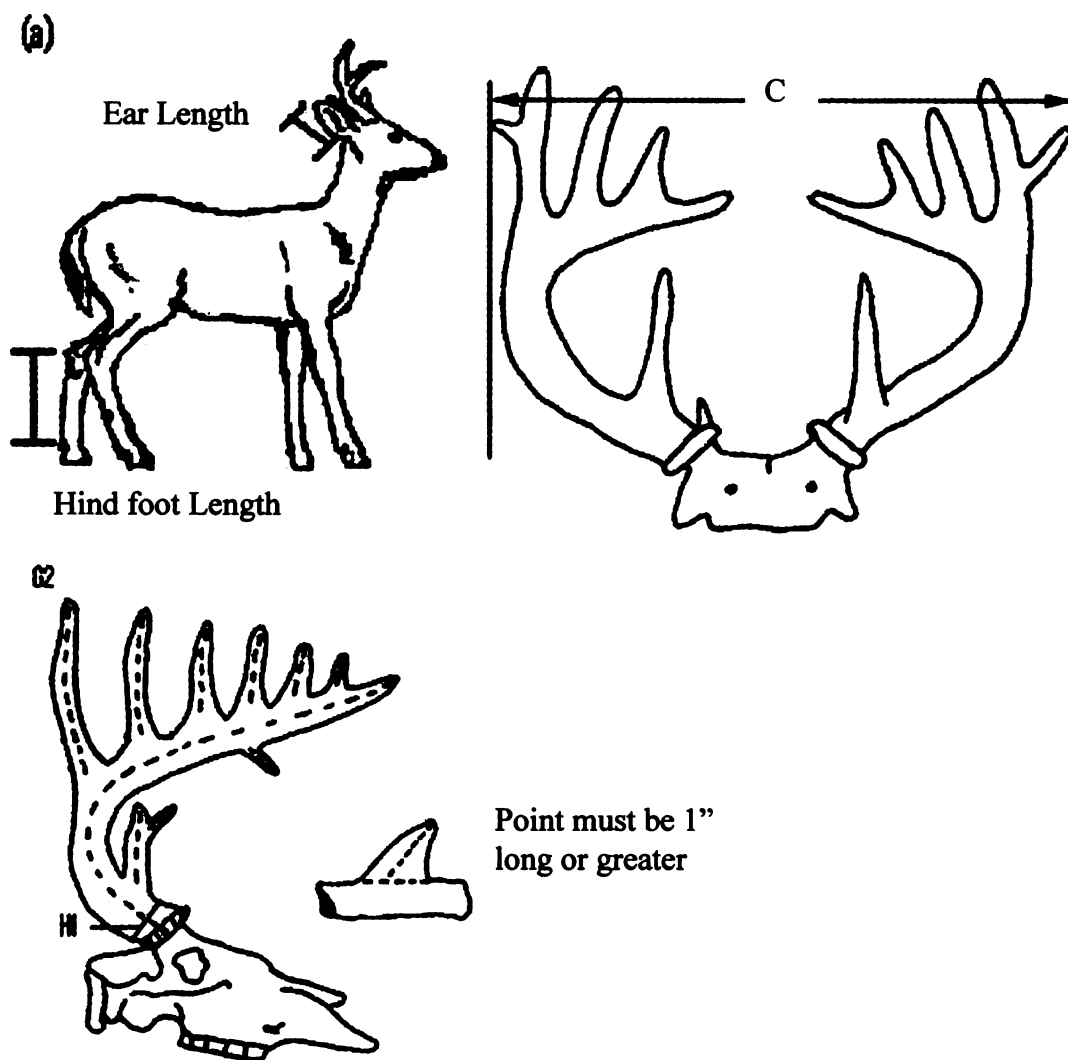


Figure 2.1. Illustration of the eight morphological measurements. (a) length of hind foot and ear (mm), G2: length of second point (mm), H1: antler beam diameter (mm), A L/R: total number antler points on left & right antler beams, C: greatest spread of antler beams (mm). Antler illustrations are adapted from the Boone and Crockett Club ®.

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CHAPTER 3

Hunter preferences for antlered white-tailed deer attributes and their harvest intentions

INTRODUCTION

3.1. Introduction

Heavy harvest pressure on white-tailed deer (Gladfelter, 1984) over the past few decades has made white-tailed deer management a prominent focus of many state wildlife agencies (Brown et al., 2000). It is now widely recognized that successful management of white-tailed deer depends on a simultaneous understanding of their biology and the preferences of those who hunt them (Bath et al., 2001). White-tailed deer hunting constituents have attitudes, values, and behaviors that are important to harvest outcomes because of the influence they have on the decision-making process. Harvest decisions have direct implications for management purposes because of the hunters' potential to harvest selectively. Trait preferences and selective harvest intentions therefore, are thought to be two important factors influencing the outcome of a deer harvest and its impact on wild deer populations.

3.1.1. Preferences

Preferences provide a basis for harvest decisions and are thought to reflect individually held values (Rokeach, 1973). Preferences for technique, style, harvest determination, and social settings have been related to recreational specialization in hunting and fishing, which is a measure of the intensity of involvement in a recreational activity (Kuentzel & Heberlein, 1992; Bryan, 1979). In wildlife management scenarios, only preferences for population sizes (Curtis & Lynch, 2001) and "types" of deer (antlered vs. antlerless; Bhandari et al., 2006) have been investigated. No previous research exists on preferences for specific white-tailed deer attributes as they relate to harvest outcomes. Preferences for specific deer attributes could have important

implications for selective harvesting if hunters are able to harvest what they prefer. Hunters might intend to harvest prey with non-preferred attributes because of harvest expectations and motivations (Fedler & Ditton, 1986) and commitment to the sport (Scott & Shafer, 2001). For example, a hunter might prefer many antler points but not be motivated enough to actively pursue bucks with those characteristics, and instead intend to harvest a buck with fewer points.

3.1.2 Hunter Intentions

Behavioral intentions are defined as a determination to act in a certain way and are frequently shown to be important predictors of behavior (Triandis, 1971; Wicker, 1969; Ajzen & Fishbein, 1974). The use of intentions to predict behavior has been explored in a variety of contexts including the prediction of election outcomes (Turner & Martin, 1984), wildland preservation (Vaske & Donnelly, 1998), and schooling-work behavior (Manski & Wise, 1983). These studies revealed that attitudes and normative beliefs about a specific behavior were found to influence behavioral intentions. In addition to attitudes, such behavioral influencing factors as social norms, personality characteristics, and situational variables also must be accounted for (Ehrlich, 1969; Warner & DeFleur, 1969). All of the aforementioned work investigating a variety of behaviors has appeared in the social psychology literature, however, the intentions regarding harvest outcomes for various prey of recreational hunters has not yet been quantified. Little is known about whether intentions are related to preferences or other factors that influence intentions in the context of recreational deer hunting. Whether intentions are an accurate predictor of harvest outcome or how they affect harvest

outcomes has also not been determined. Currently, the relationship between what hunters intend to harvest and the fulfillment of their intentions by a harvest outcome is unknown.

Understanding the relationships among preferences, intention, and harvest outcome of white-tailed deer hunters is important to wildlife management because of the potential for selective harvesting to affect herd demographics and composition. If hunters consistently prefer certain attributes and intend to harvest deer with those preferred attributes then these preferences could lead to selective (i.e., non-random) harvesting. The continuous selective removal of preferred attributes from the population could lead to the evolution of less desirable traits (e.g., Coltman et al. 2003). If, however, preferences are heterogeneous or if situational factors interrupt the connection between preferences and intentions then the potential for hunter-induced selection would be minimized.

3.2 Objectives

My first objective in this chapter was to quantify hunter preferences for specific attributes of antlered white-tailed deer and whether they are consistent. Three conceptualized buck categories (i.e., ideal, preferred and least preferred; see Chapter 2 for details) were used to identify preferences for buck attributes. Furthermore, several variables were used to quantify and help to explain variation in preferences for one buck attribute (e.g., total number of antler points). A second objective of this chapter was to understand how selective hunters intend to be and report the similarities and differences among hunters with different selectivity intentions. The intentions to be selective of Michigan firearm deer hunters were determined by asking hunters what category of buck (i.e., ideal, preferred or least preferred) they intended to harvest for their first harvested

buck during the 2006 November firearm deer season. Findings related to these objectives will be useful for managers to better understand their deer hunting constituents and the influence that characteristics of these individuals have on hunter-induced selection.

MATERIALS & METHODS

3.3 Self-administered survey

Hunter preferences for buck traits and intentions to be selective were measured using a self-administered mail questionnaire (N =3,954) with repeat mailings following Dillman (2000). Data were collected from individuals that were 1) Michigan residents, 2) 18 years of age or older as of January 1, 2006, 3) and who had purchased a license in 2006 to hunt white-tailed deer, and 4) completed and returned a Michigan Department of Natural Resources harvest questionnaire stating they had harvested a white-tailed deer (antlered or antlerless during the 2003, 2004 or 2005 season) from within the study area (see Chapter 2 for study area description). It was assumed that this was a representative sample of individuals that have hunted the Michigan study area over the past three years. All survey methodologies were approved by the University Committee Involving Research on Human Subjects and the Institutional Review Board (IRB #05-1028; Appendix J).

The mail questionnaire was designed to measure each hunter's preferences for antlered deer attributes (i.e., number of antler points, antler spread, G2 tine length & age), their attitude towards the importance of harvest selectivity, and the importance of hunter constructs (i.e., intention to be persistent, intention to be selective, expected opportunity for harvesting bucks) and hunter attributes (i.e., age, centrality to lifestyle) to their selectivity intentions. The importance of selectivity to a hunter was determined by the

importance a hunter placed on specific attributes of an antlered deer that might influence harvest outcomes. Among hunter constructs and hunter attributes, context variables (i.e., hunting pressure, land-type hunted and day of season started hunting) were also investigated for their relationship to hunters' intentions to be selective.

Descriptive categories of bucks were developed to reduce subjectivity and ambiguity among responses. Ideal, preferred and least preferred bucks were categorized for the respondents (see Chapter 2 for details) and responses pertaining to only a hunters' first harvested buck during the firearm deer season were considered. In addition, several other factors including years of hunting experience, land-type hunted and centrality of hunting to one's lifestyle were measured (see Chapter 2 for details). Preferences for total number of antler points were described for each buck category (i.e. ideal, preferred and least preferred categories). It was assumed that total number of points would provide the greatest distinction among categories of bucks because questions about preferences for the total number of antler points had the fewest non-responses. Therefore, total number of antler points for each category was used as a response variable in modeling preferences.

3.3.1 Data Analysis

Hunter survey responses were summarized and models were developed to determine the preferred total number of antler points. Relationships were also examined between preferences and aspects of firearm deer hunting including land-type hunted, hunt start date, and number of years of deer hunting experience that might help to explain variation in hunter preferences for total number of antler points. Hunter intentions to be selective were quantified by the descriptive category of buck that he or she intended to

harvest. Hunter preferences for attributes of antlered deer, the age of the respondent, the number of years of firearm deer hunting experience, importance of selectivity, expected harvest opportunity, the intention to be persistent, centrality of deer hunting to one's lifestyle, and land-type hunted were also used to develop the model exploring hunters intention to be selective (see General Methods section for detailed descriptions of each variable).

Chi-square tests were used to determine if the preferred total number of antler points differed among the three descriptive categories of buck (i.e., ideal, preferred and least preferred). All respondents providing data on buck category preference were used for chi-square analyses. Comparisons among buck categories were made using median descriptions of each buck attribute.

A series of general linear models (GLM) were assessed to investigate the relative roles of several variables hypothesized to influence hunter preferences for total number of antler points. An exploratory modeling approach was used to determine a minimal adequate model to predict variation in the total number of antler points describing a hunter's ideal, preferred and least preferred bucks. A second model was generated for each of the three buck categories with a response variable of preferred total number of antler points. The response variable was originally categorized in the questionnaire but was later converted to a continuous variable by replacing categorical values with the mean value of each respective response category (e.g., responses from category "3 to 6 points" were replaced with a value of 4.5). Preference for total number of antler points for a buck of each category were predicted using the expected opportunity to harvest an ideal, preferred, or least preferred buck, the intention to be persistent, the respondents'

age, land-type hunted, the number of years of hunting experience, and the centrality of hunting to one's lifestyle.

Observations with missing data were deleted in statistical analyses. Eigenvalues were calculated from a correlation matrix of the predictor variables to check for evidence of multicollinearity among the predictor variables. The severity of the collinearity was evaluated by calculating the condition index number of the correlation matrix and found to be satisfactory.

The nature of the data set (i.e., amount and distribution of missing data) prohibited the use of Akaike's Information Criterion (AIC) for model comparisons. Therefore, an improvised stepwise modeling approach was employed where models were sequentially evaluated based on the overall model p-values, significance of parameters in the model, residual sum of squares (RSS) and adjusted R-squared values. Numerous models were fitted and non-significant parameters were removed (i.e., insignificant p-values from ANOVA). For the reduced final fitted model, residual plots, Cook's distance plots and Q-Q plots were examined for heteroscedasticity, outliers, high leverage points and influential points. Diagnostic plots of the minimal adequate models indicated that residuals for total number of antler points were approximately normally distributed, and there were no signs of heteroscedasticity or observations with undue influence on the relationship. Variance inflation factors were also calculated for the final models and found to be satisfactory (values < 10) for all main effects. All values for the general linear models are presented as means $\pm$ SE. All analyses were performed using R (R Development Core Team, 2006).

RESULTS

Overall, a response rate of 66.5% for the mail questionnaire was achieved by using a primary mailing and two follow-up reminder mailings. Nearly all (94 %) of the 2,628 respondents were male (Table 3.1). Respondents ranged in age from 18 to 90 years old and the mean respondent age was 50 years old (SD = 14.3; Table 3.1). The majority (90 %) of the respondents indicated that they had hunted the past three years (Table 3.1) and that the most common license type that was purchased among respondents was the combination license (63%; Table 3.1). Thirty-two percent of respondents indicated that deer hunting was their most important recreational activity. A complete summary of responses from the mail questionnaire are presented in Appendix E.

Hunters had clear preferences for antlered deer. Among the three buck categories, there were significant differences in all of the attributes (number of antler points $\chi^2 = 2932.4$, df = 8, $p < 0.001$; spread $\chi^2 = 2486.5$, df = 8, $p < 0.001$; age $\chi^2 = 3204.4$, df = 8, $p < 0.001$; tine length $\chi^2 = 2560.9$, df = 8, $p < 0.001$) described by hunters. Median preferences for an ideal buck were 7 to 10 antler points, antler tine length greater than 10 inches, greater than a 21" antler spread, and 3.5 years of age or older (Table 3.2). These descriptions of an ideal deer were very similar to the descriptions of a preferred buck, but were very different from how hunters described their least preferred buck. Median preferences for a least preferred buck were 3" spike antlers with an antler spread of less than 16 inches and only 1.5 years old (Table 3.2). These clear differences between an ideal and least preferred buck indicate that hunters had clear preferences for several attributes of bucks.

For all hunters that indicated the total number of antler points was important to them (81.2% of total), a minimal model was developed to explain variation in preferences for total number of antler points of an ideal buck ($R^2 = 0.25$, $F_{14,1968} = 46.18$, $P < 0.001$; Table 3.3). Hunters who felt that their hunting experience would result in an extremely likely opportunity to harvest a least preferred buck preferred, on average, one more antler point than hunters that felt they weren't at all likely to harvest a least preferred buck (1.18 ± 0.37 , $t = 3.18$, $df = 1968$, $P < 0.01$). A similar trend was observed for hunters that felt their hunting experience would result in an opportunity to harvest an ideal buck ($F_{3,1968} = 9.88$, $P < 0.01$). Hunters that felt their hunting would result in an extremely likely opportunity to harvest an ideal buck reported that their ideal buck had on, average, 2.5 fewer antler points than hunters who reported that their hunting experience would result in only a somewhat likely opportunity to harvest an ideal buck (see Table 3.3 for statistics for each factor level). The age of the hunter negatively influenced his or her preferences for the total number of antler points of an ideal buck such that older hunters defined their ideal buck as having fewer total antler points than younger hunters (-0.03 ± 0.01 , $t = -4.61$, $df = 1968$, $P < 0.01$). If a hunter's harvest intentions for 2007 were to harvest any legal buck, they reported preferences for significantly fewer antler points than hunters who intended to be selective for a specific buck category (-3.46 ± 0.18 , $t = -19.22$, $df = 2$, $P < 0.01$). The importance of deer hunting in relation to other recreational activities also significantly ($F_{3,1968} = 9.88$, $P < 0.001$; see Table 3.3) influenced hunter preferences for total number of antler points. Compared to hunters who indicated that deer hunting was their most important recreational activity, hunters who did not consider deer hunting to be

an important activity preferred significantly (-1.36 ± 0.28 , $t = -4.89$, $df = 1968$, $P < 0.01$; see Table 3.3) fewer antler points on their ideal bucks.

Forty-one percent of hunters indicated that they intended to harvest any legal buck whereas only 9 % indicated that they intended to wait and attempt to harvest only their ideal buck (Figure 3.1). Twenty percent of respondents initially intended to harvest an ideal buck but were willing to harvest a preferred buck. Thirty percent of hunters who intended to wait to harvest either an ideal or preferred buck but were willing to harvest a least preferred buck in order to avoid going home empty handed (Figure 3.1).

