EXPLORING THE HUMAN DIMENSION OF THUNDER BAY MOOSE HUNTERS WITH FOCUS ON CHOICE BEHAVIOUR AND ENVIRONMENTAL PREFERENCES

by

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A Graduate Thesis Submitted in partial
fulfillment of the requirements for the degree of
Master of Science in Forestry

Faculty of Forestry and the Forest Environment
Lakehead University
December, 1999

0-612-52042-0

ABSTRACT

Bottan, B.J. 1999. Exploring the human dimension of Thunder Bay moose hunters with focus on choice behaviour and environmental preferences. 149pp. Advisor: Dr. W. Haider

Key Words: attitudes, discrete choice experiment, environmental and social attributes, herbicides, hunter safety apprenticeship program, moose hunters, preferences, hunter registration, site selection, survey, resource based tourism

This study examined hunters' attitudes, preferences, and support for a variety of hunting and resource management issues. The survey also included the first application of a discrete choice experiment (DCE) to hunters in Ontario, to explore how changes in environmental and social attributes influence hunter site selection.

The data used in this study were obtained from a mail survey of 1000 randomly selected moose hunters residing within the District of Thunder Bay. Research objectives related directly or indirectly to Ontario's Living Legacy program (1999), Term and Condition 80 of the Reasons for Decision and Decision - Class Environmental Assessment by the Ministry of Natural Resources for Timber Management on Crown Lands in Ontario (Ontario Ministry of the Environment 1994), the Crown Forest Sustainability Act (1995), specific moose hunting regulations, and biological issues in moose management.

Survey results indicated that respondents support all three modes of harvest registration proposed, especially registration by phone or by postcard. Most respondents support the Hunter Safety Apprenticeship Program, however, program objectives should be reviewed frequently in order to identify and address potential problems or shortcomings, if any, that might disrupt the program's true intentions. Moose hunters' concerns, and in some cases misconceptions, prove that so far forest managers have failed to educate moose hunters adequately about the use of herbicides in forest management. Respondents also reported little tolerance for improper hunter behaviour afield. Management-related issues such as insufficient conservation officers afield, the Selective Harvest System, and a variety of forestry-related impacts all impose some negative effect on one's hunting experience. Respondents overwhelmingly support the right to access and hunt all of Ontario's Crown Lands, whereas restrictions such as gating to prevent access into tourism areas were not supported. Respondents were evenly split on issues pertaining to road maintenance and restricting hunting on Crown Lands but not closing roads to the public. With regards to moose tag allocation and hunting opportunities, most respondents strongly believe that tourist outfitters 1) receive too many adult tags, 2) should only be allocated tags in WMU's where a surplus exists, and 3) should only provide moose hunting opportunities at remote (fly-in) destinations. The DCE yields negative utilities for increased distance from home to the hunting area, frequency of encounters with other hunters, height of tree regeneration and predominantly conifer regeneration cutovers. In contrast, increases in moose populations, the presence of lakes, and access, to a lesser extent, yield positive utilities.

Study results provide a variety of data which are useful in investigating the tradeoffs of possible wildlife management initiatives (enforcement, access restrictions, hunting opportunities and regulation changes), forest-use decisions (timber harvests), and other policy objectives (Ontario's Living Legacy Land Use Planning Strategy) which would particularly affect recreational moose hunters.

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ACKNOWLEDGEMENTS

The author wishes to acknowledge the assistance of the following people without whose help this project would not have been possible: my supervisor, Dr. Wolfgang Haider and committee members Dr. Art Rodgers and Dr. Peter Duinker. As well, I would like to thank Dr. Peter Boxall, for his comments and criticisms as my external examiner.

Special thanks go out to Len Hunt from the Ontario Ministry of Natural Resources, who as my surrogate advisor so to speak helped immensely with this project, my learning and growth as a person. Thank you Len for all that you have done, I am truly grateful.

I would like to thank the entire staff at the Centre for Northern Forest Ecosystem Research for their help and kind words of support. Special thanks to John McNicol, Dan Duckert, Nikki Wood, Rob Mackereth, Ed Iwachewski and Rob Rempel, who at one time or another helped during the development of this project and whose advice was greatly appreciated.

I would like to thank Don Anderson of StatDesign (Evergreen, CO) who made time in this busy schedule to provide advice and answer questions during the design of the survey.

To all my fellow grad students (Colin, Darren, Kevin, Pete, Cynthia, Paul, Sarah, Margaret, John, Anna, Sandra, Angus, Bernice, Shibi, Jackie, Ken, Laura) who supported and encouraged me throughout my two years at Lakehead, I extend my thanks to each and every one of you.

I would like to thank Dr. Dave Euler, who was instrumental in my learning and understanding of past, present and future aspects of moose management.

I would also like to thank my family, Marilyn, Ed, Donna and David, whose love, support and understanding over the last two years have kept me going. To my grandparents, Joseph, Elizabeth and Mary, who supported me with love, encouragement and helped with my tuition. Thank you everyone.

Additional thanks go out to Andrew Kolisnyk and George Pankuch for their friendship and support. To Cathy Chapin of the Geography Map Library whose guidance and friendly smile helped me complete a thesis map. To Mr. and Mrs. Jones for all their encouragement and support throughout the years, thanks kids.

Last, but by no means least, I wish to thank all the hunters who participated in the project and during focus group discussions.

Chapter 1

Introduction

In Ontario, the annual moose (*Alces alces*) hunt provides thousands of Ontario residents with the opportunity to participate in a popular outdoor recreation activity. In fact, the popularity of moose hunting has increased steadily from approximately 80 000 hunters in 1980 to over 100 000 hunters in 1998 (Bisset 1991, OMNR 1999a). As well, the increase in hunter numbers has virtually mirrored the increase in Ontario's moose population over the same time period.

Since Ontario's provincial moose population fell to an all-time low in 1978 (est. 60 000 moose province-wide), moose numbers have been on the rise. The provincial moose population was estimated as high as 120 000 but is likely around 105 000 (Bisset 1991). Moreover, it is estimated that Ontario's Northwest Region contains almost 60% of the provincial moose population (Whitlaw et al. 1993), likely contributing to the popularity of moose hunting in the region. In 1998, the Ontario Ministry of Natural Resources (OMNR) received over $3 million from sales of moose licenses (OMNR 1999a), while the economic impact of the hunt to Ontario's Northwest Region is estimated at $25 to $30 million annually (Whitlaw et al. 1993). Given the economic importance and popularity of the moose hunt, it appears important to conduct research on one of Northern Ontario's most popular outdoor recreation activities.

1.1 The Situation

Moose hunting is an important recreational activity in Northern Ontario, and is likely to continue to be so in the future. However, a wildlife manager's ability to understand, identify, and, most of all, serve the moose hunting community will require a far better assessment of the relationship between hunters and the natural environment (Kellert and Brown 1985). Therefore, to accomplish such an undertaking, wildlife managers will need to explore hunters' attitudes, opinions, preferences and behaviour in greater detail. This type of research is known as human dimensions research.

Several wildlife professionals (Cumming 1974, Ritcey 1974, Crichton 1988, Timmermann 1987, 1992) have stressed the need for attitude and public preference surveys when formulating and reviewing management objectives; however, to date only a limited number of such studies have been conducted in Ontario[1]. Research of hunters' attitudes towards and preference for management strategies and policy statements prior to their implementation would help managers to identify and formulate strategies for moose management, while at the same time it also recognizes the concerns of the hunters who must abide by them. Moose management that incorporates hunters' attitudes in the planning process will strive to place a moral responsibility on hunters, and consequently the hunter and the wildlife manager will share the responsibility of moose management.

1.2 Research Objectives

Ontario is currently undertaking a fundamental reorganization of its land-use strategy, which will influence future directions of all resource management issues on Crown Land in the province. This immense endeavour requires a pooling of existing information as well as a need for new research into various issues of concern to

[1] According to Ontario's Moose Management Policy (OMNR 1980a), public participation is to occur in the planning and management of moose.

managers and the public. In anticipation of such a need, this study constitutes human dimensions research into various management issues, land-use decisions and specific management concerns for moose, from the perspective of the hunter. In this study, research objectives relate directly or indirectly to Ontario's Living Legacy (OMNR, 1999c), Term and Condition 80 of the Reasons for Decision and Decision - Class Environmental Assessment by the Ministry of Natural Resources for Timber Management on Crown Lands in Ontario (Ontario Ministry of the Environment 1994), the Crown Forest Sustainability Act (1995), moose hunting regulations, and biological issues in moose management. Specific research objectives are individually discussed in detail below.

If moose hunting is to remain a legitimate and credible activity in Ontario, hunters must conduct their hunts in a manner that is acceptable to a majority of Ontario's society (Lee 1998). Poor hunter behaviour may not only negatively affect the hunting experience of other hunters, but it also casts a dark cloud over the entire hunting community. As well, wildlife and forest management actions may negatively affect a hunting experience. Thus, hunters were asked to comment on the potential negative effects on one's hunting experience from various hunter and management-related impacts. Exploring potential impacts will provide insight into the issues to which hunters are most sensitive. As well, such research provides managers with direction as to which issues need greater enforcement, evaluation and education.

OMNR introduced the Hunter Safety Apprenticeship Program (HSAP) in the fall of 1998. The HSAP was designed to introduce prospective hunters (12 to 14 years old) to hunting by learning from an experienced mentor. The announcement received mixed reviews. Therefore, if the HSAP is to be successful it needs to be frequently reassessed. In this study moose hunters were questioned about their support for the HSAP. This first review of the HSAP is likely one of many if the program is to improve and prosper. In future studies, the opinions of other interest groups should also be surveyed.

Public concern over herbicide use in forest management has been well documented. However, such documentation has only reflected the comments and concerns of the public at large, while user groups like moose hunters have not been asked for their specific input. Since moose are frequently hunted in cutovers, some of which are treated with herbicides, moose hunters were asked if they would continue to hunt in cutovers if they had recently been sprayed with herbicides. Collecting such information is invaluable to understanding hunters' perceptions of herbicide use.