Differences among hunters based on their responses to how selective they intended to be during the 2007 firearm deer hunting season were explored (Table 3.4). Hunters with different selectivity intentions differed in age ($F = 16.35$, $df = 3$, $P < 0.001$). Hunters intending to harvest only their ideal buck were significantly younger than those hunters who intended to harvest any legal buck (-4.54 ± 0.79 , $t = -5.75$, $df = 3$, $P < 0.001$), but hunters who intended to harvest only their ideal buck did not differ in age from those who indicated that they would harvest any legal buck (-1.34 ± 1.06 , $t = -1.27$, $df = 3$, $P = 0.204$). The proportion of hunters who hunted private land also differed among these selectivity groups ($\chi^2 = 32.17$, $df = 3$, $P < 0.001$). Hunters intending to harvest their preferred buck had the highest proportion hunting on private land (82.6%), followed by those who intended to only harvest their ideal (80.4%), least preferred (79.8%), and any legal buck (74.3%). Years of hunting experience (i.e., less than 3 years or greater than 3 years) did not vary ($\chi^2 = 1.61$, $df = 3$, $P = 0.65$) among the selectivity groups.

Preferences for the most extreme attributes of an ideal buck (i.e., > 11 points) were also reported for each selectivity group (Table 3.5). Preferences among all the most preferred ideal buck attributes were found to significantly differ among the selectivity groups (e.g., ideal buck number of antler points: $\chi^2 = 1426.03$, $df = 12$, $P < 0.001$; age: $\chi^2 = 1737.06$, $df = 12$, $P < 0.001$; spread: $\chi^2 = 1171.59$, $df = 12$, $P < 0.001$; tine length $\chi^2 = 1235.55$, $df = 12$, $P < 0.001$; see Table 3.5).

DISCUSSION

Harvesting represents the primary source of mortality for white-tailed deer populations in Michigan (Clute, 2006) so it is important to understand the preferences and selectivity intentions of hunters because of their potential to influence harvest outcomes.

Preferences for specific attributes of white-tailed deer and their relationship to harvest outcome have not previously been explored. In this study, hunters were found to clearly differentiate between what they considered to be their ideal versus least preferred bucks. Older hunters preferred fewer antler points in comparison to their younger counterparts. This relationship could be explained by a more recent popularization of deer hunting as the pursuit of 'trophies' instead of a means for enjoyment and recreation. Alternatively, preferences for buck attributes might change with age in much the same way that hunters' reasons for hunting change (Jackson, 1980). Of all hunters indicating predetermined intentions for the 2007 season, those intending to harvest any legal buck preferred fewer antler points than those hunters who intended to be selective. This suggests that number of antler points is a less important attribute for a hunter who intends to harvest any legal buck. This result has important implications because as the number

of individuals that prefer a greater number of antler points increases, the selective pressure experienced by deer with the preferred antler point attributes increases. For example, the preferences of a hunter who will only harvest their ideal buck matter for natural selection as those hunters focus on specific attributes for harvest; whereas, the preferences of a hunter who will harvest any legal buck is not as important as they are not particular to any specific attribute.

Few Michigan firearm deer hunters have selectivity intentions that are strong enough to limit their harvest to a specific buck category; many hunters (41%) intend to harvest any legal buck. One explanation for why a hunter would not intend to be more selective could be because of the challenges (e.g., hunting pressure) associated with being more selective. Hunters might also learn from their prior hunting experiences and modify their intentions appropriately. In a study of Colorado hunters, past experience significantly predicted future participation intentions (Barro & Manfredo, 1986). Litvaitis and Kane (1994) showed that hunter selectivity changed based on bear abundance whereas Taber and Dasmann (1954) found that harvest intentions changed as the perceived opportunity for harvesting larger deer diminished. The perceived opportunity to successfully harvest a buck would play a significant role in influencing antler point preferences. Hunters who reported a likely chance of harvesting either an ideal or what they considered to be a least preferred buck, had preferences for more antler points, suggesting that perceived abundance can directly influence hunter preferences. No comparable studies have investigated the effects of perceived abundance on preferences for attributes of white-tailed deer.

Different groups of hunters with different selectivity intentions were found. The group with the most hunters were found to be in the harvest any legal buck group (N = 956; 40.7%). A difference in the number of years of hunting experience did not influence how selective a hunter would be. As table 3.4 shows, the years of hunting experience among selectivity intention groups was similar. Over 90% of hunters who would only harvest their ideal buck had 3.5 or more years of hunting experience. Although hunting experience levels were similar between all four selectivity groups, one group (any legal buck) may be less persistent or less willing to hold out for an opportunity to be more selective. The centrality of hunting to ones' lifestyle, furthermore, was also found to increase the selectivity of a hunter. As predicted from the point preference model for ideal bucks, hunters who considered hunting to be their most important recreational activity preferred more points. But, as reported in Table 3.4, of all hunters willing to harvest their ideal bucks, only 13.6% considered deer hunting to be their most important recreational activity. However, 68.5% of hunters intending to harvest their least preferred buck, considered deer hunting to be their most important recreational activity. Hunters intending to harvest any legal buck that hunt private land (74.3 %) were thought to have increased chances for success in comparison to those hunters who intended to harvest an ideal buck only and hunt private land (80.4 %). However, regardless of land-type hunted, the possible opportunity to harvest an ideal buck could be low and limit one's chances for success, therefore, encouraging hunters' to be more lenient in their harvest intentions and ultimately less selective.

Managing an exploited white-tailed deer population for an abundance of a few specific, but desirable attributes for hunters' with varied preferences is difficult.

Characteristics of hunters cannot be managed for, but management regulations can be responsive to an ever-changing hunting population. Regulations focused on increasing a specific attribute (i.e., number of antler points) could be implemented; however, based on the results of this study, many hunters would not be satisfied with such regulations as many hunters are satisfied with being able to harvest any legal buck.

Due to the heterogeneity of hunter preferences between ideal and least preferred buck attributes and hunter differences among selectivity intention groups, it will remain difficult to distinctly identify attributes receiving the greatest harvest pressure. Intensity and timing of harvest, furthermore, should also be considered to avoid biased population demographics and depleted gene pools (Coltman, 2008); however, when nearly half (41 %) of all hunters intend to harvest any legal buck, the intensity of selection for specific attributes is hard to quantify because there are numerous different attributes that ‘any legal buck’ could have (i.e., individuals with highly desirable vs. sub-optimal attributes). To mitigate the adverse effects (e.g., altered demographic characteristics) of hunting, a decreased emphasis on trophy scores and particular attributes of game animals should be replaced by a greater emphasis on the enjoyment of hunting (Festa-Bianchet, 2003). Particularly for hunters in the SBWMU, many just want to harvest a buck, and therefore, a greater focus on the harvest of an antlerless deer should replace the desire to harvest a buck.

Tables & Figures

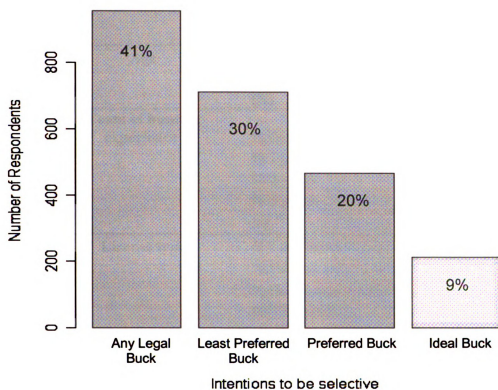


Figure 3.1. The percentages of Michigan white-tailed deer hunters out of a total of 2,425 respondents who indicated that they had specific intentions to be selective. Intentions to be selective categories (i.e., harvest any legal buck, least preferred buck, preferred buck or ideal buck) are shown on the x-axis whereas number of respondents is shown on the y-axis. Hunter selectivity increases from left to right along the x-axis.

Summary of Demographic Questions from the Survey

Variable	Statistic	Total
Sex	% Male	94
	% Female	6
	(N)	(2628)
Age	Mean	50
	Range	18-90
	(N)	(2628)
Years of hunting experience*	% 0 years	2
	% 1 year	2
	% 2 years	6
	% 3 years	90
	(N)**	(2483)
License type	% Combination license	63
	% Firearm only license	32
	% Both archery only & firearm only licenses	5
	(N)***	(2546)

*Years of hunting experience during the past three years

**This total excludes 145 observations due to missingness.

***This total excludes 87 observations due to missingness, non-sensical responses or the no license purchase.

Table 3.1. Responses to demographic questions asked of Michigan resident firearm deer hunters (n = 2,628) on the mail questionnaire conducted in 2007. Respondents were asked to record the number of years they hunted as of the last three years, and the license type they purchased.

Median trait preferences for antlered deer characteristics by buck category

	Points	G2 tine length	Spread	Age
Ideal	7 to 10	7 to 9"	16 to 20"	2.5
Preferred	7 to 10	7 to 9"	16 to 20"	2.5
Least Preferred	Legal 3" Spike	3 to 6"	< 16"	1.5

Table 3.2. A summary of the median preferred attributes for each category of buck. Note: sample sizes differ among buck category preferences due to missing data. Percentages for G2 tine lengths are reported as the mean between the left and right G2 tine length values calculated independent.

Point Preference Model for Ideal Bucks

Estimates	B	SE	t	P
Intercept	9.88	0.48	20.54	< 0.01
Age of the respondent	-0.03	0.01	-4.61	< 0.01
Odds of harvesting an ideal buck				
<i>Somewhat likely</i>	-0.80	0.19	-4.13	< 0.01
<i>Highly likely</i>	-1.37	0.43	-3.20	< 0.01
<i>Extremely likely</i>	-2.57	0.61	-4.20	< 0.01
Odds of harvesting a preferred buck				
<i>Somewhat likely</i>	0.61	0.24	2.51	0.01
<i>Highly likely</i>	0.79	0.35	2.27	0.02
<i>Extremely likely</i>	0.66	0.59	1.10	0.30
Odds of harvesting a least preferred buck				
<i>Somewhat likely</i>	0.71	0.36	1.98	0.05
<i>Highly likely</i>	1.09	0.38	2.89	< 0.01
<i>Extremely likely</i>	1.18	0.37	3.18	< 0.01
Centrality of hunting to one's lifestyle				
<i>More important recreational activity</i>	0.07	0.17	0.38	0.70
<i>No more important than other recreational activities</i>	-1.36	0.28	-4.89	< 0.01
Harvest intentions for 2007				
<i>Harvest any legal buck</i>	-3.46	0.18	-19.22	< 0.01
<i>Intentions are unknown for 2007</i>	-1.37	0.28	-4.97	< 0.01

Table 3.3. A model explaining the variation in preferences for an ideal bucks' total number of antler points. The odds of harvesting a buck of a certain category are represented by the expected opportunity of being able to harvest a buck. The level for the odds of harvesting a category of buck represented by the intercept is "Not at all likely". The centrality to one's lifestyle in the intercept is "Not at all important" and harvest intentions are to harvest a specific buck category.

<i>Selectivity Intention</i>	<i>Number of respondents</i>	<i>Mean respondent age</i>	<i>% male</i>	<i>3^{1/2}+ Years of Experience</i>	<i>% who hunt private land</i>	<i>Most important recreational activity</i>
Harvest any legal buck	956 (40.7%)	51.9 ± 14.1	92.8	861 (90.1%)	710 (74.3%)	231 (24.2%)
Harvest least preferred buck	712 (30.3%)	48.0 ± 13.6	95.5	654 (92.0%)	568 (79.8%)	488 (68.5%)
Harvest preferred buck	466 (19.8%)	47.5 ± 14.0	96.4	424 (91.0%)	385 (82.6%)	104 (22.3%)
Harvest only ideal buck	214 (9.1%)	50.7 ± 14.4	95.8	195 (91.1%)	172 (80.4%)	29 (13.6%)

Table 3.4. Descriptions of hunter groups as identified by their intentions to be selective. Number of respondents for each selectivity group is reported, followed by the percentages in each group.

Summary of Selectivity Intention Group Preferences

<i>Selectivity Intention</i>	<i>Number of respondents</i>	Preferences for Ideal Buck Attributes			
		<i>> 11 antler points</i>	<i>3.5+ years old</i>	<i>> 10 inch G2 antler tine</i>	<i>> 20 inch antler spread</i>
Harvest any legal buck	956 (40.7%)	16.9%	0.8%	24.5%	13.4%
Harvest least preferred buck	712 (30.3%)	10.7%	14.7%	37.6%	4.7%
Harvest preferred buck	466 (19.8%)	58.2%	36.9%	27.9%	72.1%
Harvest only ideal buck	214 (9.1%)	14.2%	47.6%	9.9%	9.8%

Table 3.5. Preference descriptions of hunter groups as identified by their intentions to be selective. Hunter preferences for each ideal buck attribute are reported as the percentage of hunters within each selectivity intention group.

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CHAPTER 4

Predicting the harvest success of Michigan firearm deer hunters and the attributes of their harvested deer

Introduction

4.1 Selective Harvesting

With the decline of natural predators, humans often become the primary source of mortality for many game species (Van Deelen et al., 1997). This mortality not only affects population numbers, but also has the potential to affect herd composition (e.g., age structure, sex ratio or average body size) if selective harvesting occurs (Harris et al., 2002). Historically, hunting served as the means for acquiring meat for survival. Animals with the highest yield of protein per unit effort were harvested (Gross, 1975), providing early evidence of selective harvesting (Redford & Robinson, 1987). The shift from subsistence hunting to recreational hunting (Bath et al., 2001) coincides with a change in the focus of harvest outcomes from the greatest protein yield to the most impressive secondary sexual characteristics (e.g., horns and antlers). These sex- and size-selective harvesting practices originate from the value placed on products (i.e., skins and leathers) of harvested species, hunter bias resulting from consumer preferences (Swain et al., 2007) and hunter preferences for impressive secondary sexual traits (Tenhumberg et al., 2004). Legal restrictions based on the secondary sexual characteristics of males mean that harvests are also often restricted to males that have attained a certain status (Martinez et al., 2005; Mysterud et al., 2006). As a result, selective harvesting has been associated with disrupted mate choice processes (Loehr et al., 2006; Singer & Zeigenfuss, 2002), localized genetic differentiation (Frait et al., 1998; Lee et al., 1989; Strandgaard & Simonsen, 1993), altered ecology (Loehr et al., 2006; Singer & Zeigenfuss, 2002), and population size fluctuations (Milner et al., 2006), but can also have important and adverse evolutionary consequences (Coltman, 2008).

Evolutionary responses to natural selection were previously thought to occur over long time scales, beyond the scope of wildlife conservation or management (Stockwell, Hendry, & Kinnison, 2003), but recent documentation of rapid evolutionary changes in unmanaged species (Kinnison & Hendry, 2001; Palumbi, 2001; Reznick & Ghalambor, 2001) indicate that observable evolutionary changes can occur over time scales relevant to managers. Evolutionary changes resulting from selective harvesting were first noted in commercial marine fishery populations (Browman, 2000; Conover & Munch, 2002; Reznick & Ghalambor, 2001). In hunted populations, it was predicted that an emphasis on male secondary sexual traits for harvest purposes could have similar important evolutionary consequences (Milner, Nilsen, & Andreassen, 2006; Ratner & Lande, 2001) but there have been few empirical tests of these predictions.

One important exception is the study by Coltman et al. (2003), that provided empirical evidence for an evolutionary decline in the number of 'trophy' bighorn sheep rams (*Ovis canadensis*) as a result of harvest outcomes mandated by minimum horn size regulations. Hunters were selectively harvesting males with larger body weight and horn size. Selective removal of fifty-seven large rams between 1975 and 2002 caused the populations' mean horn length and body weight to decline by 0.023 and 0.026 standard deviations per year, respectively. The resulting decline in body weight and horn length led to reduced reproductive potential of rams. The selective harvesting of large rams also led to an evolutionary change in the population, resulting in an increased frequency of less desirable 'non-trophy' (i.e., lighter weight, smaller-horned) rams.

4.2 Social sciences

4.2.1 Intention-behavior relationship theories

To quantify the degree of selectivity in hunter behavior it is necessary to understand how harvest decisions are made. The Theory of Planned Behavior suggests that intentions are an immediate determinant of variable but explicit behavior (Ajzen & Fishbein, 1991), and that they serve as a strong predictor of certain explicit behavioral outcomes (Ajzen & Fishbein, 1974; Manski, 1990), such as harvest outcome. Harvest decisions, therefore, may depend on many factors that ultimately influence the attributes of a harvested buck.

Harvest decisions are likely influenced by both context-dependent and context-independent factors (Ajzen & Fishbein, 1980; Miller & Vaske, 2003). Context-dependent factors that could influence harvest success include the species hunted, availability of game to harvest, location hunted and hunting pressure. Context-independent factors describe attributes of the hunter and tend not to vary across hunting contexts (Miller & Vaske, 2003). These could include a hunter's degree of specialization, persistence, and centrality of hunting to their lifestyle. Centrality to lifestyle is described by Kim, Scott and Compton (1997) as the degree to which one's lifestyle and social networks are combined in the pursuit of the desired leisure activity. The increased centrality of firearm deer hunting to one's lifestyle is hypothesized to increase the awareness a hunter has of the resource and the impacts he or she imposes on it through harvesting (Sutton, 2003). Buchanan (1985) noted similar trends with respect to fishing, with high levels of experience and centrality to lifestyle affecting anglers' frequency of engagement in fishing, and intensity of participation.

Empirical studies of the relationship between stated intentions, other behavior-modifying factors, and harvest outcomes are generally lacking. One such investigation of harvest decisions by bluefin tuna (*Thunnus thynnus*) anglers found that factors such as the level of previous experience and centrality of fishing to an angler's lifestyle influenced whether an angler practiced catch-and-release fishing (Sutton, 2001; Sutton & Ditton, 2001). Past social science research in wildlife management has primarily focused on predicting harvest outcomes as influenced by beliefs and attitudes (Hrubes, Ajzen, & Daigle, 2001), hunter effort (e.g., number of days in the field; Miller & Vaske, 2003; Van Deelen & Etter, 2003), or motivation (Bhandari, Stedman, Luloff, Finley, & Diefenbach, 2006; Hunt et al., 2002). Past investigations of white-tailed deer hunting has looked at the effects of beliefs, attitudes, effort and motivations on harvest success (Kennedy, 1974; Miller & Graefe, 2001; Heberlein & Kuentzel, 2002) but failed to investigate how these context-dependent and independent factors relate to harvest outcomes in terms of the attributes of the harvested animal.