Moose harvest registration in Ontario has always been strictly voluntary, yet since the early 1990's OMNR has de-emphasized the jaw/hide program which provided valuable harvest data to wildlife managers. Previous work by Hansen (1995) gauged hunters' support for collecting mandatory harvest reports, however, specific modes of registration were not evaluated. This study builds on the aforementioned work by questioning hunters about their support for three modes of harvest registration: phone, postcard, or submission of the lower jaw of harvested moose to an OMNR drop box. Such information is useful when attempting to monitor changes in age or sex structure of harvested moose. As well, timely and accurate harvest data is a necessity when calculating the annual number of adult validation tags to issue for the hunt.

Forest access roads continue to affect remote and semi-remote areas in which tourism establishments conduct their business. Forest roads constructed during timber harvesting operations provide hunters with access into previously inaccessible areas. Such access has caused tourist operators to express serious concern that further encroachment will only lower the remote or semi-remote experience paid for by their clientele. Therefore, this study attempts to address several issues surrounding access roads such as gating, use restrictions, road closures, and road maintenance. In addition to access, adult moose tag allocation and basic misconceptions are also addressed since they are relevant issues for moose hunters and tourist outfitters. The information provided by this study will be a valuable asset to both forest managers and moose managers.

To the best of my knowledge, to date no studies to date have been conducted in Ontario concerning moose hunters' preferences for environmental settings. In this study, moose hunters' environmental preferences were considered in two ways. First, a section of the survey asked respondents about their behaviour in the course of a season. This being the first behavioural study in Ontario to document moose hunters' actual preferences for environmental settings should provide resource managers with valuable baseline data on where, when, why and how moose hunters hunt for moose. Second, another section of the survey asked respondents to choose the most preferred hunting situation from a range of hypothetical hunting scenarios. The second type of experiment is known as a discrete choice experiment and provides a means to model tradeoffs explicitly. Respondents are asked to evaluate several environmental and social factors[2], such that the salient attributes within a hunters' preferred environmental setting could be modeled. Increasing our knowledge of what hunters define as a quality hunting environment will assist in identifying highly demanded environments and to develop management strategies for alleviating problems such as crowding, local over-harvesting

[2] Environmental and social attributes were distance from home to hunting area, moose populations, varying levels of crowding and access, presence of lakes, and forestry-related impacts.

of moose, and inter-hunter conflicts, which are typically associated with these areas[3]. In addition, when considering implementation of access restrictions, new regulations, enhanced hunting opportunities or improved enforcement efforts, information on hunter preferences would also be valuable to the resource manager.

1.3 Study Presentation

The remainder of this thesis is organized in the following way. Chapter 2 includes a discussion of the relevant literature pertaining to the human dimension of moose hunting and also relates key references to the management issues outlined above. Chapter 3 provides the theoretical background to research on choice behaviour, detailed information about the discrete choice experiment (DCE), and a discussion pertaining to the development of the choice model as well as how to assess model performance. Development of the DCE attributes and levels, the fractional factorial design, coding of the DCE, data collection and survey design are discussed in Chapter 4. Chapter 5 presents the survey results, including estimation of the choice model, and discusses the results in the context of moose and forest management. Finally, Chapter 6 contains a brief summary of results, outlines future areas of research and presents some concluding remarks.

[3] According to Lyons (1987, 289), when possible, the relationships between participation, experience quality, and those site characteristics that can be managed, such as crowding, hunter success, and access, should be quantified and used to guide management decisions.

Chapter 2

Human Dimensions Research in Wildlife Management - Concepts and Literature Review

To manage the moose resource effectively in the context of ecosystem management, wildlife managers need to obtain a detailed understanding of their clients' expectations from the resource. As well, understanding clients' attitudes and perceptions towards various management strategies and regulations should improve a wildlife manager's ability to manage the moose resource effectively and efficiently. One way of generating such information for resource management and policy decision-making is through human dimensions research. Human dimensions research is a unique area of investigation, which attempts to describe, predict, understand, and affect human thought and action (Manfredo et al. 1996). The usefulness of human dimensions research is not limited to wildlife management but is applicable to other areas of resource management such as forest management and fisheries management. Information acquired through public surveys can be applied to policy and management decision-making processes, hopefully increasing support and effectiveness of agency programs.

This literature review will shed some light on the history, theories and approaches that provide the foundation for the project. Introduction of the relevant theories and concepts will be followed by descriptions and examples of each. This chapter is divided into the following subsections: the human dimension of wildlife management, basic human dimensions information, traditional methods of human dimensions research, and preference research with emphasis on discrete choice experiments.

2.1 Human Dimension Of Wildlife Management

Human dimensions research began as a sub-discipline of wildlife management during the 1960's and its use and popularity have increased steadily since that time (Manfredo 1989). Manfredo et al. (1996, 54) defined human dimensions as "an area of investigation which attempts to describe, predict, understand, and affect human thought and action toward natural environments." Decker and Chase (1997, 788) described 'human dimensions of wildlife management' as identifying what people think and do regarding wildlife, understanding why, and incorporating that insight into policy and management decision-making processes and programs.

US agencies have recognized that wildlife management from a strictly biological point of view is no longer valid or socially acceptable (Heberlein 1991). In fact, Perry Olson, Director of Colorado's Division of Wildlife was quoted as saying "managing wildlife is 10 percent biology and 90 percent managing people" (Manfredo et al. 1996, 53). As early as 1979, Teague (1979, 59) noted that "Most wildlife management problems start out as biological problems but eventually become people problems.... Because we are dealing with a social science problem, we should use concepts and procedures that have been developed in the social sciences." Several studies have advocated the use of human dimensions research to allow wildlife managers and management agencies to identify, segment, understand, question and focus on the clientele they serve (Hendee and Potter 1971, Dahlgren et al. 1977, More 1984, Lyons 1987, O'Leary et al. 1987, Crichton 1988, Manfredo 1989, Peyton 1989, Heberlein 1991, Duda 1992, Gigliotti and Decker 1992, Donnelly and Vaske 1995, Decker and Chase 1997, Lauber and Knuth 1997, Sarker and Surry, 1998). In addition, an agency can increase its efficiency and effectiveness by incorporating human dimensions research into management strategies, especially at a time of shrinking budgets and increased political accountability (Duda et al. 1989). However, despite the long history of human dimensions research within the United States, resource management agencies in the province of Ontario as well as the rest of Canada have so far made relatively little, if any, use of such research.

2.2 Basic Human Dimensions Information

Basic data about human dimensions is often readily available, such as information associated with license sales. License sales and applications typically contain information about hunters. For example, in Ontario one can obtain information on the number of hunter applications, the WMUs applied for, and preferences for the type of adult tag. Obviously, there are limitations to analyses based on this type of data. To manage a moose resource effectively, wildlife managers need to know much more detail about their clientele. Such detail can be obtained by applying social science concepts and frameworks based in social psychology and other social sciences. The following section will present some of the most common concepts of human dimensions research.

2.3 Traditional Methods of Human Dimensions Research

2.3.1 Satisfaction

One of the traditional arenas of human dimensions research is the study of hunter satisfaction. The focus on hunter satisfaction evolved around the "game-bagged" and "days-afield" approaches to game management. According to these approaches, wildlife managers' primary duty was to supply hunters with a large game population, and plenty of hunter-days afield (Potter et al. 1973). Later, the "multiple-satisfaction" approach to game management combined and extended the previous two approaches in order to explore a wider range of satisfactions, providing the quality experience sought by hunters (Potter et al. 1973, Hendee 1974, Decker et al. 1980).

In traditional wildlife management, multiple-satisfaction research played an important role as managers were far more concerned about hunters' satisfaction with current management practices and strategies. For example, since 1983, when the Selective Harvest System (SHS) for moose was implemented in Ontario, several studies researched hunters' satisfaction (Borovsky 1985, Rollins 1987, Romano 1988, Rollins and Romano 1989, Wedeles et al. 1989, Hansen et al. 1995) in an attempt to identify which aspects of the system were perceived as most unfavourable by hunters. The results of such studies have led to direct changes in the SHS (e.g. the introduction of group applications for adult tags) as well as indirect changes, such as the introduction of party hunting, to increase hunter satisfaction.

2.3.2 Reasons and Motivations for Hunting

Soon after the "multiple-satisfaction" approach to game management was introduced, human dimensions research probed beyond defining a satisfying hunt, by exploring *reasons* and *motivations* for hunting. The concepts of satisfaction and motivation are closely linked as "satisfactions sought from hunting also can be regarded as reasons or motivations for participating" (Decker and Connelly 1989, 456).

In a study of Northern Ontario moose hunters, Rollins (1987) asked hunters to rate 12 reasons for hunting moose. By calculating the mean response value for each of the 12 reasons, "nature appreciation", "companionship", "stress release" and to "practice outdoor skills" were identified as the most important reasons. Similar results were found in Hansen's (1995) province-wide study of Ontario moose hunters as well as by hunting studies in other jurisdictions (More 1973, Potter et al. 1973, Stankey et al. 1973, Brown et al. 1977, Gilbert 1977, and Hautaluoma and Brown 1979).

Based on the results of in-depth personal interviews of hunters and an extensive literature review, Decker et al. (1987, 80-81) concluded "that the majority of specific reasons or motivations (but not all) for recreational hunting can be combined into three broad categories: affiliative, achievement, and appreciative", which are defined as follows:

1) Affiliative: to enjoy the company of others and reaffirm the personal relationship.

2) Achievement: becoming involved in an activity for the primary reason of meeting some standard of performance (e.g. trophy, food).

3) Appreciative: the primary goal of this group is stress reduction, through participation in an activity that provides them with a sense of peace and belonging.

To test the three motivational orientations described above, Decker and Connelly (1989) sampled 1000 deer hunters in the State of New York. Items reflecting various aspects of the deer-hunting experience were rated on a 9-point Likert-type scale. Through factor analysis, four factors emerged as indicators of hunting motivations. Three factors corresponded well to the three motivational orientations above and a fourth factor (outgroup contact) related to contact with other hunters beside members of one's own group.

2.3.3 Specialization

Shortly after reasons and motivations for hunting were explored, researchers began to develop theories of hunter specialization. It was proposed that as hunters increased in age and hunting experience, their motives or reasons for hunting would progress through a series of stages, from novice to expert. The theory of specialization originated from studies on recreational fishing (Bryan 1977, 1979), but in order to test the theory's validity it was also applied to other forms of recreation including hunting (Ditton et al. 1992).

Jackson and Norton (1979) documented relatively strong evidence for a developmental sequence for Wisconsin waterfowl hunters. Their study stands out due to its rigourous planning and execution. The following is a description of the five stages proposed by Jackson and Norton (1979, 316):

1) Shooter stage: the beginning hunter apparently needs to pull the trigger and test out the capability of the weapon. The type of target is not important.

2) Limiting-out stage: bagging game becomes the primary concern and the hunter measures success by the numbers of birds or animals shot.

3) Trophy stage: the hunter wants to shoot a bird or animal that has definite status.

4) Method stage: the hunter usually has all of the specialized equipment associated with the sport. Hunting has become one of the most important dimensions of the hunter's life.

5) Mellowing out stage: the hunter finds satisfaction in the total hunting experience. A breadth of satisfaction is available, drawn from contact with nature and treasured surroundings. Bagging game seems more symbolic than essential to the hunting process.

Jackson and Norton (1979) also identified a relationship between these stages and differences in the level of satisfaction, where more-experienced hunters were less harvest-oriented and those with less experience rated the kill and trophy as major contributing factors to overall satisfaction.

2.4 Preference Research and Choice Studies

Research on satisfaction, motivations and reasons for hunting all seem to produce the same overall results and follow similar techniques - items rated on Likert-type scales, analyzed by cluster, factor analysis or simple descriptive statistics, and discussion of the dimensions found. As previously mentioned, hunter behaviour is an important part of this project and is frequently studied in the field of human dimensions research. In this project, hunter behaviour was studied using two types of preferences commonly used as a measure of behaviour, i.e. revealed preferences and stated preferences. In simple terms, revealed preference research is based on actual behaviour, in which an individuals' behaviour is observed or they report on their behaviour ex post facto. In contrast, stated preference research focuses on intended or hypothetical behaviour (what one might do). The following sections provide examples of each type of discrete choice technique used to study the aforementioned preferences.

2.4.1 Revealed Preferences

Since revealed preference research is based on actual behaviour, data are often collected by physically observing hunters' behaviour afield, or by mail, or telephone surveys, or using trip logs. Observational data are usually considered the most reliable, but in the context of resource management are typically costly and time-consuming to obtain.

To date, the only systematic attempt to determine the economic value of recreational moose hunting in Ontario was a study by Sarker and Surry (1998). They estimated the demand for moose hunting trips in Ontario by using the travel cost method. According to Sarker and Surry (1998, 29), "demand for recreational moose hunting declines with higher travel cost and lower income and the demand is both price and income inelastic". They also point out that an important area for future unpriced valuation research would be to study the effects of timber management practices and assoicated changes to the natural environment on moose hunting (Sarker and Surry 1998). According to them, such research would allow for management practices to be redesigned to ensure the flow of maximum overall benefits from forest resources.

Coyne and Adamowicz (1992) used revealed preference data based on a mail survey to develop a multinomial-logit discrete choice model (DCM) of Alberta sheep hunters. The DCM was used to predict the change in probability of site selection for a given environmental or social quality change or site closure. Coyne and Adamowicz (1992) used the following variables in their DCM; travel cost, total sheep population, ram population, legal ram population, and hunter congestion. Results suggested that a hunting site would be more attractive to sheep hunters if sheep populations were increased, crowding were reduced, and the site were inexpensive to reach (Coyne and Adamowicz 1992).

McLeod (1995), in a similar study of Alberta moose hunters, used a multinomial-logit discrete choice model (DCM) to predict site choice and associated changes in welfare estimates based on possible management policies. More restrictive access, increased congestion and increased distance from home yielded negative utilities, whereas increased moose populations yielded a positive utility. McLeod (1995) noted the benefits to management from such research as enabling the policy-maker to assess land-use decisions based on how the users perceive the quality of the area, as well as providing another dimension of user preferences for use in decision-making.

Wildlife managers are often faced with the task of evaluating management decisions that influence wildlife habitat, access situations and wildlife populations. These management decisions, in turn, may affect the attributes of a hunting site, and thus, affect the likelihood of a hunter choosing to hunt there. Therefore, according to Coyne and Adamowicz (1992), DCM's can be used to monitor the changes in hunting participation at various sites in response to site attributes and policy changes.

2.4.2 Stated Preferences

There are two fundamentally different approaches to studying stated preferences - compositional and decompositional methods (see theoretical discussion in Chapter 3). In the absence of any compositional applications to hunting, this section deals with decompositional examples only, and the discrete choice experiment (DCE)[4] in particular.

Most recent literature illustrates the use of DCE's to assess the economic value associated with changes in site attributes, amounting to a form of non-market valuation (Morton 1993, Condon and Adamowicz 1995, Morton et al. 1995, Boxall et al. 1996, Adamowicz et al. 1997 and Bullock et al. 1998). Although my study does not adopt an economic perspective, two valuation-type hunting studies will be discussed as they constitute hunting studies applying the choice experiment method.

In a study of Saskatchewan moose hunters, Morton (1993) used a binary choice experiment to determine how the value of a recreational hunting experience changed in association with changes in one or several site attributes of the forest environment. Results were as expected; improved access and increased moose populations increased

[4] DCE's have evolved from decompositional multiattribute preference models and will be discussed in detail in Chapter 3.

the probability of a hunter choosing a particular site, whereas increased cost and congestion lowered the choice probability.

Bullock et al. (1998) used a discrete choice experiment to quantify the characteristics of deer hunting and landscape changes in the Scottish Highlands. Welfare estimates for different stalking packages were also estimated using attribute levels that resemble the alternative packages offered by estates (Bullock et al. 1998). They determined that landscape characteristics (high open mountain scenery with and abundance of mature stags) contribute significantly to the overall utility of the participant. As well, welfare estimates were higher for mixed open/forest stalking packages compared to open hill stalking packages.

Chapter 3

Multiattribute Preference Research

Toward the end of Chapter 2, several moose hunting studies were presented that applied multiattribute preference research techniques. This study applies one particular multiattribute preference research technique, the DCE. To understand DCE, it is useful to obtain a basic understanding of related techniques and also to explain the fundamental theories and concepts upon which the technique is based.

3.1 Revealed Preference and Choice Research

According to Timmermans and Golledge (1990), discrete choice models (DCM) are derived from Luce's strict utility theory and Thurstone's random utility theory (RUM). Random utility theory suggests that an individual's utility for a choice alternative is assumed to consist of a deterministic component and a random utility component (Timmermans and Golledge 1990, 313).

Luce's (1959) strict utility theory assumes "that the probability of choosing some alternative is equal to the ratio of the utility associated with that alternative to the sum of the utilities for all the alternatives in the choice set" (Timmermans and Golledge 1990 313). Luce's theory also assumes that respondents are deterministic in their choices and that model derivation uses a constant-ratio decision rule.

To model this type of revealed choice behaviour, the researcher must be able to observe the actual behaviour (e.g. the selection of a hunting environment, this is the dependent variable), and also collect information on the salient attributes of the hunting environment (independent variables) in which a hunter has chosen to hunt. Data on the dependent variable may be collected by direct observation or through survey methods. Since DCM's are based on revealed preferences (actual behaviour), comparisons can be made between groups hunting in different areas based on the attributes that define their hunting environments. Because it is impossible for a hunter to be in two places at once, it is assumed that actual behaviour "reveals" by default the highest preference for the bundle of attributes actually chosen. In other words, the hunter chooses the hunting environment that yields the highest perceived utility or satisfaction. The analysis is usually conducted with a weighted least-squares regression, or a conditional logit analysis with maximum likelihood estimation.

3.2 Stated Preference and Choice Research

An alternative to modeling preferences through revealed choices is to employ stated choices. Stated preferences and choices are based on statements of behavioural intentions, which can be modelled using either compositional or decompositional multiattribute preference modelling techniques. Both techniques are based on Thurstone's random utility model, but differ fundamentally in the way respondents evaluate attributes. The most common methods of either of the two approaches are discussed below, with special emphasis on discrete choice experiments since it is used in this study.

3.2.1 Compositional Multiattribute Preference Models

The best known example of compositional multiattribute preference models (CMPM) is the Theory of Reasoned Action proposed by Ajzen and Fishbein (1980). The Theory of Reasoned Action is a general theory of human behaviour that deals with the relationships among beliefs, attitudes, intentions and behaviour (Ajzen and Fishbein 1980). The theory has been used to predict and explain why people have (or have not) engaged in a particular behaviour (Fishbein and Manfredo 1992). "Fishbein and Ajzen (1975) contend that behaviour depends, in part, on one's attitudes, which are defined as positive or negative evaluations of a behaviour and of the object of behaviour. One's attitudes are in turn derived from beliefs about the nature of the object and the consequences of the action. Behaviour and attitudes thus ultimately derive from beliefs" (Donnelly and Vaske 1995, 308).

In compositional multiattribute preference models (CMPM), respondents rank or rate the various attributes of a good or service separately. Next, the researcher builds a model by composing (by summation or multiplication) all the relative values or part-worth utilities derived from the rankings/ratings of the individual attributes. "Thus, a compositional approach is an approach in which the overall utility for a multiattribute choice alternative is obtained as some function of the alternatives' 'perceived' attribute levels as separately and explicitly evaluated by an individual" (Timmermans 1984, 190).

3.2.2 Decompositional Multiattribute Preference Models

In contrast to CMPM's, decompositional multiattribute preference models (DMPM) derive part-worth utilities for each attribute level by decomposing an overall utility measure into scale values for the attribute levels. According to Timmermans (1984), this measurement is known as the 'conjoint measurement'.

The primary difference between the two modeling techniques is the method used by respondents to evaluate attributes. As previously mentioned, CMPM's ask respondents to rate or rank attributes individually, whereas DMPM's require respondents to rate or rank a profile of a good or service in its entirety. This method of evaluating a bundle of attributes is also referred to as the full-concept method and "is considered more realistic because all factors are considered at the same time" (Norusis 1994, 5). However, neither of these models are actual choice models since they do not include an explicit decision rule (Timmermans and Golledge 1990).