In many places, white-tailed deer (*Odocoileus virginianus*) experience intensive harvesting pressure (Waller & Alverson, 1997). This intensive harvesting could potentially result in strong selection pressures for individuals with certain attributes. In 2006, the annual harvest of white-tailed deer in the southern lower peninsula of Michigan exceeded 450,000 (Clute, 2006), representing roughly 53% of the estimated population size for that area. Due to their abundant populations and their popularity as a big game species, white-tailed deer serve as an excellent model organism to use in the investigation of hunters' selective harvest intentions and final harvest outcomes.

This study, investigated the effect of context-dependent (e.g., game availability, area hunted, and hunting pressure) and context-independent (e.g., specialization, persistence, centrality of hunting to lifestyle) factors on the successful harvest of antlered deer in one wildlife management unit in southern Michigan. I linked hunter responses on their mail questionnaire with the attributes of their respective harvested bucks to test predictions about factors influencing harvest outcomes. If hunters are harvesting selectively, one would expect that intentions to be selective would be associated with harvested deer possessing specific attributes. For example, if a hunter intends to be selective for only their ideal buck, I would expect them to harvest a buck with attributes associates with an ideal buck. Other factors, however, might mitigate these intentions and their relationship with harvest outcome. One such factor might be hunters' level of previous experience, which affects the amount, type, and diversity of information available to an individual when making harvest decisions (Schreyer, Lime, & Williams, 1984). Hunters with more years of hunting experience are hypothesized to be more knowledgeable about their hunting situation and specific method of harvesting (i.e., specialization; see Chapter 3). I would, therefore, predict that hunters with greater hunting experience would be less influenced by factors other than their intention to be selective. I also hypothesized that context-independent factors (i.e., days available to hunt and the day a hunter started hunting), self-reported persistence and degree of specialization (i.e., centrality of hunting to one's lifestyle) were important for determining harvest outcome. By examining relationships between context-dependent and independent factors associated with hunters and the attributes of their harvested deer, I hoped to gain a more comprehensive understanding of what influences whether hunters

successfully harvest an antlered deer and the likelihood that harvest pressures could result in undesirable attribute changes of antlered white-tailed deer.

MATERIALS & METHODS

4.3 Survey methods

4.3.1 Sampling criteria & sampling frame generation

Hunters' attitudes toward white-tailed deer harvests were assessed using a mail questionnaire. Data were collected from a sample of hunters based on the following criteria: 1) Michigan residents, 2) 18 years of age or older as of January 1, 2006, 3) had purchased a license in 2006 to hunt white-tailed deer, and 4) had completed and returned a 2003, 2004 or 2005 Michigan Department of Natural Resources (MDNR) harvest questionnaire stating they had harvested a white-tailed deer (antlered or antlerless) from within the research study area (see Chapter 2 for study area descriptions). The hunter sample for the survey ($n = 3,954$) was derived from a portion of the total number of firearm deer hunters who have previously hunted or hunt within the Saginaw Bay Wildlife Management Unit (SBWMU) in Michigan. It was assumed that the sample represented a cross section of individuals who have hunted the SBWMU in the past three years.

4.3.2 Mail questionnaire

The self-administered mail questionnaire with repeat mailings was conducted following Dillman (2000) beginning in January 2007. The mail questionnaire was designed to assess the relative roles of context-dependent and independent factors related to hunting (e.g., hunter persistence, landownership) in determining their relevance for predicting harvest outcomes. Several context-independent factors that could potentially

affect harvest outcome were measured including selective harvest intentions, self-reported persistence, experience (i.e., hunter age, number of years hunting) and centrality of hunting to one's lifestyle. Context-dependent factors were measured including hunting pressure, number of days hunted, the day hunting began, land-type hunted (public, private) and harvest date (see Chapter 2 for detailed descriptions of variables). Survey participants were also asked to report their harvest success from the 2006 November firearm deer season. To reduce the variability of factors contributing to harvest outcomes, this survey focused specifically on firearm white-tailed deer hunting in the SBWMU. Respondents were reminded to only provide information pertinent to firearm deer hunting within the study area during the 2006 firearm deer-hunting season. All survey methodologies were approved by the University Committee Involving Research on Human Subjects and the Institutional Review Board (IRB #05-1028; see Appendix J).

Responses to the mail questionnaire are reported in Appendix E. Throughout the results, percentages may not always add to 100 due to rounding. In reporting percentages, "< 1%" indicates that at least one respondent was included in a category and "0%" means that no one was included in a category.

4.4 Field methods

4.4.1 Check stations

In order to quantify the harvest outcome for individual hunters, data were collected on harvested deer at MDNR deer check stations. Attributes from a total of 751 antlered deer were measured at ten deer check stations during the 2006 November firearm deer season (see Chapter 2). Morphometric data collection consisted of the measurements of six traits including ear length, hindfoot length, G2 tine length (left and

right), spread, total number of antler points and antler beam diameter (left and right; see Chapter 2). These traits were identified through focus group discussions with firearm deer hunters as being important to harvest outcomes (see Chapter 2).

4.5 Data analysis

A generalized linear model (GLiM) with a logit link function was used to determine the significance of factors hypothesized to influence the probability of a hunter successfully harvesting an antlered deer. The binary response variable was whether a hunter harvested (1) or did not harvest a buck (0). Chi-square tests were used to determine if the number of respondents differed significantly among the factor levels of centrality to lifestyle, intention to be selective, land-type hunted and the day that a hunter started hunting. Interpretation of the model was based on odds ratios. The odds ratio is the odds of a hunter being successful at one level of an independent variable divided by the odds of a hunter being successful at another (lower) level of the same independent variable while all other independent variables are held constant. An odds ratio greater than 1.0 indicates a positive function of the independent variable whereas an odds ratio less than 1.0 indicates a negative function of the independent variable. It was assumed that the independent variables were linear combinations of each other and that observations were independent. All assumptions were adequately met. The dispersion parameter (1.004) of the harvest success model (i.e., binary response) was assessed using the family quasibinomial and found to be satisfactory. Variance inflation factors were also calculated for the final model and found to be satisfactory (i.e., values < 10).

Principal component analysis (PCA) was conducted on the correlation matrix of the eight morphometric variables of harvested deer. The total number of antler points

was log transformed prior to the PCA to achieve normality. The first and second principal components from this analysis were used as dependent variables in general linear modeling procedures to assess relationships between hypothesized hunter variables and the attributes of harvested deer. Attribute measurements of antlered white-tailed deer harvested and checked from within the SBWMU are reported as means $\pm$ SE unless otherwise stated.

Appropriateness of predictor variables for each model was determined based on an exploratory modeling approach. Included in these models were variables hypothesized to be important predictors of harvest outcome including the hunter's intention to be selective, preferences for trait attributes and context-independent factors including previous hunting experience, self-reported persistence, and centrality of hunting to the hunter's lifestyle. The amount and distribution of missing data in the survey responses prevented the use of likelihood based information theoretic approaches (e.g., Akaike's Information Criterion [AIC]) for model comparisons. As a result, an improvised stepwise modeling approach was employed where models with increasing complexity were evaluated using overall model p-values and a significance level of $\alpha = 0.05$. Non-significant variables were removed. All two and three-way interactions were also tested for significance in the model.

For the final fitted model, residual plots, Cook's distance plots and Q-Q plots were examined for heteroscedasticity, outliers, high leverage points and influential points. Diagnostic plots indicated that there were no signs of heteroscedasticity or observations with undue influence on the relationship. All values for the linear model are presented as means $\pm$ SE. Results include significant variable results (t-test of parameters

and their standard errors). All analyses were performed using R (R Development Core Team, 2006).

RESULTS

Forty-three percent of respondents harvested a buck during the 2006 November firearm deer season (1,021 of 2,358 respondents). Centrality of deer hunting to one's lifestyle ($\chi^2_{2,2012} = 14.72$, $P < 0.001$), intention to be selective ($\chi^2_{3,2009} = 21.66$, $P < 0.001$), land-type hunted ($\chi^2_{1,2008} = 32.70$, $P < 0.001$) and the day that a hunter started hunting ($\chi^2_{1,2007} = 44.67$, $P < 0.001$; Table 4.1) were significant factors when predicting harvest success. If deer hunting was not important to a hunter, the probability of successfully harvesting an antlered deer was reduced relative to hunters who deemed hunting a more important recreational activity (see Figure 4.1). Furthermore, hunters that intended to harvest an ideal or preferred buck but who were also willing to shoot a least preferred buck were close to one and a half times more likely to successfully harvest a buck compared to hunters who intended to harvest any legal buck (0.34 ± 0.11 , $z = 3.04$, $P < 0.01$; Figure 4.2). The most selective class of hunters (i.e., those that intended to harvest only their ideal buck), however, had a marginally lower predicted probability of successfully harvesting an antlered deer compared to hunters that were willing to harvest any legal buck (-0.33 ± 0.18 , $z = -1.88$, $P < 0.06$; see Figure 4.2). Hunters that hunted on public land also had lower predicted harvest success relative to those who hunted on private land (-0.71 ± 0.13 , $z = -5.29$, $P < 0.001$; see Figure 4.3). Finally, if a hunter started hunting on the first day of the season, they were three times more likely to harvest an antlered deer (1.00 ± 0.16 , $z = 6.35$, $P < 0.01$; see Figure 4.4) compared to hunters who started hunting after opening day.

Attributes of 751 harvested antlered white-tailed deer were measured at eight MDNR deer check stations representing 21% of all antlered white-tailed deer checked at these stations. Yearlings (1.5 year old bucks) were represented the most in the harvested bucks checked ($N = 310$; 41.2 %). Also, the number of deer harvested per day irrespective of age classes, decreased with time (see Table 4.2). Deer measured for this study also did not differ in age structure from all 3,659 deer checked by the MDNR in these areas ($\chi^2 = 2.7$, $df = 3$, $P = 0.43$; Table 4.3). Antlered white-tailed deer harvested and checked from within the SBWMU ($N = 751$; Table 4.4) had average beam diameters of 21.3 ± 3.3 mm (left beam) and 21.5 ± 3.4 mm (right beam). Harvested deer also had average hindfoot and ear lengths of 40.6 ± 2.1 and 16.0 ± 1.3 cm, respectively. Left and right G2 tine lengths were 9.2 ± 3.0 and 9.1 ± 3.0 cm, antler spread averaged 24.8 ± 6.7 cm and number of antler points averaged 6.0 ± 2.0 . For the first principal component all antler characteristics loaded positively so that large values indicated larger antlers overall (Table 4.5). All antler characteristics except for the left and right G2 tine lengths loaded negatively into the second principal component and both body size measurements (i.e., hindfoot length and ear length) loaded positively and were large values (Table 4.5). As a result, first principal component scores were interpreted as overall antler size and second principal component scores were interpreted as measures of body size relative to antler size, where larger values represent larger body size relative to antler size. Sixty-four percent of the variation in deer attributes was explained by the two principal component axes (Table 4.5).

A general linear model (GLM) was used to explain the effects of years of hunting experience, intention to be selective, preferences, and the interaction between the

intention to be selective and years of hunting experience on PC1. The overall model of these effects explained 6% of the variation in PC1 (i.e., antler size) of harvested white-tailed deer ($F_{11,369} = 2.29$, $P = 0.01$; Table 4.6). There was a marginally significant negative interaction ($F_{11,369} = 2.29$, -0.65 ± 0.37 , $t = -1.75$, $P = 0.080$; Figure 4.5) between the intention to be selective and three years of firearm deer hunting experience. For experienced hunters, antler size of harvested deer increased whereas with increasing selectivity there was no effect of selectivity on the antler size of deer harvested by inexperienced hunters. Furthermore, minimum and maximum (legal 3" spike or > 11 points) point preference for preferred bucks had a significantly greater negative effect on PC1 traits of a harvested buck (legal 3" spike: -1.66 ± 0.52 , $df = 4$, $t = -3.17$, $p < 0.01$; >11 points: -1.01 ± 0.49 , $df = 4$, $t = -2.06$, $p < 0.05$) as compared to point preference being not at all important. Overall, the model explained only a small (6 %) amount of the variation in the attributes of harvested bucks.

A general linear model (GLM) of PC2 explored the effects of several variables, however, the final reduced model only included the day of the season that a hunter started hunting, previous harvest experience, and preferences for the age of the least preferred category of bucks. Several variable interactions were investigated but none of these were significant and were, therefore, not included in the final model. The overall model explained 4% of the variation in PC2 (i.e., body size relative to antler size) of harvested white-tailed deer ($F_{6,362} = 2.59$, $P = 0.018$; Table 4.7). Previous successful harvest experience was negatively related ($t_{362} = -1.72 \pm 0.30$, $df = 1$, $P = 0.08$) to PC2 as compared to unsuccessful harvesting. Least preferred buck age preference of a 1.5-year-old buck was the only significant factor level to influence PC2 traits (-0.35 ± 0.13 , $df = 4$,

$t = -2.63$, $P < 0.05$) in comparison to preferences not at all being important. Furthermore, hunters that started hunting on opening day harvested deer with decreased body sizes relative to antler size compared to hunters who began hunting after opening day ($t_{362} = -2.12$, $p = 0.04$; see Figure 4.6).

DISCUSSION

Harvest-induced selection occurs only when there is consistent harvest pressure that selects for specific traits (Coltman et al., 2003). If hunters who intend to be selective in their harvest (i.e., harvest only their ideal buck or preferred buck), have homogenous preferences for specific traits (e.g., total number of antler points), and are successful in harvesting what they intend to harvest, then the preferential harvesting of bucks with 7-10 points, for example, would result in selective harvest pressures against bucks with those attributes.

Unlike the bighorn sheep hunters examined by Coltman et al. (2003), Michigan deer hunters appear to be harvesting opportunistically. The likelihood that morphological changes will occur in traits experiencing excessive harvest pressures is expected to be minimal. Preferences for attributes are not consistent, and therefore, the selective pressures against any one specific attribute are not consistent. Although hunters have reported intentions to harvest specific bucks, harvest intentions could likely be influenced by a hunters' certainty that a buck of such a category exists where they hunt. Such variability suggests that harvest opportunities and relative abundance of those bucks are likely sources of stochasticity.

When harvest decisions are made selectively, the potential exists for these actions to affect herd composition (Harris et al., 2002). Using the model predicting harvest

success, I found that the intention to be selective was a significant predictor of whether a hunter harvested a buck, such that hunters that intended to harvest any legal buck were less successful than those hunters who intended to harvest a specific buck category. This result is contrary to what would be expected because hunters who are willing to harvest any legal buck are less restrictive when harvesting specific attributes. However, hunters who intend to harvest an ideal only buck are likely hunters who invest more time in hunting, have greater motivation and commitment, and are more specialized (Kuentzel & Heberlein, 1992) thereby improving their chances of harvest success.

The successful harvest of a buck during the 2006 November firearm deer season was also predicted by how central deer hunting was to the respondent's lifestyle in comparison to other recreational activities. The positive effect of centrality of deer hunting to one's lifestyle on harvest success differs from work on anglers that suggested that lifestyle did not affect catch-and-release behavior (Sutton, 2003). This result was expected because as hunters become more involved with hunting, their specialization and motivation to participate in the activity would increase. The land-type hunted was also found to influence success such that hunters that hunted public land, had lower success. This could be the result of more hunting pressure, or low game availability encountered in public hunting areas. The day a hunter started hunting, influenced success as well. Opening day proved to be the most successful as most hunters were not willing to wait and harvest their buck and risk the chance of not being successful. Most deer were harvested on the first day of the hunting season, suggesting that hunters were not motivated enough to be selective or persistent in their intentions, to encounter opportunities to be more selective. All of these findings indicate that harvest success is

highly variable among the hunting population. One common theme among each of these findings is that motivation might be an important determinant in harvest success as well.

Research has suggested that motivations are important determinants of whether a hunter harvests an antlered versus antlerless deer (Bhandari et al., 2006), but no comparable research investigating if casual hunters have lower success rates exists. If motivations were important to harvest success rates, two opposing patterns would have emerged in my data. One would be that highly motivated hunters would be expected to have a higher success rate than compared to hunters who are not highly motivated. Secondly, hunters who are highly motivated but also highly selective could be as unsuccessful as hunters who were not highly selective or motivated.

The interaction between the intention to be selective and years of hunting experience (Figure 4.5) were investigated for their combined influence on harvest outcome. Hunters who intended to be more selective did harvest bucks with larger antlers if they were experienced hunters but not if they were inexperienced. These results would cause one to expect that more selective hunters would harvest larger bucks. According to the harvest data however, selective hunters didn't always harvest bucks with more points. This could be because of hunter motivation for pursuing bucks with specific attributes or hunter preferences for attributes. Harvest composition was comprised of yearling-aged bucks harvested on opening day. Given that most bucks are harvested the first day of the season suggests that hunters might intend to be selective but are not waiting long enough to do so; or they remain less selective and harvest the first opportunity presented to them. The two models that were developed to explain variation in attributes of harvested bucks, explained very little (PC1 model: 6%, PC2 model: 4%).

It is suggested that to more accurately predict the size of antlered deer harvested, spatio-temporal factors (e.g., geography, land-use; McCullough, 1984) in conjunction with hunter factors will need to be examined to provide a greater comprehensive assessment of their relationship to harvest outcomes.

Preferences for both the total number of antler points and the age of specific buck categories were found to influence the attributes of harvested deer. This is an important finding since the determinants of specific attributes of a harvested deer were previously only speculative (Festa-Bianchet, 2003). Now though, it seems that hunter preferences for two specific deer attributes have an important influence on the attributes of harvested bucks. If these two attributes remain the primary deciding attribute of whether to harvest a buck, management to limit the removal of bucks with these attributes from a population need to be developed.