3.2.3 Discrete Choice Experiments (DCE)

Discrete choice experiments (DCE) combine two or more of the multiattribute profiles described above, and then require respondents to choose the most preferred alternative. In other words, respondents are forced to make explicit trade-offs between multiattribute profile alternatives. Such a choice procedure is considered more realistic, because it emulates closely the choice behaviour a respondent encounters in real life. For example, hunting is an indivisible good that requires individuals to choose among alternative sites, each having different attributes. The site chosen reflects the salient attributes of a hunters' preferred environment. Other advantages of such an experimental approach are that the problem of multicollinearity encountered when attempting to collect empirical data is avoided, and non-existing alternatives can also be evaluated (Hensher et al. 1999).

DCE's follow the tradition of DMPM's since they rely on some type of experimental design to generate hypothetical scenarios (or profiles). The details of selecting and operationalizing specific experimental designs will be discussed in the next chapter. By basing the response task on actual choice, DCE's are also compatible with the RUM, as respondents are asked simply to choose among the various hypothetical alternatives.

3.3 Model Development

Because respondents choose among alternatives, the RUM (McFadden 1974) is an appropriate analytical approach. "The RUM is particularly appealing because it is consistent with notions of utility as a function of environmental attributes, the ability to substitute between a defined set of hunting sites, and its ability to model complex behavioural processes" (Boxall et al. 1995, 4). The following section provides a more formal discussion of the RUM.

Consider a set of all alternative hunting sites, denoted by C. Goods such as a hunting trip are mutually exclusive, because one cannot visit two hunting sites simultaneously. The individual hunter will choose only one site per trip from a set of alternative sites. The various exogenous constraints that individual n faces, such as awareness or availability of all sites included in C, reduces the set of alternatives to C_n, where $C_n \varepsilon C$. The utility (u) of site i being chosen by individual n is represented as[5]:

$$U_{in},\ i \ \varepsilon\ C_n \qquad (1)$$

where alternative i is chosen by individual n if

$$U_{in} > U_{jn}, \qquad \forall\, j \neq i,\ j \varepsilon C_n \qquad (2)$$

which expresses the fact that the perceived utility of alternative i is greater than the perceived utility of alternative j.

[5] This section closely follows descriptions in Morton (1993, 18).

Next, the utility (U) associated with alternative i can be separated into a deterministic and a stochastic component:

$$U_i = V_i + \varepsilon_i \tag{3}$$

where V_i is the deterministic component, as measured by the various variables in the model, and ε_i is a stochastic component. Selection of one alternative over another implies that the deterministic utility of that site (V_i) is greater than the deterministic utility of another (V_j). Based on these premises, one can analyze the aggregate probability of choice of one alternative (Pr(i)) over another, under the premise that

$$Pr\,(i) = Pr\,\{V_i + \varepsilon_i \; > \; V_j + \varepsilon_j; \quad \forall j \varepsilon C_n\} \tag{4}$$

where C_n is the choice set of individual n. Assuming a Type I extreme value error distribution with scale parameter μ, equation 4 leads to the multinomial logit (MNL) model for predicting aggregate choice probabilities (McFadden 1974):

$$Pr\,(i) = \frac{e^{\mu Vi}}{\sum_{j \varepsilon C_n} e^{\mu Vj}} \tag{5}$$

Equation 5, in simple terms, means that the probability of selecting alternative i equals the utility of alternative i divided by the sum of the deterministic utility of all other alternatives. In addition to assuming a distribution for the error terms, they are also assumed to be independent and identically distributed (McLeod 1995, 24).

The most important assumption of the MNL model is independence from irrelevant alternatives (IIA), which means that the ratios of the probabilities of choosing either site i or site j does not depend at all on the existence and characteristics of site a, b and so forth. According to Stynes and Peterson (1984, 303), the IIA property implies that the ratio of the probability of choice for any two alternatives is independent of any other alternatives.

3.4 Model Performance

There are numerous ways to test model performance such as: 1) inspect the parameters for having the expected signs, 2) perform various likelihood ratio tests, 3) perform goodness-of-fit measures, and 4) test the IIA assumption described above in the case of the multinomial logit model.

The first and easiest method to assess model performance is to ensure that parameter estimates have the expected signs (Ben-Akiva and Lerman 1985). Next, there are specific procedures, which can be used to assess model performance such as likelihood ratio tests and goodness-of-fit measures.

According to Ben-Akiva and Lerman (1985, 164), the likelihood ratio test (G^2) is similar to the F-Test in multiple regression, a joint test of the goodness-of-fit of several parameters. In the likelihood ratio test, the hypothesis that all the parameters are simultaneously equal to zero is tested. This statistic is asymptotically chi-squared distributed with degrees of freedom equal to the number of free parameters in the model (Intelligent Marketing Systems Inc. 1993, 6-11)[6]. Therefore, if the value of the likelihood ratio test statistic is greater than the chi-square value, the null hypothesis can be rejected.

[6] See Appendix III for the equation used to calculate the likelihood ratio test statistic.

However, according to Haider (1991, 96), "textbooks indicate that such high levels of significance are very common for this test, which limits its usefulness".

Therefore, a third measure of model performance may be used, the goodness-of-fit measure. Analogous to R^2 in multiple regression, a pseudo-R^2 (rho-square or ρ^2) has been developed for logit models "...which utilizes a ratio of maximized log likelihood values rather than a ratio of sum of squares" (Wrigley 1985, 49)[7].

Lastly, the IIA assumption can be tested for the MNL model. The software package used for the MNL analysis in this study, NTELOGIT, provides a convenient statistical test for the IIA property based on McFadden (1987) (Intelligent Marketing Systems Inc. 1993, 8-1). Probability values are given to indicate if the IIA hold in the data set or is violated. Values close to 1.0 indicate little or no probability of violation, whereas values that fall below 0.05 indicate that the IIA assumption has been violated.

[7] See Appendix III for equations used to calculate Rho-square values and ranges of acceptability.

Chapter 4

Survey Design

In the fall of 1998, a mail survey of moose hunters in the District of Thunder Bay was conducted. The survey collected information about moose hunters related to: general hunter characteristics, socio-economic data, motivations for hunting, locational characteristics important for site selection, preferences for moose and season, preferred hunting techniques, issues of concern to hunters and management, harvest registration, herbicide use in forest management, tourism-related issues, a description of present hunting environments, and a DCE to investigate trade-offs between sites with varying attributes. A copy of the questionnaire is included in Appendix I.

4.1 The Survey

The survey was developed to examine multiple issues. The first section of the questionnaire asked respondents about general hunting characteristics and experiences. Next, respondents rated the importance of nine reasons for deciding when to hunt moose as well as ten factors, which might influence where they decide to hunt moose. Moose and season preference and use of various hunting techniques were indicated by checking a box from lists provided or by Likert-type scales. From a list of items, respondents were asked the extent to which various hunter and management related impacts negatively affected their hunting experience, if at all. Hunter support of three modes of harvest registration was elicited, and opinions about two presently controversial issues, the Hunter Safety Apprenticeship Program and herbicide use, were also investigated. Several statements pertaining to tourism and moose hunting issues were listed and hunters were asked about their agreement with each statement. From a list of items describing typical moose hunting site attributes found in Northern Ontario, hunters were asked to indicate which attributes best described the area in which they presently hunt moose. A major portion of the survey was dedicated to the choice experiment. Hunters were asked to choose between two hypothetical hunting sites with varying levels of the following attributes: distance from home, vehicle access requirements, frequency of encounters with other hunting parties, the presence of lakes in the area, moose population, height of new growth in cutovers, and predominant forest type regenerating. If hunters had no preference for either site, they were given the option of choosing "not to go moose hunting". The final section of the survey examined various socioeconomic characteristics of the hunter.

4.2 Development of the Discrete Choice Experiment

4.2.1 Attributes and Levels

Before discussing the specifics of the model estimation or model results, the design of the choice experiment and how the model attributes were selected needs to be discussed. Careful review of recent literature, coupled with focus-group discussions and numerous revisions, helped to refine the attributes and attribute levels for the choice experiment. The seven site-quality attributes examined in this study are (see Table 4.1): distance from home to hunting area, vehicle access requirements within hunting area, frequency of encounters with other hunting parties, the presence of lakes in the hunting area, moose population, height of new growth regenerating in cutovers, and predominant forest type regenerating in cutovers.

Table 4.1 Attribute list - definition of attributes and their levels

Attribute	Definitions and Levels
Distance	The approximate one way distance in kilometres from the hunter's home to the hunting area: *1 = 150 km from home* *2 = 250 km from home* *3 = 350 km from home*
Access	Approximate access conditions within the hunting area[8]: *1 = 30% of area only accessible by 2wd vehicle* *2 = 50% of area only accessible by 2wd vehicle* *3 = 70% of area only accessible by 2wd vehicle*
Encounters	The number of encounters with other hunting parties during a day's moose hunting within the area: *1 = No other hunters* *2 = 1-3 other hunting parties* *3 = 4 or more other hunting parties*
Lakes	Presence of lakes within hunting area: *1 = No lakes* *2 = Few lakes* *3 = Many lakes*
Moose	Evidence of moose seen during a day's moose hunting within the area based on seeing or hearing moose or seeing fresh sign such as tracks, browse, bush thrashing, rut pits or droppings: *1 = Evidence of 1 moose every two or more days* *2 = Evidence of 1 to 2 moose per day* *3 = Evidence of 3 of more moose per day*
Height	Height of regeneration growing in cutovers within hunting area: *1 = Less than 1 m in height* *2 = 1 to 2 m in height* *3 = Greater than 2 m in height*
Forest type	Predominant type of forest regeneration growing in cutovers within hunting area: *1 = Hardwood* *2 = Conifer*

[8] All hunting areas were assumed to be 100% accessible by 4 wheel-drive vehicles.

These attributes of moose hunting sites were chosen specifically because many are directly related to forest and resource management. Few previous studies have investigated the effects of forest management on hunting in any detail. In fact, McLeod (1995) recognized that this was one of the shortcomings of her study and indicated that future research should include various tree/stand classes or years of mature forest within each scenario. As well, Sarker and Surry (1998) mentioned that an important area for future unpriced valuation research was to study the effect timber management practices had on the environmental settings preferred by moose hunters.

The significance of the chosen attributes was confirmed during the focus-group sessions, as well as in the consultations with OMNR biologists, wildlife specialists and foresters. Repeated testing helped to ensure that the choice experiment contained as much relevant information as possible pertaining to moose hunting environments, while still allowing for the task to remain simple.

4.2.2 Experimental Design

Choice experiments require careful experimental design to manipulate the hypothetical attributes systematically (Timmermans 1984). Full factorial designs contain all possible combinations of attributes on their respective levels; however, "with an increasing number of attributes or levels or both, the evaluation task becomes unmanageable for the respondent" (Haider and Ewing 1990, 35). Therefore, researchers typically use a fractional factorial design that minimizes the number of hypothetical choice sets by precluding estimation of all possible interaction effects (Timmermans 1984).

The full factorial design ($3^{12} \times 2^{2}$) contains well over 1 million hypothetical hunting sites, far too many for use in a survey. Instead, 3^{13} fractional factorial design was used which required only 27 replications in order to estimate all main effects (Addelman 1962)[9].

Obviously, the 3^{13} fractional factorial design was highly desirable, but it does not accommodate the 14 variables of the $3^{12} \times 2^2$ design reflecting the attribute list in Table 4.1. Nevertheless, it was possible to accommodate the 14 variables in the design by collapsing one three-level variable to two levels to accommodate the variable forest type; then, the resulting two level variable was 'folded over' by adding 1 modulo 2 to its coding (Louviere 1988) to generate the forest type variable for the second alternative. In addition to the fold-over design, distance was confounded with the blocking variable, meaning that site B had a constant distance value in place for all three versions. For example, the distance attribute for site B in survey version #1 was always 250 kilometres from home, while site A changed according to the design. Only 27 choice sets are required to estimate all main effects from this design. However, 27 choice sets are still too many for one individual to evaluate. Therefore, 'blocks'[10] can be developed in factorial designs to reduce further the number of choice sets that one respondent must evaluate (Rand 1997). In this study, the 27 choice sets were separated into three blocks, producing three different survey versions such that each respondent was required to complete only nine choice sets. Such a design ensures that all attributes and attribute levels are not confounded with each other (i.e. they are orthogonal).

4.2.3 Coding of Discrete Choice Experiment

The statistical analysis of categorical data requires some form of dummy coding of the attribute levels. Although traditional dummy coding (0,1) will work, it is not the best

[9] Such a design is known as a Resolution 3 design (a main effects design) as defined by Dey (1984).

method of coding for this data. Instead, effects codes were used to define a contrast with an option being the origin (Louviere 1988). For this coding, the default level is represented by the negative sum of the other two levels because the level associated with the base case ('access ~30% by 2wd' in the example in Table 4.2) is coded as -1, -1. Consequently, the average code for this attribute is zero and will not be correlated with the intercept estimate.

Table 4.2 Example of effects coding for distance from home

Levels	Variables	
	Access 1	Access 2
Access (~70% by 2wd)	1	0
Access (~50% by 2wd)	0	1
Access (~30% by 2wd)	-1	-1

Although effects coding could be used to code all attributes, the distance attribute, which was presented on three levels (150km, 250km, 350km), can be treated as a continuous variable and orthogonal polynomial coding can be applied (Louviere 1988), resulting in a linear and quadratic estimate. The resulting estimate makes for easy interpolation for all values of the variable. The linearized coding adopted for distance was 1, 0,and -1; while the quadratic was -1, 2, and -1.

4.3 Data Collection, Survey Design and Implementation

All hunters residing in the District of Thunder Bay who purchased a moose license in 1997 were selected from OMNR's general license database. Postal codes from the

[10] Blocking is used when conditions cannot be held constant for all trials of an experiment. Without blocking, there is a danger that these underlying blocking factors (too many choice sets) may affect the response and confound the results of an experiment (Rand 1997, 1).

City of Thunder Bay and other towns within the District of Thunder Bay[11] with a population greater than 200 residents were used to run the query on the general license database (see Appendix I for postal codes). Of all the hunters identified in the query, a random sample of 1000 moose hunters was selected to participate in the study.

The sample was drawn randomly from the general license database, which includes all license purchasers, to avoid selecting only those hunters who had successfully received an adult tag in 1997 and are inventoried separately in the adult tag database. Since hunters who received an adult tag may respond differently to particular questions when asked, the sample was taken from the general moose hunting population[12].

Testing of the questionnaire was undertaken throughout the various stages of its development. The survey was circulated among peers and faculty within the Faculty of Forestry and the Forest Environment at Lakehead University, OMNR biologists, wildlife specialists and foresters, and the Board of Directors of the Northwestern Ontario Sportsmen Alliance. Comments and suggestions pertaining to the survey design and question wording were considered, and if appropriate, incorporated into the questionnaire.

A focus-group session with moose hunters in Thunder Bay also examined the questionnaire and discussed their perceptions and opinions of quality hunting sites, game populations, number of encounters, and heights of regeneration in cutovers most frequently hunted in. Focus-group participants were selected from a local sportmen's organization. After revisions were made from the focus-group discussions, the

[11] In this study, the District of Thunder Bay is defined as published in the 1999 Hunting Regulations - Map 3 (OMNR 1999a, 14-15). The study area was further restricted to the town of Nipigon and all other cities or towns from Nipigon west to the western and northern borders of Map 3 (see Figure 4.1).
[12] For a detailed description of the adult tag draw (lottery system and group application systems), see Hansen (1995) or the OMNR Hunting Regulations Summary (1999a).

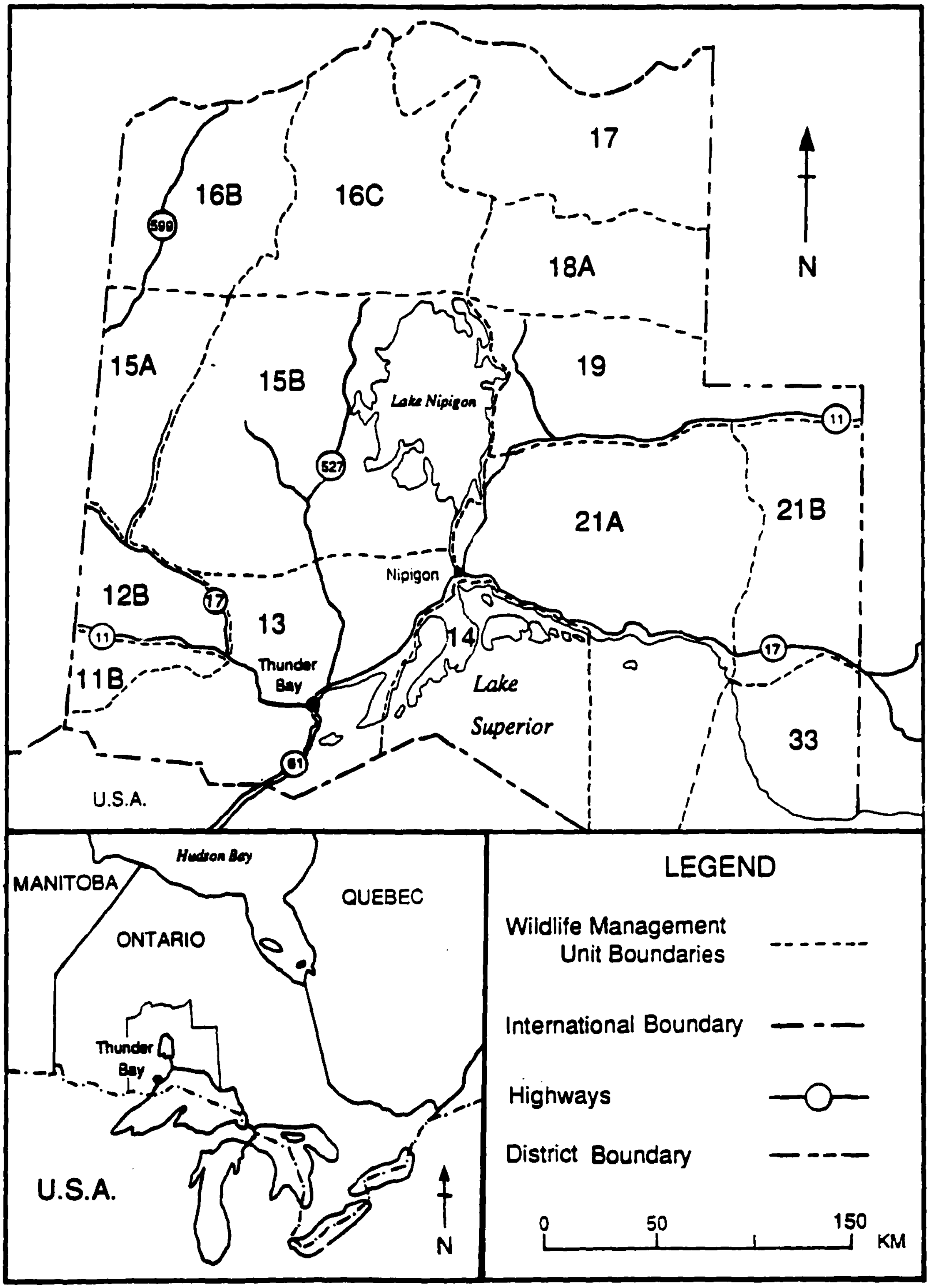

Figure 4.1. Study Area of the Thunder Bay Moose Hunter Survey.

questionnaire was again circulated among peers and Faculty of Forestry and the Forest Environment, OMNR biologists, wildlife specialists and foresters and moose hunters. These discussions and repeated reviews were helpful in refining the survey, especially the choice experiment. Due to budgetary and time constraints, a mailed pretest was not used.

The attributes and attribute levels for the choice experiment represent, as closely as possible, the important characteristics of hunting sites in Northern Ontario. As well, to explore potentially new hunting opportunities, one level from each attribute represented an environmental or social condition that would currently not exist (or which seldom occurred). All attributes and attribute levels were developed in a similar manner as the questionnaire.