Tables & Figures

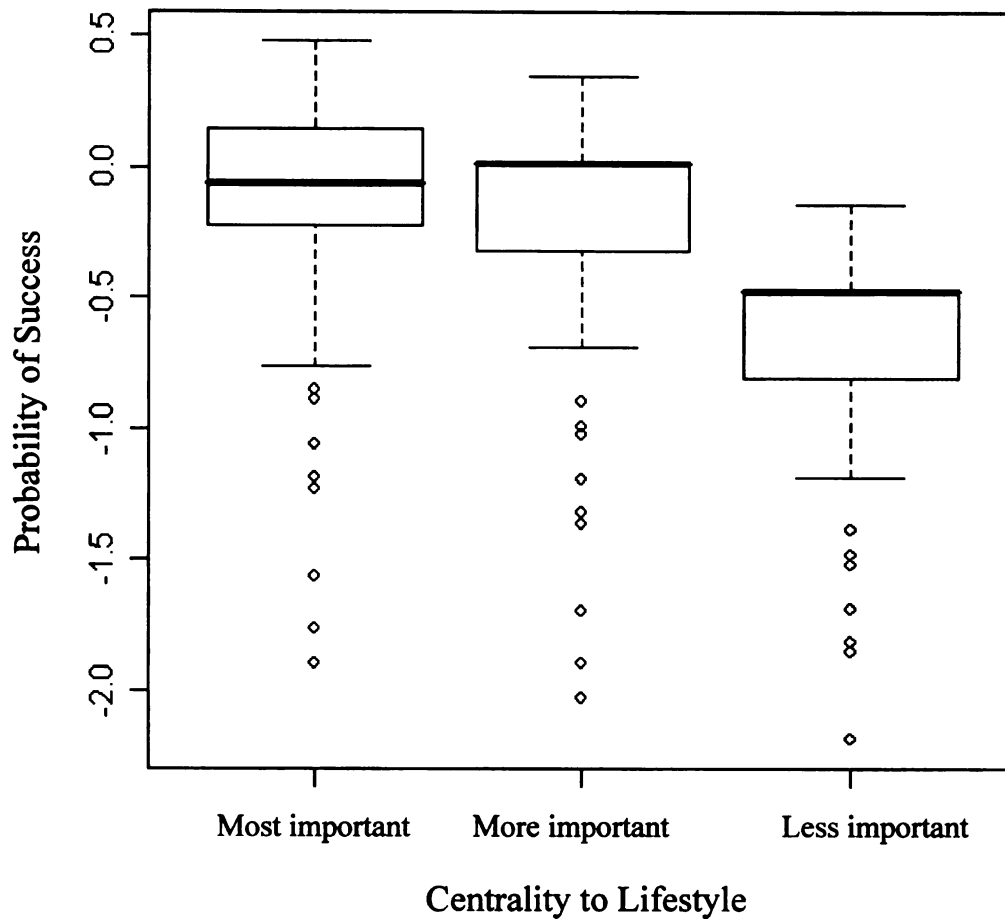


Figure 4.1. Effects of centrality of deer hunting to one's lifestyle on the probability of successfully harvesting an antlered deer. The y-axis is a log-odds scale representing the likelihood of a hunter successfully harvesting an antlered white-tailed deer. The mid-line of each box represents the median probability of success for those respondents who indicated the centrality of hunting to their lifestyle had greater importance. The box indicates the boundary created by the lowest and highest 25% of the data. The whiskers encompass the smallest and largest non-outlier observations while the open circles represent outliers.

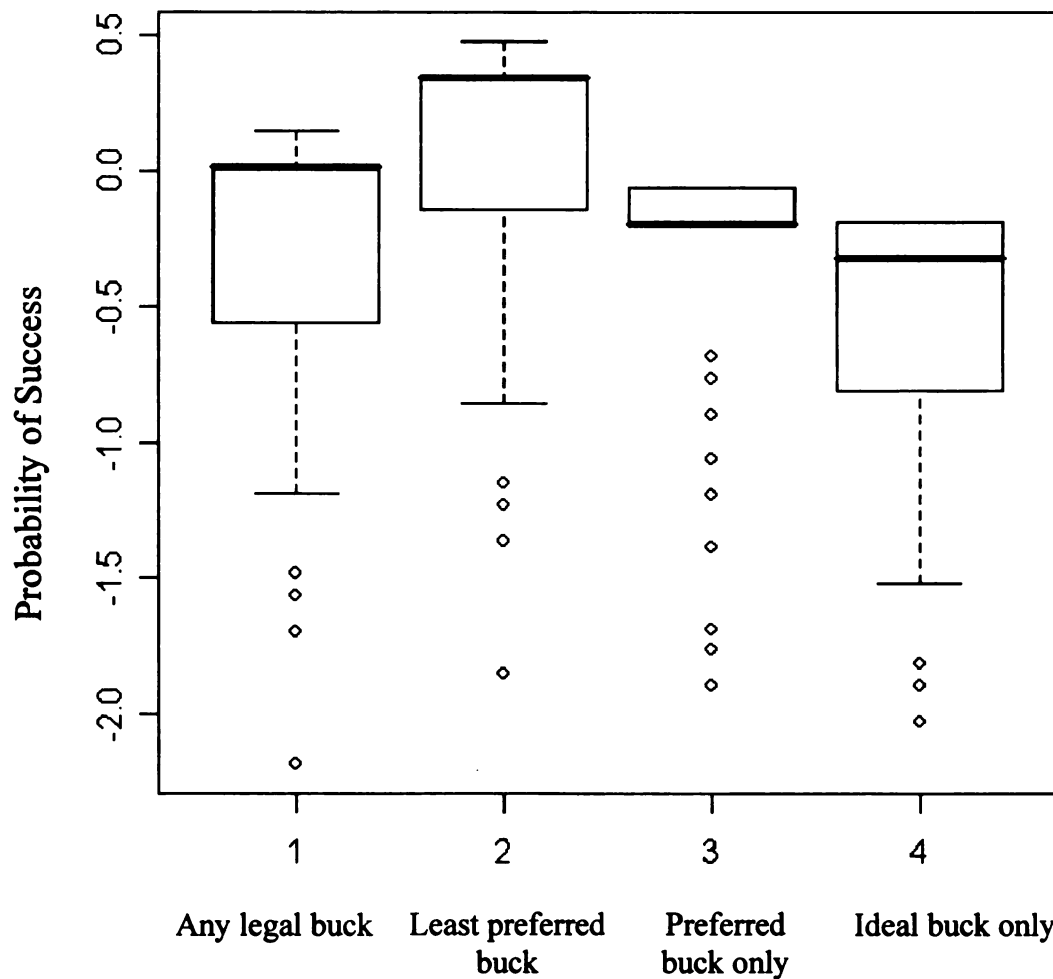


Figure 4.2. Probability of success given a hunter's intention to be selective for a buck category. Any legal buck refers to a buck with at least 3" antler tines. An ideal buck is defined as those that you would not hesitate to take if the opportunity presented itself. The y-axis is a log-odds scale representing the likelihood of a hunter successfully harvesting a category specific buck. The mid-line of each box represents the median probability of success. The box indicates the boundary created by the lowest and highest 25% of the data. The whiskers encompass the smallest and largest non-outlier observations whereas the open circles represent outliers.

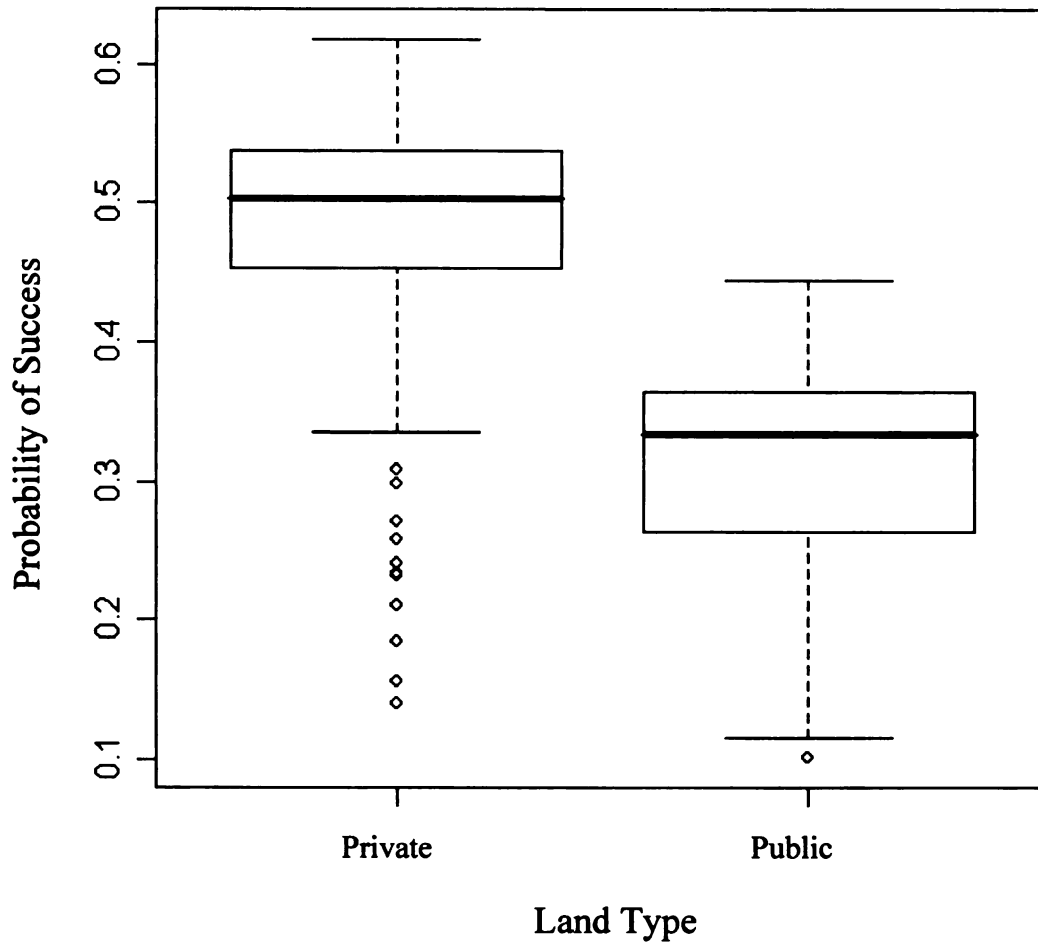


Figure 4.3. Differences in the probability of predicted harvest success between hunters on private and public land. The y-axis is the probability a hunter successfully harvesting a buck. The mid-line of each box represents the median probability of success for those respondents who indicated the land type they hunted. The box indicates the boundary created by the lowest and highest 25% of the data. The whiskers encompass the smallest and largest non-outlier observations whereas the open circles represent outliers.



Figure 4.4. Differences between the day that a hunter started hunting and the probability of harvest success. The y-axis is the probability a hunter successfully harvesting a buck. The mid-line of each box represents the median probability of success for those respondents who indicated the day of the season that they started hunting. The box indicates the boundary created by the lowest and highest 25% of the data. The whiskers encompass the smallest and largest non-outlier observations whereas the open circles represent outliers.

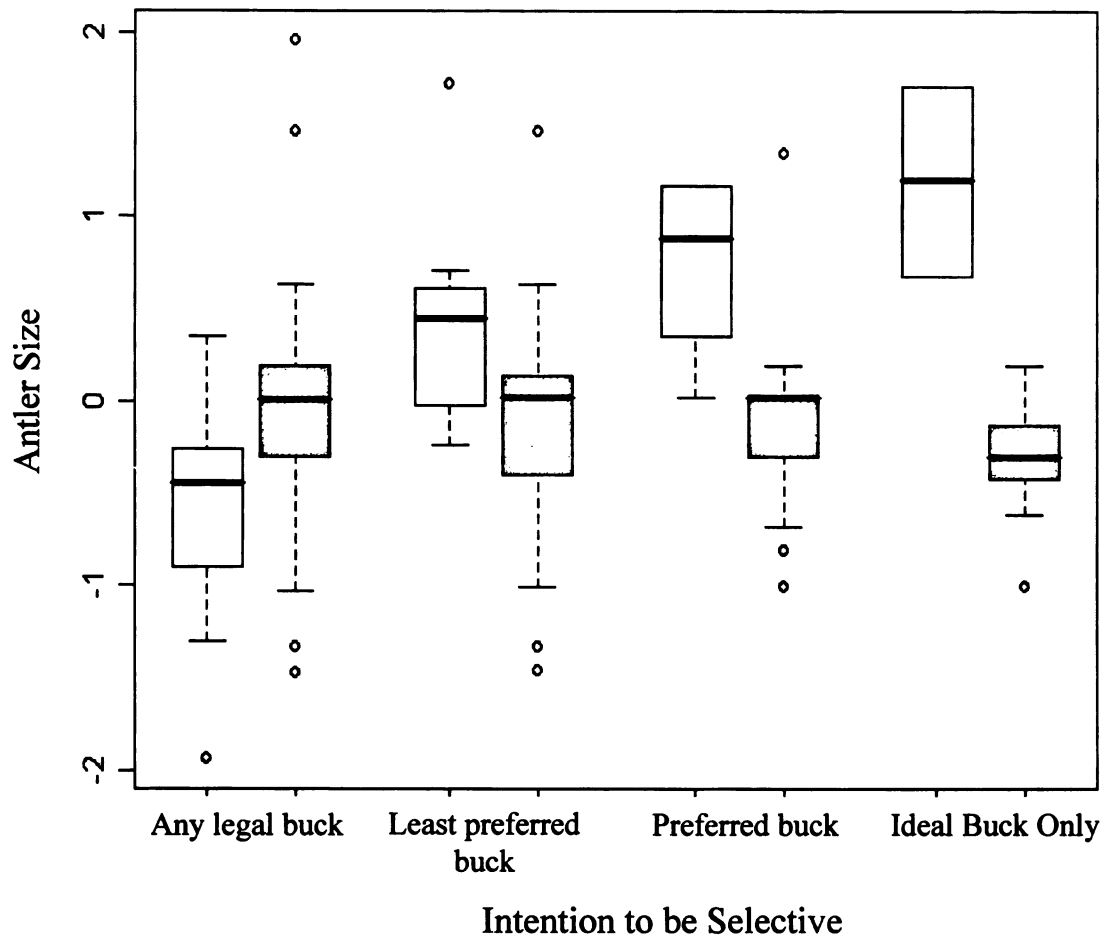


Figure 4.5. Box plot displaying the interaction between the intention to be selective and the number of years of hunting experience as influencing principal component one. The interaction is negative suggesting that the intention to be selective only matters for experienced hunters (i.e., light grey) whereas for inexperienced hunters (i.e., dark grey) the intention to be selective appears to have no modulating effect on harvest outcome in terms of antler size.

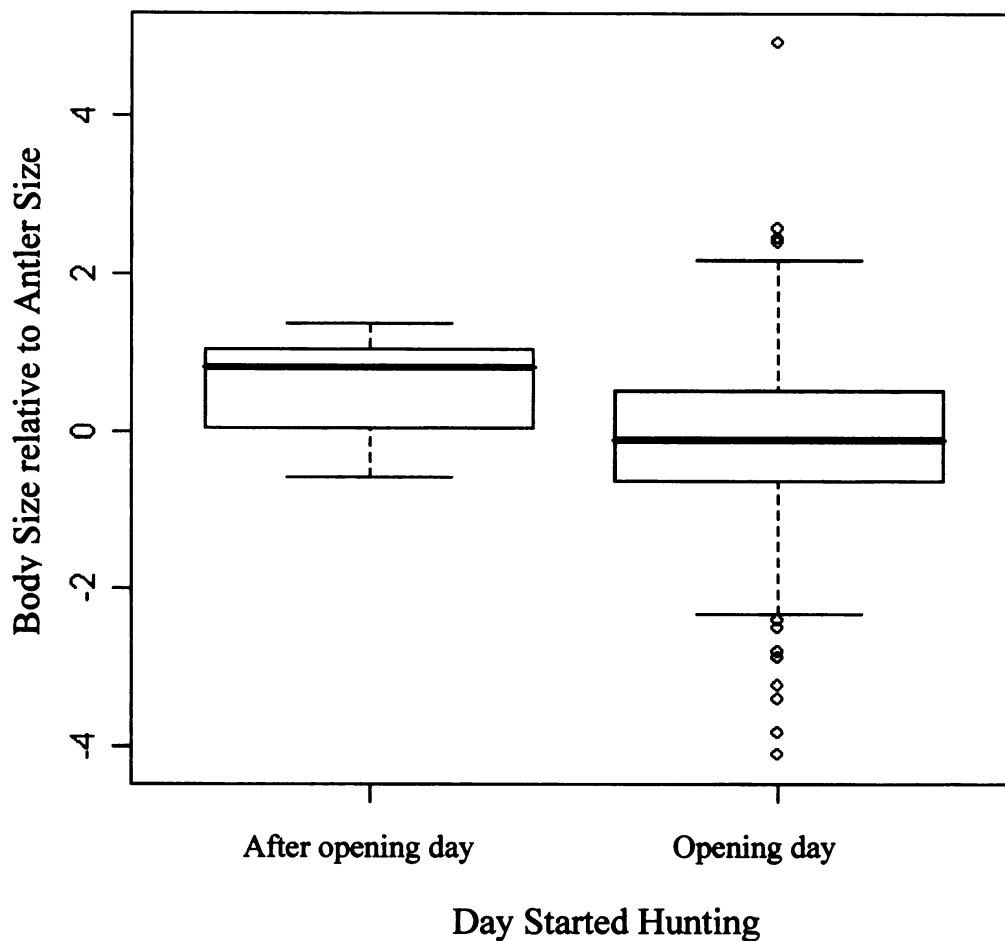


Figure 4.6. Differences between the day that a hunter started hunting (0 = opening day of November 15th, 2006 or any day after opening day) in the second principal component score of their harvested deer. Large values of PC2 are interpreted as small antler size relative to large body size. In contrast, small values of PC2 represent larger antler size relative to body size.