The survey package mailed to respondents contained a questionnaire, a business reply envelope, a cover letter and a draw form[13]. Every respondent who successfully completed and returned the survey and draw form became eligible for a draw for one of five $50 gift certificates redeemable at a local sporting goods store. Survey implementation followed the Total Design Method of Dillman (1978). The questionnaire was presented in a booklet format and printed on green 21.7cm x 35.7cm (8½" x 14") paper. According to Gallant (1998), surveys printed on coloured paper receive higher return rates than surveys printed on plain white paper. Gallant also suggests selecting a colour that would reflect the topic of interest. Therefore, green was selected over plain white paper.

The survey was mailed on the 16th of November 1998, during the middle of the moose hunting season so that hunters had an opportunity to have hunted and the

[13] See Appendix I for copies of the cover letter and draw form used.

experiences of the hunt would be recent[14]. Following the technique described by Dillman (1978), hunters were mailed an initial survey package, followed by a postcard reminder one week later, and another survey package to non-respondents two weeks later (7th December 1998). The second survey package contained another copy of the questionnaire, a follow-up letter[15], a draw form and a business reply envelope. Brown et al. (1989) cautioned that December is typically a poor month to schedule a survey because people are busy with holiday preparations and the numerous activities associated with the holiday season. However, due to time constraints, postponing the survey until after the holidays would have delayed the project by at least two months, and at the same time introduced a potential for recall bias. The closing date for accepting completed surveys was the 11th of January 1999. The response rate to the survey was 63.5% (635 returned surveys of the 1000 mailed). Seven surveys were unusable, leaving 628 (62.8%) for the final analysis. In a similar study of Saskatchewan moose hunters by Morton (1993), a slightly lower response rate (51.6%) was obtained. All usable surveys were analyzed using the Statistical Package for the Social Sciences (Norusis 1997), while the DCE results were analyzed using NTELOGIT software (Intelligent Marketing Systems Inc. 1993).

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[14] This time of the season was selected because, according to Cumming (1972), the earlier half of the season is by far the most popular time to hunt.
[15] See Appendix I for a copy of the follow-up letter.

Chapter 5

Results and Interpretations

In this chapter, the survey results are presented and discussed in the context of moose and forest management in Northern Ontario. Socioeconomic characteristics of hunters and a basic description of their hunting behaviour are covered first, followed by a discussion of hunters' motivations for hunting moose. Next, hunters' moose and season preferences are explored in some detail. Thereafter, a large section focuses on management-related issues such as forest-management guidelines revisions, land-use planning, herbicide use, and the Hunter Safety Apprenticeship Program (HSAP). The final section consists of a detailed description of the present hunting environments and the results of the discrete choice experiment.

5.1 Socioeconomic Results

The survey solicited information about hunters' age, gender, education, income and place of residence. The largest proportion of hunters (30.3%) were between 36 and 45 years old (Table 5.1a and b) and over 50% of the sample was comprised of middle-aged hunters, between 36 and 55 years of age. Similar results were found by Hansen (1995), where over 40% of moose hunters were between 31 and 45 years of age. Both studies asked for age groups only, so calculating the average age of moose hunters was not possible. However, according to the 1996 Provincial Moose Hunt Summary (OMNR 1997), the average age of Thunder Bay moose hunters is 43.8 years, corresponding well with both this study as well as Hansen (1995). In much of the statistical analyses below, age is used as a segmentation variable. To make the contrasts simpler,

Table 5.1 Socioeconomic characteristics of moose hunters

		Percent
a) Age of hunters sampled (6 categories)	**N=622**	
15-25 years old		6.4
26-35 years old		19.3
36-45 years old		30.5
46-55 years old		23.0
56-65 years old		12.9
66 years old an older		7.9
b) Age of hunters sampled (3 categories)	**N=622**	
Young (15-35 years old)		25.7
Middle-aged (36-55 years old)		53.5
Elderly (56+ years old)		20.7
c) Gender of hunters sampled	**N=621**	
Male		89.2
Female		10.8
d) Highest level of education completed	**N=614**	
Elementary/junior High (grades 7-9)		8.6
High school (grades 10-12)		43.2
Trade school or technical college		37.1
University degree		11.1
e) Hunters' place of residence	**N=618**	
Thunder Bay		72.9
Another town		11.5
Rural		15.7
f) Annual household income of hunters sampled	**N=570**	
Less than $20 000		7.2
$20 001 - $40 000		25.6
$40 001 - $60 000		33.0
$60 001 - $80 000		20.4
$80 001 - $100 000		7.9
Greater than $100 000		6.0

respondents' age was reduced to three categories (Table 5.1b) leading to comparisons between young, middle-aged and older hunter segments[16].

Hunting typically has been dominated by the male segment of the population. Therefore, not surprisingly, the vast majority (89%) of all hunters sampled were male (Table 5.1c). As well, a chi-square test revealed a significant difference between gender and age (χ^2=12.164, df=5, $p<0.05$) (Appendix II, Table A.1). Both male and female hunters were concentrated in the middle-aged segment; however, a greater proportion of the male segment fell into the young age category. A plausible explanation for the difference between male and female age distributions is that, typically, males are initiated into hunting during early adolescence by fathers or male relatives (Adams and Thomas 1983, Decker et al. 1984, Dowd 1993, Adams and Steen 1997). In contrast, Jackson et al. (1989) discovered that female hunters in Wisconsin typically started hunting because of husbands rather than fathers. Thus, if husbands are primarily responsible for female initiation, then females would begin hunting at an older age than males, an hypothesis confirmed by this study.

With respect to hunters' education, 43.2% of respondents indicated at least a high school education, and another 37.1% reported having attended a trade school or technical college (Table 5.1d).

Hunters were asked to indicate whether they resided in Thunder Bay, in another town in Thunder Bay District (e.g. Upsala), or in an unincorporated rural area (Table 5.1e). As expected, an overwhelming number of hunters (72.8%) live in the City of Thunder Bay, with 15.7% and 11.5% reported as living in an unincorporated area or in

[16] Throughout the remainder of the thesis, results by age will be reported only if statistically significant differences were observed.

another town respectively.

Thirty-three percent of respondents indicated that their household income was between \$40 001 to \$60 000 and almost eighty percent (79%) fell between \$20 001 to \$80 000 of household income (Table 5.1f). A chi-square test between hunter age and household income documented a significant difference (χ^2=82.085, df=10, $p<0.05$). Middle-aged hunters (36 to 55 years old) make up the bulk of hunters with a household income between \$40 001 to \$80 000, and also contain the greatest number of incomes over \$100 000 (see Table A.2). In contrast, hunters in the youngest and oldest age groups were predominantly at the lower end of the income scale (\$20 001 to \$40 000).

5.2 Hunter Profile

5.2.1 Hunter Characteristics

This section provides insight into respondents' general experience with hunting and moose hunting, their preference for hunting in specific Wildlife Management Units (WMU), their status in the moose draws of 1997 and 1998, and their success in harvesting a moose in 1997.

General hunting experience was found to be quite substantial, with an average of over 26 years of experience and a range from a minimum of 2 years to a maximum of 60 years. Almost three-quarters of all respondents (73.1%) had hunted between 11 to 40 years, with approximately one-third (30.9%) hunting between 21 to 30 years (Table 5.2).

According to Table 5.2, years of moose hunting experience lagged behind general hunting experience by approximately 6 years. Moose hunters had on average 20 years of experience, and approximately 74% had at least 11 years or more of experience.

Table 5.2 Years of general hunting experience, moose hunting experience and years hunted in preferred WMU*

	Years							
	1-10	11-20	21-30	31-40	41-50	51+	mean	S.E.
General hunting experience N = 623	13.6	23.6	30.9	18.6	9.4	3.2	26.1	0.52
Moose hunting experience N = 624	26.6	32.4	25.3	12.0	3.0	0.6	19.92	0.46
Hunted in preferred WMU N = 613	48	33.3	14.2	3.4	0.8	0.3	13.92	0.39

*Values are expressed in row percent

When asked how long hunters had hunted in their preferred WMU, the length of tenure appeared surprisingly brief, at least upon first look. The average tenure was 14 years, with 48% and 33% of all hunters reporting to have hunted in their preferred WMU for 1 to 10 and 11 to 20 years respectively. The result is most likely due to the selective harvest system implemented in 1983, which required hunters to apply for adult validation tags in specific WMU's. Prior to the selective harvest system, hunters were permitted to hunt adult moose in any WMU of their choice[17]. Further analyses and discussions of hunters' preferred WMU's are located in section 5.11.

5.2.2 Hunters' Preferences for Other Game and Status in Tag Allocation

The majority of respondents (80.3%) reported hunting other game besides moose during their moose hunting trips (Table 5.3). Of all hunters surveyed, 18.2% reported hunting for deer, 8.9% hunted waterfowl, and an overwhelming majority, 76.9%, hunted for small game.

In 1997, 37.9% of all hunters sampled received an adult tag (Table 5.4), whereas in 1998 the number of successful applicants dropped slightly to 34.5%. These numbers

[17] Hunters' current preference of WMU to hunt moose can be found in Appendix II, Table A.9.

Table 5.3 Degree of hunting for other game besides moose during moose hunting trips

		Yes
Hunt moose only:	N=628	19.7
Hunt deer:	N=627	18.2
Hunt waterfowl:	N=628	8.9
Hunt small game:	N=628	76.9

may not be completely accurate because hunters were not asked if they had applied for an adult tag. Thus, a potential bias may exist in that more hunters who did not receive a tag may have chosen not to complete the survey.

Finally, results from both questions were combined to compare the number of hunters who had received at least one adult tag in either 1997 or 1998 to those hunters who did not receive an adult tag in either. Almost 30% of hunters did not receive an adult tag for either year. Buss and Truman (1990) pointed out that especially in the northern regions of the province, hunters believe they should receive one adult tag at least every two years, which is not the case.