Harvest Success Model

Estimates	B	SE	z	Odds ratio	P
Intercept	-0.86	0.17	-4.84	0.42	< 0.01
Centrality of hunting to lifestyle					
<i>More Important</i>	-0.13	0.10	-1.32	0.87	0.19
<i>Not Important</i>	-0.63	0.16	-4.01	0.53	< 0.01
Selectivity intentions					
<i>Ideal to Preferred to Least Preferred</i>	0.34	0.11	3.04	1.40	< 0.01
<i>Ideal to Preferred</i>	-0.20	0.13	-1.60	0.81	0.11
<i>Ideal Only</i>	-0.33	0.18	-1.89	0.72	0.06
Land ownership					
<i>Public</i>	-0.71	0.13	-5.29	0.49	< 0.01
Day began hunting					
<i>First day of the season</i>	1.00	0.16	6.35	2.73	< 0.01

Table 4.1. The final model parameter estimates for predicting the harvest success of a hunter. Odds ratio values > 1 indicate a positive relationship between the variable and predicting harvest success. An odds ratio value < 1 indicates a negative association.

Selectivity intentions are relative to a hunters' intention to harvest any legal buck. Land ownership is relative to hunting on private land, and the day began hunting is relative to a hunter who started hunting any day after opening day. The centrality of deer hunting to one's lifestyle is relative to deer hunting being considered a hunters' most important recreational activity.

Day of Harvest

<i>Age Class</i>	<i>1st</i>	<i>2nd</i>	<i>3rd</i>	<i>6th</i>	<i>9th</i>	<i>10th</i>
1.5	310	66	55	6	6	4
2.5	78	16	19	3	3	1
3.5	26	11	7	0	0	0
4.5	4	0	2	0	0	0
8.5	1	0	0	0	0	2

Table 4.2. The number of deer harvested per hunting day by age classes.

<i>Ages</i>	<i>MSU</i>		<i>MDNR</i>	
	<i>Number Harvested</i>	<i>Proportion of Harvest</i>	<i>Number Harvested</i>	<i>Proportion of Harvest</i>
1.5	495	65.9 %	2494	52.4 %
2.5	137	18.2 %	828	17.8 %
3.5	51	6.7 %	452	10.0 %
4.5	6	0.8 %	117	2.5 %

Table 4.3. Comparison of ages of harvested bucks between the samples collected for this study (MSU) and the Michigan Department of Natural Resources (MDNR) samples.

PC1 represents antler size while PC2 is body size
relative to antler size

Phenotypic Traits (N)	Age Classes			
	1.5 (495)	2.5 (137)	3.5 (51)	4.5 (6)
Left G2 Tine Length (cm)	9.21±2.97	12.36±4.29	14.21±4.00	12.30±5.56
Right G2 Tine Length (cm)	9.07±2.97	12.26±4.35	14.02±4.24	13.24±4.84
Left Beam Diameter (mm)	21.27±3.33	25.84±4.63	28.57±4.21	27.00±2.10
Right Beam Diameter(mm)	21.46±3.42	25.68±4.97	28.67±4.42	28.33±3.08
Hindfoot Length (cm)	40.64±2.07	40.94±2.16	40.99±2.23	40.75±3.67
Ear Length (cm)	15.97±1.28	16.14±0.88	16.20±1.04	16.77±0.88
Beam antler spread (cm)	24.82±6.66	34.58±7.6	39.56±7.07	38.24±7.38
Total number of points	5.25±1.94	7.18±2.03	7.98±1.67	7.33± 1.63

Table 4.4. Eight morphological characters of four age classes of harvested white-tailed deer (*Odocoileus virginianus*) from the Saginaw Bay Wildlife Management Unit in Michigan during the November firearm deer season of 2006. Sample sizes (N) within each age class are shown in parentheses.

Items	PC 1	PC 2
Total number of points	0.76	-0.24
Left G2 Tine Length	0.70	0.13
Right G2 Tine Length	0.73	0.13
Left Beam Diameter	0.92	-0.09
Right Beam Diameter	0.90	-0.08
Outside antler spread	0.84	-0.16
Ear Length	0.26	0.51
Hindfoot Length	0.19	0.81
Eigenvalue	2.02	1.02
% explained variance	50.94	13.08

Table 4.5. Factor loadings of the first and second principal components from principal component analyses of eight morphological antlered deer traits.

PC1 Model					
Estimates	B	SE	df	<i>t</i>	P
Intercept	-0.74	0.74	-	-1.07	0.31
Intention to be selective	0.66	0.35	1	1.85	0.06
Preferred buck point preference					
<i>Legal 3" spike</i>	-1.66	0.52	4	-3.17	< 0.01
<i>3 – 6 points</i>	-0.50	0.35	4	-1.42	0.16
<i>7 – 10 points</i>	-0.62	0.36	4	-1.73	0.08
<i>Greater than 11 points</i>	-1.01	0.49	4	-2.06	0.04
Years of hunting experience					
<i>3 years</i>	0.93	0.73	1	1.27	0.21
Least preferred buck age preference					
<i>Fawn</i>	-0.20	0.36	4	-0.55	0.58
<i>1 ½ years old</i>	0.44	0.29	4	1.51	0.13
<i>2 ½ years old</i>	0.13	0.41	4	0.33	0.74
<i>3 ½ years old</i>	1.77	0.69	4	2.54	0.01
Intention to be selective x Years of hunting					
<i>3 years</i>	-0.65	0.37	1	-1.75	0.08

Table 4.6. The final model parameter estimates for predicting the morphological characteristics of a harvested antlered deer in terms of the first principal component (i.e. size of antler traits). Preferences for points and age are relative to preferences not at all being important to a hunter.

PC2 Model

Estimates	B	SE	df	<i>t</i>	P
Intercept	1.23	0.4	-	3.05	< 0.01
Day when started hunting					
<i>First Day (Opening Day)</i>	-0.61	0.29	1	-2.12	0.04
Harvest Experience					
<i>Successful</i>	-0.51	0.3	1	-1.72	0.09
Least preferred buck age preference					
<i>Fawn</i>	-0.33	0.18	4	-1.89	0.06
<i>1 ½ years old</i>	-0.35	0.13	4	-2.63	0.01
<i>2 ½ years old</i>	-0.20	0.20	4	-1.05	0.30
<i>3 ½ years old</i>	-0.06	0.35	4	-0.16	0.87

Table 4.7. The final model parameter estimates for predicting the morphological characteristics of a harvested antlered deer in terms of the second principal component (i.e. size of body traits relative to antler size).

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CHAPTER 5

General Discussion

General Discussion

Harvest-induced selection occurs only when there is consistent harvest pressure that selects for specific traits (Coltman et al., 2003). If hunters 1) consistently prefer extreme traits, 2) intend to be selective in their harvest (i.e., harvest only a preferred buck) and 3) are successful in harvesting what they intend to harvest, then there will be hunter-induced selection against bucks with preferred attributes. In this study, I found support for the first premise that hunters prefer bucks with extreme traits, but there were many hunters that intended to not be selective at all and harvest outcome was only slightly affected by hunter selectivity indicating that hunter-induced selection on white-tailed deer is likely weak.

5.1 Hunters prefer rare attributes

Hunters preferred attributes of bucks that represented a small proportion of white-tailed deer in the SBWMU. The average harvested buck, however, did not reflect hunters' preferences for their ideal or preferred antlered deer attributes but instead the regulation minimum of at least a 3" spike antlered buck. If hunters harvested what they preferred prior to the start of the firearm season, attribute preferences of hunters would be reflected by their harvested buck as has been shown to be the case with recreational and subsistence hunters (Mysterud et al., 2006; Ginsberg & Milner-Gulland, 1994). However, as illustrated in Chapter 4, this is not the case with Michigan firearm deer hunters that hunt in the SBWMU. This contradicts research findings that suggest recreational and subsistence hunters do exhibit a harvest preference (Ginsberg & Milner-Gulland, 1994).

Due to the limited availability of bucks with desirable attributes that are in high demand by hunters, the chances that these bucks survive a hunting season would be low. Therefore, highly preferable traits are likely being removed from populations each season and these bucks do not have the opportunity to influence antler attributes of future populations. This leads to sustained selection for smaller antler attributes because each successive hunting season removes individuals with larger antler attributes. These hunter preferences however, will only result in hunter-induced selection if hunters intend to be selective for these attributes and are successful in harvesting what they intend to harvest.

5.2 Many hunters do not intend to be selective

Many hunters instead intend to harvest any legal buck (i.e., opportunistic), thereby maximizing their chances to harvest a buck during the firearm deer season. Many reasons can be offered as to why hunter intentions often do not match their preferences. For example, a motivating factor for such hunters' harvest intentions would not concern select attributes of bucks but instead potentially focus on social or economic reasons for harvesting bucks. From a social standpoint, many hunters engage in hunting because it's a family tradition and something they can share with others. Hunters of this mindset would be considered to place less emphasis on specific deer attributes and more on the enjoyment of being able to hunt. For many though, deer hunting and harvesting is a means of subsistence. Therefore, hunters might concern themselves with attributes other than antlers, to justify their harvesting decisions.

Hunter satisfaction, if realized by the successful harvest of any legal buck, would be met; however, it would be lacking if measured by preferences and selectivity intentions being realized by hunters' harvest outcomes. Some hunters intend to be

selective but lack access to the opportunities where the availability of deer that match their selectivity intentions are abundant; therefore, instead of having the option to choose among bucks they might settle for a buck they don't prefer or have their selectivity intentions realized by going home without having harvested a buck at all.

5.3 Harvest outcome is largely stochastic

Despite the plurality of hunters who intend to harvest any legal buck, there was a smaller subset of hunters who intended to be selective and only harvest a buck that met a certain minimum standard. Hunters who intended to be more selective did harvest bucks with larger antlers if they were experienced hunters but not if they were inexperienced. Two hunters might have the same harvest intentions but only one is successful based on their previous experience suggesting that no matter how selective an inexperienced hunter intends to be, their experience levels limit them from successfully being more selective.

From the large range of buck attributes that were harvested, it is apparent that no one segment of the buck population is being harvested exclusively. Two-thirds of the bucks collected for this study were harvested on the opening day of the season and two-thirds of the harvest was yearling-aged bucks, which had attributes consistent with hunters' least preferred bucks (Table 5.1). The relationship between hunter intentions to harvest any legal buck and harvest outcome highlights the breakdown between hunter preferences and their intentions to be selective. Hunters do have preferences, but remain unwilling to risk not at all getting a buck in order to get a buck that they prefer.

To determine the potential for hunter-induced selection it is necessary to predict and assess the impacts of hunter harvests using empirical data (Coltman et al., 2003).

This research provided valuable information to the MDNR about their deer hunting constituents' preferences and intentions for the harvest of antlered white-tailed deer.

This research provided a starting point to determine if hunters have the capability through harvesting practices in the SBWMU to cause observable changes in the antler characteristics of white-tailed deer. It remains an important objective in future research to determine the intensity and direction of harvest-induced selection that might lead to the evolution of less desirable attributes in harvested animals.

Table

Median trait preferences for antlered deer characteristics by buck category

	Points	G2 tine length	Spread	Age
Ideal	7 to 10 (8.1%)	7 to 9" (4.25%)	16 to 20" (10.1%)	2.5 (18.2%)
Preferred	7 to 10 (8.1%)	7 to 9" (4.25%)	16 to 20" (10.1%)	2.5 (18.2%)
Least Preferred	Legal 3" Spike (38.9%)	3 to 6" (67.1%)	< 16" (89.2%)	1.5 (65.9%)

Table 5.1. A summary of the median preferred attributes for each category of buck. Note: sample sizes differ among buck category preferences due to missing data. Values in parentheses indicate the percentage of harvested bucks (N = 751) meeting or exceeding the median preferences for each attribute. Percentages for G2 tine lengths are reported as the mean between the left and right G2 tine length values calculated independent.

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APPENDIX A

Focus Group Meeting Script

WHITE-TAILED DEER FOCUS GROUP SCRIPT

1. Introductions:

Facilitator:

Thank you for coming here this evening. My name is Elizabeth Ball and I am a research assistant at Michigan State University working with Dr. Andrew G. McAdam. The purpose of tonight's meeting is to gain insight into how hunters select the deer they want to harvest and whether those preferences might effect the genetics of deer over time. We want to design a survey that will be mailed out to a large sample of deer hunters, but to do that we need to get a better understanding of what questions to ask and how best to ask them. That is why we are here this evening. I'd like you to help me explore this idea of selecting the deer to harvest and then I will use that information to design our survey. We'll also be taking some preliminary physical measurements of deer at check stations based on what we learn here tonight to further explore whether any patterns emerge. For this discussion we are going to focus on firearm hunting in the Saginaw Bay management unit.

I'd like to acknowledge the fact that meetings recently regarding Deer Population Goals have been held throughout the state. I'd like to inform you that this isn't about any of that. However, I feel this meeting and what we will be discussing is equally important. If you do not feel it is important or you do not find interest in what we will be discussing here tonight, then you are free to leave. If you happen to choose this option, I thank you for coming regardless of your decision to not participate.

We won't be asking any personal questions, but I want to assure you up front that everything that is said here tonight is confidential. At no time will any of your responses be associated with your name. We will only use first names in our discussion, and your names will not be included in the report of this study.

2. What our task is here tonight:

- a.** The purpose of this study is to find out Whether or not hunters represent a **SELECTIVE FORCE** that could act on the genetic makeup and biology of deer over time. We are restricting ourselves in this first exploration to **THE SAGINAW BAY MANAGEMENT UNIT** and the buck harvest choices made by hunters during the **FIREARM** deer season, although we may also have time to ask about antlerless decisions.
- b.** If you permit me, I would like to tape our discussions. This is only so I can correctly record what is said here tonight and concentrate on the discussion rather than take detailed notes. Once I have made my notes from the tape it will be erased. Your identity will be confidential. Again, we will only use first names in our discussion, and your names will not be included in the report of this study. May I proceed with taping this

meeting?

- c. To get the most out of our discussions tonight, there are a few simple ground rules for us to follow.
 - i. It is important that each of you share what is on your mind. We will often be following a “round robin” format. This means that I will go around the room and ask each individual in turn to provide their point of view. If you have more than one idea, give the most important one first and then we’ll move on to the next person. We’ll keep going around the table until all the ideas are collected. Part of my job as moderator is to ensure that everyone has a chance to share their views. Sometimes we will use this round robin approach and sometimes we can just have an open discussion.
 - ii. Please don’t be swayed by other opinions if you have a different point of view. I expect that there will be differences of opinions in this group and it is important to know what the group disagrees on as well as agree. We are not here to persuade each other of anything, but rather to share our opinions.
 - iii. I am not looking for any particular responses to the questions I have for you. There is no right or wrong answers. I would like you to share your views and respect the views of others although you may disagree.
 - iv. Any time that a question is unclear, please ask for clarification
 - v. As facilitator, I may ask you to be brief and I may need to interrupt you or redirect the conversation. Please know up front that I do not mean to be rude or discourteous but we have a carefully designed set of research questions and I am just trying to keep to our schedule and achieve our goals.
 - vi. Please speak one at a time and loud enough so that everyone here can hear your comments.
 - vii. Finally, we only have two hours to discuss several things which are central to this study. So, let’s try to stay on track. Personal experiences are interesting, but we need to stick to topics that will help me understand what deer characteristics you use when you decide to harvest or to pass. We have scheduled the meeting for two hours, but we have much to discuss. Should the need arise, would you be willing to stay until 9:30?

- viii. My task is to keep everyone on the topic and your task is to provide your experience and input. Does anyone have any questions on the ground rules?
 - ix. Is everyone OK with the ground rules?
 - x. All of you should have been given one of the surveys when you came in. Please do not forget to leave that with me. This provides me with a better profile for the group and covers some items so we don't have to take time from our discussions. Please don't put your name on it.
 - xi. Any questions about any thing related to our meeting this evening? Say where the restrooms are located.
- d. I would like to start the meeting by going around the table and having you introduce yourself – first names only, please – and telling me where you live within the Saginaw Bay Management Unit.

FOCUS OF THE MEETING

1. a. We might have a mix of hunters here that range from definite trophy hunters to folks who are interested only in the hunt experience and putting venison in the freezer. But every deer hunter goes to the field with some set of expectations or hopes and some notion about the type of deer they will shoot.
- b. Just to get us started, think about 3 categories of bucks when you hunt in the 10 county Saginaw Wildlife Management unit. The **ideal** buck you'd like to harvest, the **preferred** buck to take if the ideal doesn't show, and the **last resort** buck that you'd take if you had to.
- c. We're going to talk about what physical characteristics make that an ideal buck, a preferred buck or a last resort buck. Then we are going to talk about what conditions or factors cause you to shift your decision from one to the other. Let's take factors like safety, legal shooting time, clean shot, and ethical shot out of the picture. We can assume we are talking about a buck harvest opportunity that already meets those criteria.

HARVESTABLE DEER LEVEL #1

2. Let's consider what characteristics would make a buck *your* ideal buck.
- a. Let's go around the table and each of you give me the one most important characteristic of a buck that you feel would make it your ideal buck.

b. Just give me one and we will move on to the next person and keep going around until the ideas are all out. I will write them on the easel so we can keep track of them. If someone has already mentioned your most important attribute, tell me that and I'll add a check for everyone who says that is most important.

c. Jon Doe, let's start with you. What is the most important characteristic of a buck that qualifies it as an ideal buck for you?

These are the most important things you look for in an ideal buck, any other characteristics that may not be so important, but they do count? [I'd open this up to the group and list them on the easel as they come up with things.]

3. Now that we have a composite list of characteristics that make a buck ideal I need a better sense of how important these are to the group. [clean up the list if it needs it; collapse any; make sure you understand what each item means and ask if any are unclear to you; might also ask the group if the list is clear to them]

A. Take a minute to consider the list and decide what is the most important

B. I'll give you 3 votes, so you can hold up your hand and vote for the three things on the list most important to you

C. So, how many would put this one in the top 3 to 5 most important characteristics of an ideal deer in the Saginaw Bay Wildlife Management Area?

4. Now, I need to be sure I understand how you judge a buck's physical characteristics. Some are obvious, but let's take this one [e.g., body size]. If there isn't another deer to compare it against, what features of the deer tell you that it has an ideal [body size]?

PROBE: How do you judge a characteristic you listed (quantifiable)?

NOTE: this section will be repeated in order to quantify traits for each deer level.

BODY SIZE

- Total length?
- Shoulder height?
- Size of brisket?
- Relative proportion of body size to leg length?
- Ground shrinkage?

AGE

- Behavior?
- Social interactions with other deer?

ANTLER SIZE

- Ear length?
- Diameter of antler beams?
- Number of points?
- Spread of antlers?
- Configuration: typical vs. non-typical?
- Antlers wider than ears?

MISCELLANEOUS

- Tail length?
- Hind foot length?
- Behavior?
- Color of tarsus glands?

HARVESTABLE DEER LEVEL #2

5. Let's consider what characteristics would make a buck *your* preferred buck if the ideal buck isn't available.

a. Let's go around the table and each of you give me the one most important characteristic of that buck that you feel would make it your preferred buck and that helps you to decide whether to harvest it or not.

b. Just give me one and we will move on to the next person and keep going around until the ideas are all out. I will write them on the easel so we can keep track of them. If someone has already mentioned your most important attribute, tell me that and I'll add a check for everyone who says that is most important.

c. Jon Doe, let's start with you. What is the most important characteristic of that buck which would make it your preferred buck?

6. Now that we have a composite list of characteristics that make a buck ideal I need a better sense of how important these are to the group.

A. Take a minute to consider the list and decide what is the most important

B. Let's use a show of hands, by voting any number of times until the list is ranked to show which are the most important characteristics of an ideal deer in the Saginaw Bay Wildlife Management Area as far as you are concerned.

C. So, how many would put this one in the top 3 to 5 most important characteristics?

7. **[IF THERE ARE NEW FEATURES ON THE LIST, OTHERWISE THIS WOULD NOT BE NECESSARY TO REPEAT WOULD IT?]**Now, I need to be sure I understand how you judge a buck's physical characteristics. Some are obvious, but let's take this one [e.g., body size]. If there isn't another deer to compare it against, what features of the deer tell you that it has an ideal [body size]?

PROBE: How do you judge a characteristic you listed (quantifiable)?

NOTE: this section will be repeated in order to quantify traits for each deer level.

BODY SIZE

- Total length?
- Shoulder height?
- Size of brisket?
- Relative proportion of body size to leg length?
- Ground shrinkage?

AGE

- Behavior?
- Social interactions with other deer?

ANTLER SIZE

- Ear length?
- Diameter of antler beams?
- Number of points?
- Spread of antlers?
- Configuration: typical vs. non-typical?
- Antlers wider than ears?

MISCELLANEOUS

- Tail length?
- Hind foot length?
- Behavior?
- Color of tarsus glands?

HARVESTABLE DEER LEVEL #3

8. If neither an ideal buck nor a preferred buck show up, what are their characteristics that even your last resort buck must have?

a. Let's go around the table and each of you give me the one most important characteristic of that buck that you feel would make it your last resort buck and that helps you to decide whether to harvest it or not.

b. Just give me one and we will move on to the next person and keep going around until the ideas are all out. I will write them on the easel so we can keep track of them. If someone has already mentioned your most important attribute, tell me that and I'll add a check for everyone who says that is most important.

- c. Jon Doe, let's start with you. What is the most important characteristic of that buck which would make it your last resort buck?

9. Now that we have a composite list of characteristics that make a buck a last resort I need a better sense of how important these are to the group.

A. Take a minute to consider the list and decide what is the most important

B. Let's use a show of hands, and you can vote any number of times until the list is ranked to show which are the most important characteristics of an ideal deer in the Saginaw Management Area as far as you are concerned.

C. So, how many would put this one in the top 3 to 5 most important characteristics?

10. Now, I need to be sure I understand how you judge a buck's physical characteristics. Some are obvious, but let's take this one [e.g., body size]. If there isn't another deer to compare it against, what features of the deer tell you that it has an ideal [body size]?

PROBE: How do you judge a characteristic you listed (quantifiable)?

NOTE: this section will be repeated in order to quantify traits for each deer level.

BODY SIZE

- Total length?
- Shoulder height?
- Size of brisket?
- Relative proportion of body size to leg length?
- Ground shrinkage?

AGE

- Behavior?
- Social interactions with other deer?

ANTLER SIZE

- Ear length?
- Diameter of antler beams?
- Number of points?
- Spread of antlers?
- Configuration: typical vs. non-typical?
- Antlers wider than ears?

MISCELLANEOUS

- Tail length?
- Hind foot length?
- Behavior?
- Color of tarsus glands?

ROUND ROBIN: I need a sense of how often you are able to harvest an ideal buck, a preferred buck and a last resort buck.

a. In the last 5 years of hunting in this part of MI (the SBWMU), how many of those years have you harvested the **ideal** buck with a FIREARM as your first buck of the season?

PROBE: how many years out of the past 5 have you harvested an **ideal** buck during ARCHERY season instead of firearm season?

PROBE: how many years out of the past 5 have you harvested an **ideal** buck during FIREARM season as your SECOND buck of the year?

b. In the last 5 years of hunting in this part of MI (the SBWMU), how many of those years have you harvested the **preferred** buck with a FIREARM as your first buck of the season?

c. Now how many years of the past 5 in this part of MI (the SBWMU) have you harvested what you would consider your **preferred** buck instead of an **ideal** buck as your first FIREARM buck of the season?

d. Now how many years of the past 5 in this part of MI (the SBWMU) have you harvested what you would consider your **last resort** buck instead of an **ideal** buck as your first FIREARM buck of the season?

e. How many of you can remember the attributes of the bucks you have harvested within the last five years?

ROUND ROBIN: I need a sense of how good you think you are at judging the characteristics of a buck that you feel are most important?

f. How often are you correct in your judgment of a deer (i.e. it matches your expectations and doesn't suffer from ground shrinkage or turn out to be bigger than you thought?).

i. When does this happen?

COMPROMISES FOR ALL LEVELS

Okay, the group has told me how often you are successful at harvesting your ideal/preferred/last resort buck (i.e. the deer that either meets those standards that we've just discussed or doesn't). Now, I'd like you to think about what factors would cause you to decide it was time to shift from the "ideal" to the preferred buck quality. When and why do you decide?

- a. TO TAKE Your preferred instead of ideal buck;
- b. TO TAKE Your last resort instead of preferred buck

PROBE: Do you go to the hunt with the intention to shoot the first **preferred** buck unless an **ideal** buck comes through first?

PROBE: what causes the risk of not harvesting your **ideal** buck to become greater than the intentions to harvest your **preferred** or **last resort** buck with all the important characteristics?

1. When the season is running short (temporal constraints)
 - i. the longer I wait, the greater my chances are for not harvesting any legal buck let alone my ideal buck
2. Availability of deer
 - i. as the season progresses, there are less deer available for harvest
3. Land type I am hunting
 - i. public lands
 - a. fewer deer
 - b. greater hunting pressure
 - ii. private lands
 - a. own: I am my own deer manager

b. rent / lease: I must manager deer for the land owner

BASED ON WHAT YOU'VE HEARD HERE TONIGHT, WHAT PROBLEMS ARE WE GOING TO HAVE DESIGNING A SURVEY THAT WILL GIVE A VALID MEASURE OF HOW MUCH SELECTIVITY IS GOING ON IN A GIVEN MANAGEMENT UNIT?

CONCLUSION: This ends the formal part of our discussions. Are there any other comments you would like to make concerning selective deer hunting or this evenings discussions? I would like to thank you for assisting me in this study. If you have any further questions or concerns, please feel free to contact me at the number on the letter I provided when you came in. Once again thank you.

APPENDIX B

Focus Group Postcard Invitation

(originally printed on 4x6" notecard)

Dear Sir or Madam:

If you hunt white-tailed deer within the Saginaw Bay Management Unit, I'd like to invite you to participate in a focus group discussing how hunters select the deer they harvest. The Department of Fisheries and Wildlife at Michigan State University will be holding these focus groups for research purposes in March. Focus groups involve 8 to 12 people in a relaxed two-hour discussion led by a trained facilitator. If you would be interested in discussing how harvest is affected by hunter selectivity at such a meeting, please complete and return the attached postage paid card. If you have any questions please contact me.

Sincerely,

Elizabeth Ball/ Project Coordinator
Michigan State University
Ph. 517-353-3030

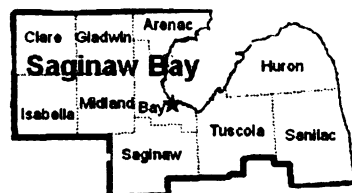
Elizabeth Ball/Research Assistant
Department of Fisheries and Wildlife
Rm. 13 Natural Resources Building
Michigan State University
East Lansing, MI, 48824-1222

Elizabeth Ball
13 Natural Resources Bld.
Dept. Fisheries and Wildlife
Michigan State University
East-Lansing, MI 48824



RECIPIENT NAME
RECIPIENT ADDRESS

1) Please circle the counties in the Saginaw Bay Management Unit where you hunt deer.



2) Which of the following seasons do you hunt? (Check all that apply)

☐ Archery
☐ Firearm

3) How many of the following did you harvest last deer season? (If none write 0)
_____ antlered deer _____ antlerless deer

If you are willing to participate in a focus group, please provide your name and phone number below so we may contact you to arrange a time, date, and location for the meeting.

Name: _____

(Area Code :) _____ / _____

APPENDIX C

Focus Group Meeting Participant Consent Form

Focus Group Meeting for the Development of Michigan's Firearm Deer Hunter Selectivity Survey. Conducted by the Department of Fisheries and Wildlife, Michigan State University

Dear Focus Group Participant,

Thank you for taking the time to participate in this two hour meeting. Focus groups are an important way that the researcher's gathers citizen's views on issues like hunter selectivity. The researchers will take tonight's comments into consideration when developing Michigan's Firearm Deer Hunter Selectivity Survey.

Comments provided at this meeting should provide a wide range of views on deer hunting selectivity. Meeting discussions will be used in developing a mail survey to be sent to firearm deer hunters within the Saginaw Bay Management Unit.

Your participation at tonight's meeting is voluntary. You may refuse to answer certain questions or exclude yourself from parts of the discussion. You can be assured that all data gathered will remain confidential and your privacy will be protected to the maximum extent allowable by law. If you have questions about the study, contact Dr. Andrew McAdam, 13 Natural Resources Building, Michigan State University, East Lansing, MI 48824 or by phone at (517) 432-0396 or email at mcadama@msu.edu. In case you have questions or concerns about your rights as a research participant, please feel free to contact Peter Vasilenko, Ph.D., Michigan State University's Chair of University Committee on Research Involving Human Subjects by phone: (517) 355-2180, fax: (517) 432-4503, email: [<irb@msu.edu>](mailto:irb@msu.edu), or regular mail: 202 Olds Hall, Michigan State University, East Lansing, MI 48824-1047.

By printing and signing your name on the reverse side of this letter, you consent to your voluntary participation in this meeting. To ensure an accurate documentation of tonight's comments, I am requesting that you permit me to audiotape the meeting. This is only so I can correctly record what is said here tonight and concentrate on the discussion rather than take detailed notes. Once I have made my notes from the tape it will be erased. By printing and signing your name in the appropriate section on the back of this letter, you consent to being audio taped tonight. For your reference/files, I am providing you a copy of this letter to take home.

Sincerely,

Elizabeth Ball
Additional Investigator
Michigan State University
Department of Fisheries and Wildlife

I consent to my voluntary participation in this focus group:

_____ (PRINTED NAME)

_____ (SIGNATURE)

I consent to being audio taped during this focus group:

_____ (SIGNATURE)

APPENDIX D
Focus Group Meeting Survey

SBMU FIREARM DEER HUNTER FOCUS GROUP MEETING
MARCH 20TH, 2006
BAY COUNTY COMMUNITY CENTER
SAGINAW, MICHIGAN

- 1. Please check all of the seasons you typically hunt deer in the Saginaw Bay Wildlife Management Unit counties.**

Early Archery _____ Firearm _____ Late Archery _____ Muzzleloader _____

- 3. What type of land do you deer hunt in the 10 county area of the SBWMU?**

Public _____

Private _____

Both _____



- 4. Do you own land that you use for deer hunting in the SBWMU counties?**

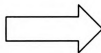
Yes _____ No _____

- 5. Name up to 3 counties that you have hunted in the Saginaw Bay Wildlife Management Unit in the past 5 years.**

- 6. How many total antlered and antlerless deer have you harvested in the past 5 years in any of the Saginaw Bay Wildlife Management Unit counties?**

Antlered _____ Antlerless _____

Please turn over



7. Please indicate how many of your harvested deer you have on display in your home, business or elsewhere.

Number of head or shoulder mounts? _____

Number of full body mounts? _____

Number of European mounts (with skull and antlers)? _____

Number of antler-only mounts? _____

8. Do you hunt on land managed by a collaboration of private land owners in this Saginaw Bay WMU where hunters are encouraged to shoot:

Only certain sized bucks Yes _____ No _____

A certain number of does Yes _____ No _____

9. On the land you hunt in this SBWMU, are there any restrictions imposed by yourself, your hunting friends or the landowner regarding the deer that can be harvested (other than the legal restrictions set by the MIDNR)? *Please explain.*

APPENDIX E

**“What Buck Would You Choose? A Survey of Deer Hunter
Preferences and Decisions in the Saginaw Bay Wildlife
Management Unit” Survey Instrument and Percent Response**

What buck would you choose?

*A survey of deer hunter preferences and
decisions in the Saginaw Bay Wildlife
Management Unit*

RECIPIENT NAME

RECIPIENT ADDRESS



PLEASE NOTE!

THIS IS A SURVEY OF HUNTER HARVEST CHOICES FOR **BUCKS** IN THE **SAGINAW BAY UNIT**. SOME PEOPLE HUNT IN MORE THAN ONE LOCATION AND MAY HAVE DIFFERENT HARVEST INTENTIONS FOR THOSE AREAS. PLEASE ANSWER ALL OF THE QUESTIONS IN THIS SURVEY AS THEY APPLY TO THE AREA YOU HUNT THE **MOST FOR BUCKS DURING THE NOVEMBER FIREARM SEASON IN THE SAGINAW BAY UNIT** (SEE MAP ON THE SURVEY COVER). THANK YOU.

1. Which license or combination of licenses did you purchase in **2006 to hunt antlered deer**? (*Please circle only ONE response.*) Non-response rate: 2%

1. I did not purchase a deer hunting license: 1%
2. Combination license (firearm and archery): 61%
3. Firearm only license: 31%
4. Both archery only and firearm only licenses: 5%

2. Which of the following **2006** deer seasons did you hunt in the **Saginaw Bay Unit**? (*Please circle all that apply.*)

1. Early archery (Oct. 1 – Nov. 14): Hunted: 49% Not hunted: 51%
2. Late archery (Dec. 1 – Jan. 1): Hunted: 19% Not hunted: 81%
3. November firearm (Nov. 15 – 30): Hunted: 91% Not hunted: 9%
4. Muzzleloader (Dec. 8 – 17 for zone 2) & (Dec. 1 – 17 for zone 3): Hunted: 39% Not hunted: 61%
5. Late firearm (Dec. 18 – Jan. 1): Hunted: 9% Not hunted: 91%
6. I hunted none of the 2006 deer seasons in the Saginaw Bay Unit: Hunted: 96% Not hunted: 4%

3. How would you describe what the hunting pressure was **within a mile** of your Saginaw Bay Unit hunting area during the **2006 November firearm deer season**? (*Please circle only ONE response.*) Non-response rate: 7%

1. Very light: 6% 2. Light: 16% 3. Moderate: 40% 4. Heavy: 21% 5. Very heavy: 9%
6. I am unsure: 0%

4. How many of the **past three years (2003, 2004, 2005)**, have you hunted each of the deer seasons in the Saginaw Bay Unit? (*Please circle the number of years hunted in each season.*)

EARLY ARCHERY: 0 YEARS: 9% 1 YEAR: 4% 2 YEARS: 6% 3 YEARS: 45% NOT SURE: 1% NON-RESPONSE RATE: 35%

NOVEMBER FIREARM: 0 YEARS: 2% 1 YEAR: 2% 2 YEARS: 5% 3 YEARS: 85% NOT SURE: 9% NON-RESPONSE RATE: 6%

MUZZLELOADER: 0 YEARS: 10% 1 YEAR: 7% 2 YEARS: 8% 3 YEARS: 35% NOT SURE: 1% NON-RESPONSE RATE: 39%

LATE ARCHERY: 0 YEARS: 17% 1 YEAR: 6% 2 YEARS: 5% 3 YEARS: 16% NOT SURE: 1% NON-RESPONSE RATE: 56%

5. Please check the type of land you have hunted the most in the **Saginaw Bay Unit** during the **past 3 years (2004, 2005, and 2006)**. (*Please circle only ONE response.*) Non-response rate: 4%; Non-sensical answer rate: 6%

1. Private land that I own: 31%
2. Private land leased by me and/or close relatives/friends: 8%
3. Private land leased or owned by my hunt club: 2%
4. Private land which I don't own but hunt for free: 34%
5. Public land: county, state or federal: 14%
6. I am unsure: 0%

6. Please describe the bucks you harvested in the Saginaw Bay Unit as either restricted or unrestricted during the past three November firearm deer seasons (2004, 2005, and 2006). (Please check the appropriate boxes in each column.)