Table 5.4 Hunters' status in the adult validation tag draws of 1997 and 1998

		Yes
Received an adult tag in 1997:	N=625	37.9
Received an adult tag in 1998:	N=624	34.5
Received one adult tag in either 1997 or 1998:	N=628	70.4

5.2.3 Hunter Success

Hunters were asked if they had successfully harvested a moose in 1997. Almost 25% of all respondents reported a successful hunt (Table 5.5). In comparison, according to the 1996 Provincial Moose Hunt Summary (OMNR 1997), the success rate for hunters in the District of Thunder Bay was only 11.5%. This discrepancy deserves some explanation; the fact that the provincial survey was based on data collected in 1996 could not lead to such a difference. It is possible that hunters in this survey reported a successful hunt despite actually being unsuccessful in 1997, or they may have reported the success of their 1998 hunt[18]. On the other hand, the provincial survey could also be inaccurate. Differences may be attributable to variation between studies in defining the District of Thunder Bay boundary; yet since both surveys were taken from a random sample of the moose hunting population, such large differences should theoretically not exist. It was recommended by Timmermann et al. (1993) that higher quality district mail survey data should be phased in to replace provincial harvest statistics, which are reasonably accurate on a regional or provincial level but not on a WMU basis. Finally, differences may be a result of a non-response bias from hunters who were unsuccessful in either harvesting a moose or receiving an adult tag. It is likely that successful hunters are more likely to complete questionnaires than unsuccessful hunters. Apparently an important conclusion from the discussion above is that the OMNR should explore other means of determining hunter success rates to ensure that the moose resource is not over-exploited (e.g. mandatory registration).

Success rates also differed slightly between the two most popular WMU's near the City of Thunder Bay. Hunters who indicated WMU 13 as their preferred WMU reported a

Table 5.5 Hunters' successfully harvesting a moose in 1997, by WMU's 13 and 15B

		Yes
Harvested a moose in 1997:	N=628	24.7
Harvested a moose in WMU 13:	N=292	26.4
Harvested a moose in WMU 15B:	N=146	27.4

[18] Note that the initial mailing of the survey was on the 16th of November 1998, during the middle of the moose hunting season.

success rate of 26.4%, while 27.4% of hunters in WMU 15B were successful. Again both these figures are much higher than the respective 1996 Provincial Moose Hunt Survey (OMNR 1997) of 11.3% and 15.4% respectively.

5.3 Hunting Motivations and Locational Characteristics

Hunters are by no means a homogeneous group; in fact, several studies have argued that treating them as such could have repercussions on hunter satisfaction and the success of management objectives (Applegate, 1977; Brown et al., 1977; Wright et al., 1977; Hautaluoma and Brown, 1979). Therefore, this section will focus on identifying moose hunters' primary motivations and the locational characteristics important in deciding where to hunt moose.

5.3.1 Hunting Motivations

Hunters rated the importance of nine different motivational factors on a five-point Likert scale. Based on mean scores, respondents reported "to appreciate nature" as the most important reason for deciding to hunt moose (mean = 4.51). "To spend time with family and friends" (mean = 4.15), "to relax" (mean = 4.10), and "to escape from the everyday routine" (mean = 4.05) were also rated highly (Table 5.6). In contrast, the only motivational factor that hunters did not rate important was "to shoot a trophy moose (mean = 1.56)". The results are consistent with other studies that non-hunting reasons are evaluated as more important than actual hunting items (More 1973, Potter et al. 1973, Schole et al. 1973, Stankey et al., 1973, Brown et al. 1977, Gilbert 1977, Hautaluoma and Brown 1979, Rollins 1987, Hansen 1995, and Tynon 1997).

Table 5.6 Hunting motivations rated on a five-point scale

Motivations	N	Mean	Std. Error
To appreciate nature/being outdoors	617	4.51	0.03
To spend time with friends/family	610	4.15	0.04
To relax	612	4.10	0.04
To escape from the everyday routine	610	4.05	0.05
To experience the challenge of the hunt	609	3.87	0.05
To enjoy physical exercise	617	3.71	0.04
To test hunting skills	602	3.51	0.05
To put meat on the table	614	3.15	0.06
To shoot a trophy moose	612	1.56	0.04

To explore hunters' motivational responses further, a Kruskal-Wallis test was used to test whether the motivational responses differed among age groups (Table 5.7). Then, a Mann-Whitney test was applied on the motivational items in order to attribute significant differences to specific age groups.

Middle-aged and elderly hunters were found to show less preference for hunting trophy moose than younger hunters (χ^2=20.815, df=2, $p<0.05$). These results are similar to findings by Jackson and Norton (1979) and to some extent support the notion that hunters progress through a series of stages as they mature in age and hunting experience. In this case, younger hunters would be at the "trophy" stage, whereas elderly hunters may be represented by the "mellowing out" stage.

A significant difference (χ^2=22.593, df=2, $p<0.05$) was found between age and the importance of "to escape the everyday routine." Elderly hunters differed from both young and middle-aged counterparts. The youngest age group rated "to put meat on the table" the highest (χ^2=6.939, df=2, $p<0.05$), while the oldest age group reported the lowest rating. This relationship is likely explained from the perspective that younger hunters were found to be more harvest-oriented than other age groups, especially the elderly hunters. Lastly, younger hunters were more interested in the challenge of the hunt than

Table 5.7 Kruskal-Wallis test of hunters' motivations by age of hunter

	Kruskal-Wallis test				Mann-Whitney
Motivations	Young (15-35)	Middle-aged (36-55)	Elderly (56 or older)	Asymptotic significance	Differences*
Trophy	346.80	290.86	281.52	0.000	Y-M, Y-E
Escape	320.38	317.71	239.38	0.000	Y-E, M-E
Meat	330.10	302.43	276.02	0.031	Y-E
Challenge	327.57	299.00	276.53	0.037	Y-E

Cell values represent mean rankings
*Mann-Whitney test used to determine significant differences between pairs of age groups. (Significant differences are indicated by the first letter of the age group pair, e.g. Young differ from Elderly (Y-E))

elderly hunters (χ^2=6.609, df=2, p<0.05). The elderly age group repeatedly recorded the lowest ratings of all three groups, indicating that possibly these motivational factors are not responsible for motivating elder hunters to hunt moose.

To explore relationships between the motivational items more formally, a Principal Components Analysis with Varimax rotation was performed on all nine items (Table 5.8). The analysis produced three components with eigenvalues greater than 1 and each explaining at least 10% of the variation in the data. Component 1, labeled the "social" component, explained 28.7% of the variation in the data and consisted of the following items; family, relax and escape. The second component was called the "hunt" component because it contained such motivations as meat, trophy, skill, and challenge. Sixteen percent of the variation in the data was explained by component 2. Finally, nature and exercise made up component 3 (the "nature" component), and explained 11.5% of the variation. In general, these results were similar to the three major hunting motivations described by Decker et al. (1987), with the "social" component closely resembling their affiliative component, the "hunt" component virtually mirroring their achievement component, and lastly the "nature" component aligning closely with their appreciative component.

Table 5.8 Principal components analysis of hunting motivations

a) Initial Eigenvalues			
Component	Total	% of Variance	Cumulative %
1	2.579	28.658	28.658
2	1.451	16.122	44.780
3	1.038	11.536	56.316

b) Component Loadings*	Social	Hunt	Nature
Escape	0.809		
Family	0.724		
Relax	0.649		
Challenge		0.772	
Skills		0.737	
Meat		0.562	
Trophy		0.418	
Exercise			0.825
Nature			0.821

Extraction Method: Principal Components Analysis
Rotation Method: Varimax with Kaiser Normalization

5.3.2 Locational Characteristics

Hunters were asked to rate ten locational characteristics on a five-point Likert-type scale as to their importance in the decision about where to hunt moose. Characteristics covered such issues as camp ownership, road access and perceived rate of success (Table 5.9).

Respondents rated "I am familiar with the area" (mean = 4.29), "I hunt with friends and family there" (mean = 4.10) and "I know the area will not be crowded" (mean = 3.97) the highest. Similar to results discussed in the motivation section, "a good chance of harvesting a trophy moose" (mean = 1.73) was not an important locational characteristic in deciding where to hunt moose. These results parallel the findings of Morton (1993) and Bissell et al. (1998) who also identified familiarity with the area as well as the influence of family and friends as important characteristics when selecting a location for the hunt.

Table 5.9 Hunters' ratings of ten locational characteristics

Locational Characteristics	N	Mean	Std. Error
I am familiar with the area	617	4.29	0.04
I hunt with friends/family there	616	4.10	0.05
I know the area will not be crowded	601	3.97	0.05
I have a good chance of harvesting a moose	610	3.67	0.05
I pursue other recreational opportunities there	604	3.09	0.06
Well established road network	588	3.07	0.05
Lots of new access roads and cutovers	584	3.02	0.06
I own a camp in the area	582	2.09	0.07
I know someone who owns a camp in the area	574	1.95	0.06
I have a good chance of harvesting a trophy	610	1.73	0.05

To determine if the age of respondents had any influence on the rating of these characteristics, hunters' responses were again tested using a Kruskal-Wallis test (Table 5.10). Selecting an area with a good chance of harvesting a moose was found to be less important to hunters 56 years old and older when compared to young and middle-aged hunters (χ^2=20.525, df=2, p<0.05). The opportunity of harvesting a trophy moose is evaluated differently between all three age groups (χ^2=20.573, df=2, p<0.05). The youngest age group reported the highest ratings, followed by middle-aged hunters and lastly, the elderly age group. Both this result and the previous correspond well to the motivational factors discussed by Jackson and Norton (1979). Finally, a significant difference was found between young and middle-aged hunters regarding preference for areas with an abundance of new access roads and cutovers (χ^2=6.793, df=2, p<0.05).

These results make intuitive sense in that younger hunters have already revealed their preference for motivational factors related to the hunt and perceived rates of success. In contrast, elderly respondents placed the least amount of importance on harvesting a moose but still preferred to choose a location that had an abundance of new access roads and cutovers. Lastly, the locational characteristics of middle-aged hunters appeared to be between the younger and elderly age groups, placing greater emphasis on choosing locations where the perceived chance of harvesting a moose or trophy moose was greater than that for elderly hunters but less than that of younger hunters. The low importance rating of new access roads and cutover by middle-aged hunters, however, defies explanation.