IN THE SAGINAW BAY UNIT...	IN 2004 FIREARM SEASON 48% I DIDN'T HARVEST MY 1ST BUCK IN THE 2004 FIREARM SEASON	IN 2005 FIREARM SEASON 56% I DIDN'T HARVEST MY 1ST BUCK IN THE 2005 FIREARM SEASON	IN 2006 FIREARM SEASON 51% I DIDN'T HARVEST MY 1ST BUCK IN THE 2006 FIREARM SEASON
THE FIRST BUCK I SHOT THERE THAT YEAR WAS...	16% A RESTRICTED BUCK (4 OR MORE POINTS ON AN ANTLER) 21% AN UNRESTRICTED BUCK (AT LEAST A 3" SPIKE) 3% I DON'T REMEMBER 9% NON-RESPONSE RATE 3% NON-SENSICAL RESPONSE S	13% A RESTRICTED BUCK (4 OR MORE POINTS ON AN ANTLER) 19% AN UNRESTRICTED BUCK (AT LEAST A 3" SPIKE) 1% I DON'T REMEMBER 9% NON-RESPONSE RATE 3% NON-SENSICAL RESPONSES	18% A RESTRICTED BUCK (4 OR MORE POINTS ON AN ANTLER) 21% AN UNRESTRICTED BUCK (AT LEAST A 3" SPIKE) < 1% I DON'T REMEMBER 7% NON-RESPONSE RATE 3% NON-SENSICAL RESPONSES
THE SECOND BUCK I SHOT THERE THAT YEAR WAS...	34% I DID NOT GET A 2ND BUCK IN THE 2004 FIREARM SEASON 5% A RESTRICTED BUCK (4 OR MORE POINTS ON AN ANTLER) 2% AN UNRESTRICTED BUCK (AT LEAST A 3" SPIKE) 2% I DON'T REMEMBER 57% NON-RESPONSE RATE	34% I DID NOT GET A 2ND BUCK IN THE 2005 FIREARM SEASON 4% A RESTRICTED BUCK (4 OR MORE POINTS ON AN ANTLER) 2% AN UNRESTRICTED BUCK (AT LEAST A 3" SPIKE) 1% I DON'T REMEMBER 58% NON-RESPONSE RATE	37% I DID NOT GET A 2ND BUCK IN THE 2006 FIREARM SEASON 4% A RESTRICTED BUCK (4 OR MORE POINTS ON AN ANTLER) 3% AN UNRESTRICTED BUCK (AT LEAST A 3" SPIKE) 1% I DON'T REMEMBER 56% NON-RESPONSE RATE

7. As a recreational activity, how important to you is **deer hunting** compared to your other recreational activities?
(Please circle only ONE response.)

1. My most important recreational activity: 32%
2. One of my more important recreational activities: 51%
3. No more important than any other recreational activity: 10%
4. Less important than most of my other recreational activities: 2%
5. Not at all important to me as a recreational activity: 1%

8. How many days did you have available to hunt during the **2006 November firearm deer season in the Saginaw Bay Unit?** *(Please count a partial day as one day and write the number.)* Average: 9.65 days

I had _____ days available to hunt the 2006 November firearm deer season.

9. How many total days did you hunt during the **2006 November firearm deer season in the Saginaw Bay Unit?** *(Please count a partial day as one day and write the number below.)* Average: 7.27 days

I hunted _____ days in the Saginaw Bay Unit during the 2006 November firearm season.

10. On what day did you **begin hunting in the Saginaw Bay Unit for a 2006 November firearm buck** after the season opened on November 15th? *(Please circle only ONE response.)* Non-response rate: 8%

1. I began hunting on the first day the season opened (Wednesday, Nov. 15): 80%
2. I began hunting on the second day of the season (Thursday, Nov. 16): 2%
3. I began hunting on the third day of the season (Friday, Nov. 17): 3%
4. I began hunting during the first weekend (Saturday & Sunday, Nov. 18 – 19): 7%
5. I began hunting during the second week (Monday – Friday, Nov. 20 – 25): 9%
6. I am unsure

11. How many days did you hunt during the **2006 November firearm deer season in the Saginaw Bay Unit** before harvesting your **first buck** for the year? *(Please count a partial day as one day and write the number below.)* 1 day: 19%, 2 days: 5%, 3 days: 3%, Other: 8%; Non-response rate: 22%

I hunted _____ days before harvesting my **first 2006 buck** during the November firearm deer season.

or ☐ I harvested my **first 2006 buck** during the early archery season. 10%

or ☐ I harvested my **first 2006 buck** after the November firearm season or I did not harvest a buck at all. 33%

12. After getting your first buck during the **2006 November firearm deer season**, how many days did you continue to hunt before harvesting your **second** firearm buck?

(For example: If you harvested your first buck on November 15th and your second buck on November 20th you would answer 5 days. If you got two bucks on the same day, write "0".)

0 days: 3%, 1 day: 1%, 2 days: 1%, 5 days: 1%, Other: 3%; Non-response rate: 40%

I hunted _____ days between my **first** and **second** buck harvest.

or ☐ I harvested my **second 2006 buck** after the November firearm season or I did not harvest a **second** buck at all. 52%

13. When you are deciding whether to shoot a buck during the **November firearm season in the Saginaw Bay Unit**, how important to you are each of the following characteristics? (See map on cover of the Saginaw Bay Unit.)

HOW IMPORTANT TO YOU ARE THESE CHARACTERISTICS IN HELPING YOU DECIDE TO HARVEST A BUCK?	PLEASE CIRCLE <u>ONE</u> NUMBER FOR THE IMPORTANCE OF EACH CHARACTERISTIC				
	EXTREMELY IMPORTANT	MODERATELY IMPORTANT	SLIGHTLY IMPORTANT	NOT AT ALL IMPORTANT	I AM UNSURE
TOTAL NUMBER OF ANTLER POINTS ON THE RACK	23%	26%	21%	21%	9%
ANTLER BEAM DIAMETER (ANTLER MASS)	10%	20%	23%	36%	11%
OVERALL BODY SIZE OF THE BUCK (WEIGHT)	15%	33%	23%	20%	10%
LENGTH OF THE ANTLER TINES	12%	24%	24%	29%	10%
OUTSIDE SPREAD OF THE ANTLERS	12%	22%	22%	33%	20%
WHETHER THE ANTLER RACK HAS A TYPICAL OR NON-TYPICAL ARRANGEMENT	4%	12%	18%	55%	11%
THE BUCK AGE OF	11%	22%	23%	33%	11%

We are interested in what you consider to be your “ideal,” “preferred,” and “least preferred” buck that you would harvest during the November firearm deer season. Below we present three categories of bucks a hunter might have in mind. You might not go out to hunt thinking in terms of these three categories, but please read through the three categories of bucks below and **refer to them** when you answer the questions that follow.

1. WHAT IS AN IDEAL BUCK?

- AN IDEAL BUCK IS ONE YOU WOULD NOT HESITATE TO TAKE IF THE OPPORTUNITY PRESENTED ITSELF.
- YOU MIGHT BE WILLING TO PASS UP SHOTS AT OTHER BUCKS FOR PART OR ALL OF THE NOVEMBER FIREARM SEASON TO WAIT FOR THIS BUCK.
- YOU ARE REASONABLY CERTAIN A BUCK OF THIS CATEGORY EXISTS IN THE AREA THAT YOU HUNT THE MOST WITHIN THE **SAGINAW BAY UNIT**.

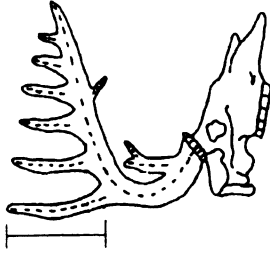
2. WHAT IS A PREFERRED BUCK?

- YOU WOULD TAKE A BUCK LIKE THIS WHEN YOU WERE NOT WILLING TO WAIT ANY LONGER FOR YOUR IDEAL BUCK.
- YOU MIGHT BE WILLING TO PASS UP SHOTS AT OTHER LEGAL BUCKS FOR PART OR ALL OF THE NOVEMBER FIREARM SEASON TO WAIT FOR A BUCK OF AT LEAST THIS STANDARD.
- YOU ARE REASONABLY CERTAIN A BUCK OF THIS CATEGORY EXISTS IN THE AREA THAT YOU HUNT THE MOST WITHIN THE **SAGINAW BAY UNIT**.

3. WHAT IS A LEAST PREFERRED BUCK?

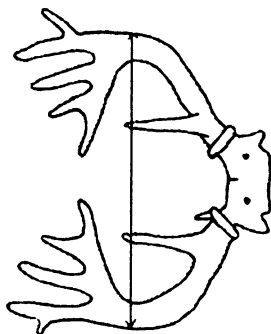
- YOU WOULD TAKE A LEAST PREFERRED BUCK ONLY AFTER YOU GAVE UP WAITING FOR YOUR IDEAL AND PREFERRED BUCKS.
- YOU MIGHT DECIDE TO HARVEST YOUR LEAST PREFERRED BUCK FOR VENISON OR BECAUSE YOU WOULD RATHER NOT RISK ENDING YOUR NOVEMBER FIREARM SEASON WITHOUT HARVESTING A BUCK AT ALL.
- YOU ARE REASONABLY CERTAIN A BUCK OF THIS CATEGORY OR BETTER EXISTS IN THE AREA THAT YOU HUNT THE MOST WITHIN THE **SAGINAW BAY UNIT**.

Longest Antler Tine



14. What length does the longest antler tine need to be to define your ideal, preferred, and least preferred bucks?
(Please refer to the diagram at right and circle only ONE response for each row.)

HOW LONG DOES THE LONGEST ANTLER TINE NEED TO BE FOR A(N)...	THIS IS NOT IMPORTANT TO ME	SHORTER LENGTH THAN THE EARS (ABOUT 3-6 INCHES)	SAME LENGTH AS THE EARS (ABOUT 7-9 INCHES)	LONGER LENGTH THAN THE EARS (ABOUT 10+ INCHES)	
				I AM UNSURE	
...IDEAL BUCK?	24%	4%	19%	41%	4%
...PREFERRED BUCK?	23%	13%	36%	14%	4%
...LEAST PREFERRED BUCK?	36%	38%	8%	2%	6%



15. What antler beam spread helps you define your ideal, preferred, and least preferred bucks? (Please refer to the diagram at right and circle only ONE response for each row.)

THE MINIMUM ANTLER BEAM SPREAD FOR A(N)...	THIS IS NOT IMPORTANT TO ME	LESS THAN WIDTH BETWEEN THE EAR TIPS (LESS THAN 15 INCHES)	AS WIDE AS THE DISTANCE BETWEEN THE EAR TIPS (ABOUT 16- 20 INCHES)	WIDER THAN DISTANCE BETWEEN THE EARS (GREATER THAN 21 INCHES)	I AM UNSURE
...IDEAL BUCK?	27%	4%	23%	34%	4%
...PREFERRED BUCK?	27%	16%	35%	9%	3%
...LEAST PREFERRED BUCK?	44%	34%	5%	1%	5%

16. What minimum total number of antler points do you use to identify your ideal, preferred and least preferred bucks? (Please circle only ONE response for each buck category.)

	THIS IS NOT IMPORTANT TO ME	LEGAL 3" SPIKE	3 - 6 POINTS	7 - 10 POINTS	GREATER THAN 11 POINTS
IDEAL BUCK	18%	4%	7%	39%	25%
PREFERRED BUCK	17%	4%	26%	38%	6%
LEAST PREFERRED BUCK	25%	33%	24%	7%	1%

17. What age class do you use to define your ideal, preferred and least preferred bucks? (Please circle only ONE response for each buck category.)

	THIS IS NOT IMPORTANT TO ME	FAWN (1/2 YEAR OLD)	1 ½ YEARS OLD	2 ½ YEARS OLD	3 ½ YEARS OLD OR OLDER
IDEAL BUCK	20%	< 1%	8%	19%	45%
PREFERRED BUCK	19%	< 1%	15%	44%	12%
LEAST PREFERRED BUCK	23%	14%	38%	12%	2%

18. Please classify each of the five legal bucks below as an "ideal", "preferred" or "least preferred" buck for your Saginaw Bay Unit hunting area. If you would not harvest the buck, check "non-shooter". (Please check ONE answer for each one of the 5 buck diagrams.)



BUCK A IS...

11% IDEAL
4% PREFERRED
35% LEAST PREFERRED
36% A NON-SHOOTER
4% UNDECIDED
9% NON-RESPONSE



BUCK B IS...

15% IDEAL
33% PREFERRED
29% LEAST PREFERRED
11% A NON-SHOOTER
2% UNDECIDED
9% NON-RESPONSE



BUCK C IS...

40% IDEAL
41% PREFERRED
7% LEAST PREFERRED
1% A NON-SHOOTER
1% UNDECIDED
9% NON-RESPONSE



BUCK D IS...

62% IDEAL
25% PREFERRED
1% LEAST PREFERRED
1% A NON-SHOOTER
1% UNDECIDED
10% NON-RESPONSE



BUCK E IS...

80% IDEAL
7% PREFERRED
1% LEAST PREFERRED
1% A NON-SHOOTER
1% UNDECIDED
10% NON-RESPONSE

FOR THIS QUESTION, ASSUME YOU COULD LEGALLY HARVEST ANY TWO BUCKS DURING THE NOVEMBER FIREARM SEASON WITHOUT ANTLER POINT RESTRICTIONS AND THAT YOU HAVE NOT TAGGED ANY EARLY ARCHERY BUCKS. USE THE DIAGRAMS ABOVE TO ANSWER THE FOLLOWING QUESTION.

19. Which of the bucks pictured above (A, B, C, D or E) would you be willing to shoot for...

... your **first** buck of the firearm season? (Please check all that apply.)

Y: 30% ¹ A	Y: 45% ² B	Y: 59% ³ C	Y: 56% ⁴ D	Y: 59% ⁵ E	Y: 1% ⁶ NONE OF THESE
N: 70%	N: 55%	N: 41%	N: 44%	N: 41%	N: 99%

... your **second** buck of the firearm season? (Please check all that apply.)

Y: 17% ¹ A	Y: 32% ² B	Y: 52% ³ C	Y: 58% ⁴ D	Y: 60% ⁵ E	Y: 3% ⁶ NONE OF THESE
N: 83%	N: 68%	N: 48%	N: 42%	N: 40%	N: 97%

20. Which statement below best describes what your intentions were for harvesting a buck when the **2006 November firearm deer season** began on November 15th? (Please check only ONE response.) Non-response rate: 8%

9% 1. I intended to shoot only a buck that met my **ideal buck** standards, even if it meant not getting a buck during the 2006 November firearm deer season.

18% 2. I intended to try to harvest my **ideal buck** for a while, but would not have settled for anything less than my **preferred buck** standard, even if it meant not getting a buck during the 2006 November firearm deer season.

28% 3. I intended to wait a while to harvest either an **ideal or preferred buck**, but intended to harvest a **least preferred buck**, if necessary, to avoid going home without venison during the 2006 November firearm deer season.

37% 4. I intended to take any **legal buck** that presented an opportunity during the 2006 November firearm deer season.

FOR THE NEXT 3 QUESTIONS, PLEASE CONSIDER WHAT YOUR FUTURE HARVEST INTENTIONS WOULD BE. ASSUME YOU HAVE NOT YET HARVESTED ANY BUCKS DURING EARLY ARCHERY SEASON AND HAVE 2 BUCK TAGS TO FILL IN THE NOVEMBER FIREARM SEASON OF **2007**.

21. Which of these best describes what your intentions will most likely be regarding the harvest of your **first buck during the 2007 November firearm season**? *(Please check ONE of the following.)*

44% 1. I intend to wait at least part of my season to try to get a buck that meets my ideal, preferred or least preferred standards. *(If you checked here, please go to question 22.)*

36% 2. I intend to harvest any legal buck and will not wait for an opportunity to shoot some particular size or category of buck. *(If you checked here, please go to question 23.)*

12% 3. I don't know what my intentions will be for the buck I would shoot in the 2007 November firearm season. *(If you checked here, please skip to question 23.)*

22. Please estimate when during the 2007 November firearm season you would be most likely to stop waiting for a particular category of buck and take another if the opportunity was presented. (Please circle ONE response for each row.)

REMAINING OPPORTUNITY TO HUNT IN THE 2007 NOVEMBER FIREARM DEER SEASON				
I WOULD STOP WAITING FOR:	75% OF MY OPPORTUNITY TO HUNT REMAINS	50% OF MY OPPORTUNITY TO HUNT REMAINS	25% OF MY OPPORTUNITY TO HUNT REMAINS	I WOULDN'T SHOOT ANYTHING LESS THAN A BUCK OF MY IDEAL OR PREFERRED STANDARDS I AM UNSURE
AN IDEAL BUCK AND TAKE A PREFERRED BUCK WHEN...	18%	15%	9%	43%
AN IDEAL OR PREFERRED BUCK AND TAKE A LEAST PREFERRED BUCK WHEN...	12%	9%	17%	45%

23. How many of each category of bucks would it be reasonable for you to expect to live on the land you hunt the most in the Saginaw Bay Unit on the first day of the November 2007 firearm season? (Please circle only ONE response for each buck category.)

CATEGORIES OF BUCK	NO BUCKS	1 – 2 BUCKS	3 – 4 BUCKS	5 - 6 BUCKS	7 - 8 BUCKS	MORE THAN 9 BUCKS
IDEAL BUCK	22%	46%	10%	4%	2%	2%
PREFERRED BUCK	9%	35%	25%	9%	4%	2%
LEAST PREFERRED BUCK	5%	18%	20%	18%	11%	14%

24. How likely is it that you will have the opportunity while on land you hunt the most in the Saginaw Bay Unit during the 2007 November firearm season to harvest each category of bucks? (Please circle only ONE response for each buck category.)

CATEGORIES OF BUCK	LIKELIHOOD OF HARVESTING BUCKS OF EACH CATEGORY				
	EXTREMELY LIKELY	HIGHLY LIKELY	SOMEWHAT LIKELY	NOT AT ALL LIKELY	I AM UNSURE
IDEAL BUCK	3%	4%	37%	39%	16%
PREFERRED BUCK	4%	14%	50%	17%	16%
LEAST PREFERRED BUCK	32%	23%	24%	6%	16%

25. Below are some different scenarios of a **first buck harvest** that you might find yourself in during the **2007** firearm season. Please read through these scenarios and then choose what your intentions will most likely be for the harvest of your **second buck during the 2007 November firearm season in the Saginaw Bay Unit.** (Please check only ONE response for each column.)

1. IF YOUR FIRST BUCK WAS AN IDEAL BUCK, YOUR SECOND BUCK WOULD BE...	2. IF YOUR FIRST BUCK WAS A PREFERRED BUCK, YOUR SECOND BUCK WOULD BE...	3. IF YOUR FIRST BUCK WAS A LEAST PREFERRED BUCK, YOUR SECOND BUCK WOULD BE...
24% I WOULD NOT SHOOT A SECOND BUCK. 17% I WOULD NOT SHOOT A SECOND BUCK. 15% AN IDEAL BUCK. 28% AN IDEAL BUCK. 20% A PREFERRED BUCK. 13% A PREFERRED BUCK. 5% A LEAST PREFERRED BUCK. 6% A LEAST PREFERRED BUCK. 21% ANY LEGAL BUCK. 21% ANY LEGAL BUCK. 5% I AM UNSURE. 4% I AM UNSURE. 9% NON-RESPONSE 10% NON-RESPONSE		14% I WOULD NOT SHOOT A SECOND BUCK. 25% AN IDEAL BUCK. 23% A PREFERRED BUCK. 20% ANY LEGAL BUCK. 4% A LEAST PREFERRED BUCK. 4% I AM UNSURE. 10% NON-RESPONSE

26. How important is it to you that your **2007 firearm bucks harvested in the Saginaw Bay Unit** would be of the following categories? (Please circle only ONE response for each buck category.)

HOW IMPORTANT IS IT TO YOU THAT YOUR...	CATEGORIES	EXTREMELY	MODERATELY	SLIGHTLY	NOT AT ALL	I AM
		IMPORTANT	IMPORTANT	IMPORTANT	IMPORTANT	UNSURE
FIRST BUCK WOULD BE...	IDEAL	18%	20%	14%	19%	30%
	PREFERRED	17%	25%	14%	15%	30%
	LEAST PREFERRED	5%	11%	18%	28%	38%
	ANY LEGAL BUCK	17%	8%	9%	33%	33%
SECOND BUCK WOULD BE...	IDEAL	25%	15%	9%	17%	30%
	PREFERRED	15%	22%	11%	18%	30%
	LEAST PREFERRED	3%	7%	12%	33%	38%
	ANY LEGAL BUCK	12%	6%	7%	35%	31%

27. Please use this space to add any additional comments or questions you would like to share.

Comments:

Thank You for devoting your time and effort to this important research! Please see the results from this research, which will be posted at www.fw.msu.edu

To return this questionnaire, simply put it in the postage-paid return envelope provided, seal it, and drop it in the mail. Thank You!

ELIZABETH BALL, RESEARCH ASSISTANT
MI DEPT. OF NATURAL RESOURCES, WILDLIFE DIVISION
P.O. BOX 30030, LANSING, MI 48909-9965

APPENDIX F

**“What Buck Would You Choose? A Survey of Deer Hunter
Preferences and Decisions in the Saginaw Bay Wildlife
Management Unit” Survey Cover Letter 1**

Michigan Deer Hunter:

This survey is designed to explore what physical characteristics of **bucks** hunters look for when deciding whether or not to harvest a buck. As hunters, we venture afield each fall with some idea of the buck we'd like to harvest. Some of us have a very specific buck in mind. Some of us want venison in the freezer and are less concerned about the characteristics of the buck we harvest. Many of us are somewhere in between.

In the first phase of this study, we are focusing on the **Saginaw Bay Wildlife Management Unit (hereafter referred to as the Saginaw Bay Unit)**. We would appreciate your assistance in this study of deer hunter preferences and decisions in the field. Please complete this questionnaire, seal it in the postage paid envelope provided and put it in the mail.

Your responses will remain confidential and your privacy will be protected to the maximum extent allowable by law. Records from this survey will be stored in databases at Michigan State University during the duration of this project. Only project researchers will have exclusive access to the data.

If you checked your buck into a MDNR deer check station and received a postcard and additional measurements were collected from your buck, your responses to this survey will be linked to the data collected from your buck. If no additional measurements were collected from your buck at a MDNR check station, your responses will remain anonymous.

Taking a few minutes to fill out this questionnaire is completely voluntary and indicates your voluntary agreement to participate in this study. If you have any questions or concerns regarding your rights as a study participant you may contact – anonymously, if you wish – Peter Vasilenko, Ph.D., Director of Human Research Protections, (517) 355-2180, fax (517) 432-4503, email irb@msu.edu, or mail 202 Olds Hall, Michigan State University, East Lansing, MI 48824-1047.

If you have any questions regarding this survey, please contact me at the address below, toll-free at 1-800-557-2148, or email at: balleli2@msu.edu.

Thank you for your assistance!

A handwritten signature in black ink that reads "Elizabeth Ball". The script is cursive and fluid, with the first name and last name clearly legible.

Elizabeth Ball, Research Assistant
Michigan Department of Natural Resources, Wildlife Division
P.O. Box 30030, Lansing, MI 48909-9965

APPENDIX G

**“What Buck Would You Choose? A Survey of Deer Hunter
Preferences and Decisions in the Saginaw Bay Wildlife
Management Unit” Survey Reminder Postcard**

(originally printed on 4x6" notecard)

Dear Michigan Deer Hunter:

Two weeks ago, you received a survey regarding the harvest of bucks in the Saginaw Bay Wildlife Management Unit.

If you already completed and returned the survey, please accept my sincere thanks! If you have not, taking the time to fill out and return the survey will benefit the management of Michigan's white-tailed deer. It is vital that we receive your input!

If by some chance you did not receive the questionnaire, or it got misplaced, please call me toll free at 1-800-557-2148 to receive another copy.

Sincerely,

Elizabeth Ball



Michigan Department of Natural Resources
Wildlife Population Studies
Box 30030
Lansing, MI 48909-7530

PRESORTED
FIRST CLASS
U.S. Postage
PAID
Lansing,
Michigan

RECIPIENT NAME

RECIPIENT ADDRESS

APPENDIX H

**“What Buck Would You Choose? A Survey of Deer Hunter
Preferences and Decisions in the Saginaw Bay Wildlife
Management Unit” Survey Cover Letter 2**

Dear Michigan Deer Hunter:

A survey regarding your preferences and decisions while hunting in the Saginaw Bay Wildlife Management Unit was recently sent to you. This survey is designed to explore what physical characteristics hunters look for when deciding whether or not to harvest a particular buck.

I would like to remind you that your responses are important. As a Michigan deer hunter you were randomly selected to represent fellow sportsmen and women. Your responses supply valuable information to the Michigan Department of Natural Resources and researchers at Michigan State University.

The time it will take you to complete this questionnaire will only help to better serve the needs of Michigan deer hunters. Again your assistance in this study of deer hunter preferences and decisions in the field is greatly appreciated. Please complete this questionnaire, seal it in the postage paid envelope provided and put it in the mail.

Your responses will remain confidential and your privacy will be protected to the maximum extent allowable by law. Records from this survey will be stored in databases at Michigan State University during the duration of this project. Only project researchers will have exclusive access to the data.

Taking a few minutes to fill out this questionnaire is completely voluntary and indicates your voluntary agreement to participate in this study. If you have any questions or concerns regarding your rights as a study participant you may contact – anonymously, if you wish – Peter Vasilenko, Ph.D., Director of Human Research Protections, (517) 355-2180, fax (517) 432-4503, email irb@msu.edu, or mail 202 Olds Hall, Michigan State University, East Lansing, MI 48824-1047.

If you have any questions regarding this survey, please contact me at the address below, toll-free at 1-800-557-2148, or email at: balleli2@msu.edu.

Your cooperation is greatly appreciated!

A handwritten signature in black ink that reads "Elizabeth Ball". The signature is written in a cursive, flowing style.

Elizabeth Ball, Research Assistant
Michigan Department of Natural Resources, Wildlife Division
P.O. Box 30030
Lansing, MI 48909-9965

APPENDIX I
Field Collections Postcard

(originally printed on 4x6" notecard)

Dear Michigan Deer Hunter:

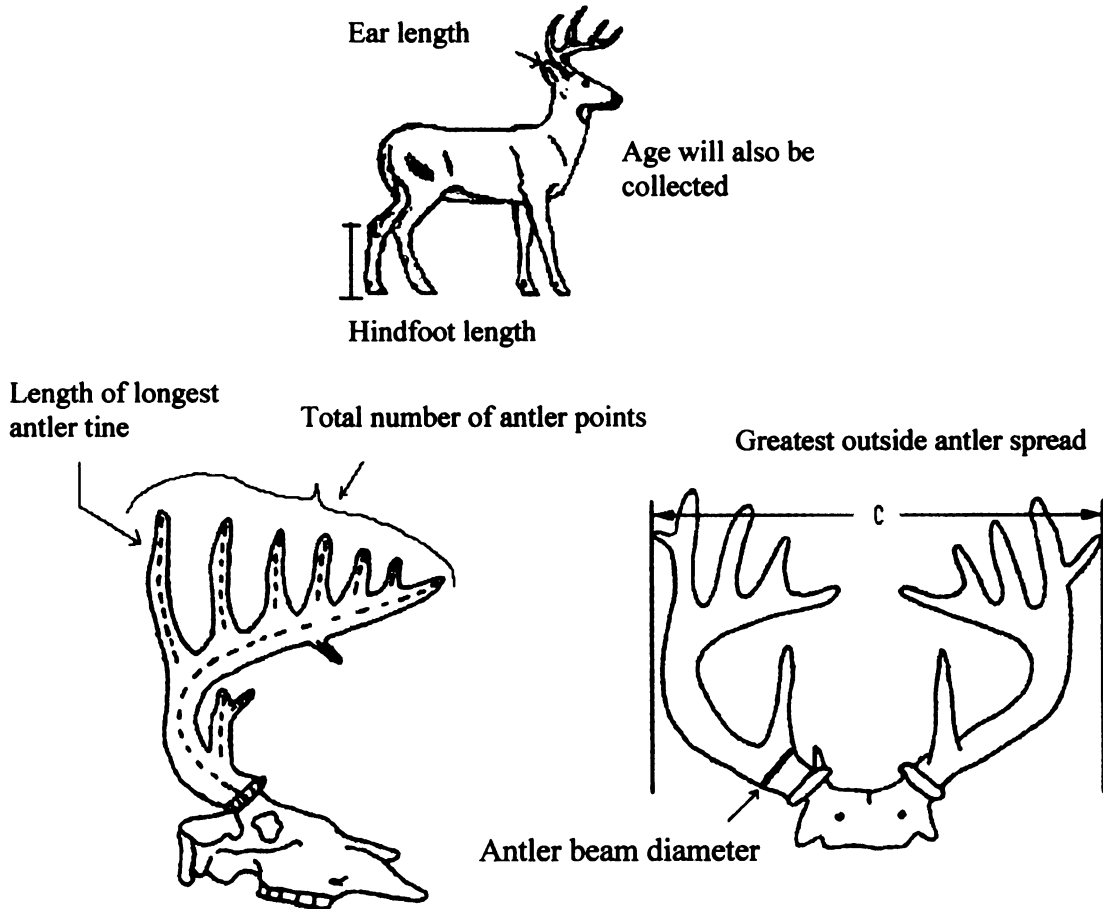
We are taking additional measurements of your 2006 firearm buck as part of some exciting research by Michigan State University. This research project is designed to investigate Michigan deer hunters' preferences, attitudes, and selectivity regarding their buck harvests. This study will help MDNR deer managers to investigate the possible changes in future buck characteristics resulting from selective harvest. As a hunter that checked-in a buck harvested within the **Saginaw Bay Wildlife Management Unit**, you will receive a mail questionnaire early next year. Another 3,500 randomly selected individuals who hunted this unit will also receive the questionnaire. Please watch your mailboxes after **January 1st, 2007**. **Your responses to the survey will be especially important. We want to know what you want and how you made decisions in the field about which buck to harvest.** When our data are analyzed in 2007, we will put a report on the website of the Department of Fisheries and Wildlife, Michigan State University (<http://www.fw.msu.edu/>). **Thank You.**



Sincerely,

Elizabeth Ball/ Graduate Student
Michigan State University
Ph. 1-800-557-2148

Measurements taken from your antlered white-tailed buck harvested in the Saginaw Bay Wildlife Management Unit



APPENDIX J
Research Approval Letters

MICHIGAN STATE
UNIVERSITY

Revision
Application
Approval

October 27, 2006

To: Andrew McAdam
Department of Fisheries and Wildlife
Michigan State University
East Lansing, MI 48824

Re: IRB # 05-1028 Category: EXPEDITED 2-7
Revision Approval Date: October 27, 2006
Project Expiration Date: October 26, 2007

Title: QUANTIFYING HUNTER-INDUCED SELECTION ON WHITE-TAILED DEER.

The Institutional Review Board has completed their review of your project. I am pleased to advise you that the revision has been approved.

Revision to include changes to the the postcard and research methodology.

The review by the committee has found that your revision is consistent with the continued protection of the rights and welfare of human subjects, and meets the requirements of MSU's Federal Wide Assurance and the Federal Guidelines (45 CFR 46 and 21 CFR Part 50). The protection of human subjects in research is a partnership between the IRB and the investigators. We look forward to working with you as we both fulfill our responsibilities.

Renewals: IRB approval is valid until the expiration date listed above. If you are continuing your project, you must submit an *Application for Renewal* application at least one month before expiration. If the project is completed, please submit an *Application for Permanent Closure*.

Revisions: The IRB must review any changes in the project, prior to initiation of the change. Please submit an *Application for Revision* to have your changes reviewed. If changes are made at the time of renewal, please include an *Application for Revision* with the renewal application.

Problems: If issues should arise during the conduct of the research, such as unanticipated problems, adverse events, or any problem that may increase the risk to the human subjects, notify the IRB office promptly. Forms are available to report these issues.

Please use the IRB number listed above on any forms submitted which relate to this project, or on any correspondence with the IRB office.

Good luck in your research. If we can be of further assistance, please contact us at 517-355-2180 or via email at IRB@msu.edu. Thank you for your cooperation.

Sincerely,



Peter Vasilenko, Ph.D.
SIRB Chair



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INSTITUTIONAL
AFFAIRS
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Programs

AND HEALTH
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BOARD (BIRB)

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2 Olds Hall
East Lansing, Michigan
48824-1046
517-355-2180
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MICHIGAN STATE UNIVERSITY

Revision Application Approval

December 6, 2006

To: Andrew McAdam
Department of Fisheries and Wildlife
Michigan State University
East Lansing, MI 48824

Re: IRB # 05-1028 Category: EXPEDITED 2-7
Revision Approval Date: December 6, 2006
Project Expiration Date: January 16, 2007

Title: QUANTIFYING HUNTER-INDUCED SELECTION ON WHITE-TAILED DEER.

The Institutional Review Board has completed their review of your project. I am pleased to advise you that the revision has been approved.

Approved revision to reflect a change in the subject cover letter.

The review by the committee has found that your revision is consistent with the continued protection of the rights and welfare of human subjects, and meets the requirements of MSU's Federal Wide Assurance and the Federal Guidelines (45 CFR 46 and 21 CFR Part 50). The protection of human subjects in research is a partnership between the IRB and the investigators. We look forward to working with you as we both fulfill our responsibilities.

Renewals: IRB approval is valid until the expiration date listed above. If you are continuing your project, you must submit an *Application for Renewal* application at least one month before expiration. If the project is completed, please submit an *Application for Permanent Closure*.

Revisions: The IRB must review any changes in the project, prior to initiation of the change. Please submit an *Application for Revision* to have your changes reviewed. If changes are made at the time of renewal, please include an *Application for Revision* with the renewal application.

Problems: If issues should arise during the conduct of the research, such as unanticipated problems, adverse events, or any problem that may increase the risk to the human subjects, notify the IRB office promptly. Forms are available to report these issues.

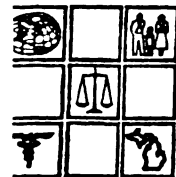
Please use the IRB number listed above on any forms submitted which relate to this project, or on any correspondence with the IRB office.

Good luck in your research. If we can be of further assistance, please contact us at 517-355-2180 or via email at IRB@msu.edu. Thank you for your cooperation.

Sincerely,



Peter Vasilenko, Ph.D.
SIRB Chair



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**MICHIGAN STATE
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**Revision
Application
Approval**

December 18, 2006

To: Andrew McAdam
Department of Fisheries and Wildlife
Michigan State University
East Lansing, MI 48824

Re: **IRB # 05-1028** Category: EXPEDITED 2-7
Revision Approval Date: **December 18, 2006**
Project Expiration Date: **December 17, 2007**

Title: **QUANTIFYING HUNTER-INDUCED SELECTION ON WHITE-TAILED DEER.**

The Institutional Review Board has completed their review of your project. I am pleased to advise you that the revision has been approved.

Approved revision to include a change in non-response letter and the reminder post card being sent out as follow up to the respected participants.

The review by the committee has found that your revision is consistent with the continued protection of the rights and welfare of human subjects, and meets the requirements of MSU's Federal Wide Assurance and the Federal Guidelines (45 CFR 46 and 21 CFR Part 50). The protection of human subjects in research is a partnership between the IRB and the investigators. We look forward to working with you as we both fulfill our responsibilities.

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Sincerely,



Peter Vasilenko, Ph.D.
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