Table 5.10 Locational characteristics believed to be important in selecting a location for the hunt by age of hunter*

	Kruskal-Wallis test				Mann-Whitney
Locational Characteristics	Young (15-35)	Middle-aged (36-55)	Elderly (56 or older)	Asymptotic significance	Differences*
Harvest a moose	330.41	311.38	243.33	0.000	Y-E, M-E
Harvest a trophy moose	340.14	300.56	258.25	0.000	Y-M, Y-E, M-E
Access roads and cutovers	311.60	273.64	305.18	0.033	Y-M

Cell values represent mean rankings
*Mann-Whitney test used to determine significant differences between pairs of age groups. (Significant differences are indicated by the first letter of the age group pair, e.g. Young differ from Elderly (Y-E))

5.4 Hunter Preference

This section explores respondents' moose and seasonal preferences as well as preferences for various hunting techniques. Respondents were asked about the preferred kind of moose they would harvest if not restricted by any tag system, and their most preferred time of the season to hunt moose. Finally, respondents rated on a six-point Likert scale their use of five hunting techniques.

5.4.1 Moose Preference

Twenty-nine percent (28.9%) of respondents reported "no preference" for the type of moose they would harvest if there were no restrictions (Table 5.11). Approximately

Table 5.11 Hunters' preferred moose if not restricted by a tag system

Moose Preference N=616	Percent
No preference	28.9
Yearling Bull	26.1
Adult Bull	17.0
Calf	11.2
Yearling Cow	9.4
Trophy Bull	4.2
Adult Cow	3.1

26% of respondents indicated a preference for shooting a yearling bull, followed by 17.0% reporting a preference for an adult bull. The two lowest preferences were reported for adult cows (3.1%) and trophy bulls (4.2%), indicating that perhaps, respondents are aware of which animals are the prime breeders and thus prefer not to harvest them because of their importance to sustaining and increasing herd numbers. It appears that the hunt is focused on adult bulls, yearling bulls and calves[19], as a result of harvest strategies (e.g. the selective harvest system) that were designed to protect a larger proportion of breeding cows and focus more hunting pressure on bulls and calves (Timmermann and Whitlaw 1992). However, the question then arises at what point this preference for the bull and calf segment of the herd could affect future growth potential? Timmermann and Rempel (1998) pose a similar question in a study that examined moose age and sex structure from voluntarily submitted moose jaws, during liberal non-selective (1971-1982) and controlled selective harvest periods (1983-1992), by Ontario moose hunters. They suggested that managers across the province should examine, in greater detail, calf harvests and overall population trends (Timmerman and Rempel 1998) to determine the long-term consequences of following policy objectives (OMNR 1980a) currently guiding the selective

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[19] In further testing, respondents' moose preference was analyzed by age; however, no statistical differences were found.

harvest system.

5.4.2 Season Preference

Respondents were asked to indicate the time of season they most preferred to hunt moose by choosing one of six options (Table 5.12). Over fifty percent (51%) of respondents have an early fall (October) preference for hunting moose, likely associated with the opening date of the season, which for most hunters surveyed was 10th October 1998. The second most preferred time of the season to hunt moose was late fall, after snow (November), which is preferred by 16.0% of hunters. Hunting after snowfall facilitates the tracking of moose, snowmachines may be used and normally there are fewer hunters afield during this time.

Table 5.12 Hunters' preferred time of season to hunt moose

Season Preference N=614	Percent
Early fall (October)	51.0
Late fall-after snow (November)	16.0
No preference	11.9
Late fall-before snow (November)	8.3
Early fall (September)	7.2
Early winter (December)	5.7

5.4.3 Hunting Techniques

Respondents were asked to rate on a six-point Likert scale their use of five common moose hunting techniques (Table 5.13). Walking/stalking was the most frequently applied technique (mean=4.29), followed by calling and sitting/standing (mean=3.66) and following tracks (mean=3.48). Similar results were found in Hansen's (1995) province-wide study of Ontario moose hunters.

In addition to rating hunting techniques, respondents were asked to indicate which technique they considered the most productive for themselves, with regard to harvesting

Table 5.13 Hunting techniques used to hunt moose

Hunting technique	N	Mean	Std. Error
Walking/stalking	603	4.29	0.04
Calling and sitting/ standing	565	3.66	0.05
Following tracks	553	3.48	0.05
Use motorized vehicle	509	3.19	0.06
Setting up drives	394	2.48	0.07

moose (Table 5.14). Almost 45% of respondents reported the walking/stalking technique as being the most productive, while 25.5% and 18.2% of respondents respectively identified calling and sitting/standing and using motorized vehicles to cover large areas as their most productive techniques.

Hunter success, especially in new cutovers, has been a concern to wildlife managers since logging became highly mechanized in the late 1960's and early 1970's. Mechanization led to large cutovers and the emergence of vast road networks which ultimately provided hunters with access to moose populations previously inaccessible. The result was often an overexploited moose population in the newly accessible hunting areas. This situation has led wildlife managers to suggest that restrictions on hunter access to new cutovers be implemented if increased moose densities are to be achieved[20]. Although access restrictions are well suited to protect the moose herd, the results presented in this section provide managers with further alternatives to restricting access. Knowing how moose are being hunted and what techniques are typically most productive allows managers to develop alternative management strategies, such as restrictions on particular hunting techniques. For example, managers may be able to achieve the same objective of conservation of the moose resource in new cutovers by

[20] Rempel et al. (1997) suggested that restrictions on hunter access in new cutovers be implemented along with managing landscape patterns to emulate the structure of natural burns if increased moose densities are to be achieved.

restricting the use of motorized vehicles in new cutovers to retrieval of downed game only, but not to hunt.

Table 5.14 Most productive hunting technique, as reported by hunters

Hunting technique N=592	Percent
Walking/stalking	44.6
Calling and sitting/standing	25.5
Use motorized vehicle	18.2
Following tracks	5.1
Setting up drives	3.4
Other	3.2

5.5 Issues of Concern to Hunters and Managers

To maintain hunting as a respectable and legitimate use of Ontario's natural resource base, hunters must conduct their hunts in a manner that is acceptable to both the hunting community and the majority of Ontario's citizens. Thus, a hunting experience may be affected negatively by the behaviour of other hunters, by resource managers, or by wildlife and forest management actions. Therefore, respondents were asked to indicate on a five-point Likert-type scale if, or by how much, any one of fifteen effects would negatively influence their hunting experience (see Table 5.15).

5.5.1 Hunter Related Effects

Issues most negatively reported by respondents were hunters poaching (mean = 4.69), taking unsafe shots (mean = 4.66) and leaving garbage behind (mean = 4.53). Hunters also indicated little tolerance for drinking, blocking roads and crowding each other when hunting. The only issue to receive a moderately negative effect rating was hunters using off-road vehicles excessively (mean = 3.32).

Table 5.15 Issues of concern to hunters and resource managers

Hunters concerns about other hunters:	N	Mean	Std. Error
hunters poaching	582	4.69	0.04
hunters taking unsafe shots	584	4.66	0.04
hunters leaving garbage behind	604	4.53	0.04
hunters crowding each other	599	4.32	0.04
hunters blocking roads	594	4.27	0.05
hunters drinking while hunting	579	4.16	0.05
hunters using off-road vehicles excessively	542	3.32	0.06
Hunters concerns about resource management:	N	Mean	Std. Error
selective harvest restrictions	558	3.68	0.05
herbicide use by forest industry	555	3.66	0.06
clearcuts too large`	540	3.53	0.06
slash burned during hunting season	521	3.49	0.06
not enough CO's patrolling	549	3.41	0.06
slash and other debris left along roadways	526	3.21	0.06
areas closed to hunting	494	3.15	0.06

According to recommendation #106 of the Consolidated Recommendations of Ontario's Round Tables (OMNR 1999b), OMNR should develop an Ontario hunting policy. If such a policy is to have merit within the non-hunting community, the issues discussed above should be used to develop a code of ethics which hunters ought to respect during their hunts. The non-hunting public demands that hunting be conducted in a responsible and ethical manner, otherwise the future existence of hunting may be bleak (Stewart 1998). Therefore, a hunter's code of ethics would improve the image of all hunters from society's view and ensure that Ontario's hunting heritage remains strong. This question did not ask, however, whether such effects are actually occurring. Rather, the objective was to obtain basic hunter feedback on potentially negative effects from other hunters.

5.5.2 Management Related Effects

This section of the survey asked respondents to evaluate actual and potential effects from management activities on one's hunting experience. Respondents still reported some negative effect from selective harvest restrictions (mean = 3.68, Table 5.15). However, Hansen's (1995) extensive review of Ontario's moose management program found that hunters generally supported and understood the selective harvest system.

Respondents rated four issues pertaining to forest-management practices that could negatively affect one's hunting experience: herbicide use, clearcutting, slash left along roadways, and slash burning during hunting season. Respondents reported the use of herbicides by forest managers as imposing a negative effect on their hunting experience (mean = 3.66). The issue of herbicides will be examined in greater detail in section 5.9. Large clearcuts received a slightly lower mean rating compared to herbicide use (mean = 3.53).

Slash burned during hunting season received a somewhat negative rating from respondents (mean = 3.49). In written comments, hunters expressed concern that fire and smoke frightened moose away from hunting areas and were fearful that fires could get out of control and burn standing timber. However, there is no scientific evidence to support the notion that moose fear either the smoke or flames of a fire. OMNR accepted recommendation 74 of the Consolidated Recommendations of Ontario's Round Tables (OMNR 1999b, 16) to support and promote making prescribed burning a more cost-effective and reliable silvicultural tool. Thus, concerns are bound to arise over prescribed burning, of which many are likely to be shared with forest managers' use of fire. Therefore, managers could address both issues to ensure that the hunting community and the public in general become well-educated regarding the use of fire as a tool in forest management. Recommendation 80 of the Consolidated Recommendations of

Ontario's Round Tables (OMNR 1999b) is also well suited to addressing and educating the public about the use of fire in forest management.

Slash left along roadways can pose serious obstacles to both hunters and animals, physically and visually. Hence, hunters reported a somewhat negative rating of slash and other debris left along roadways (mean = 3.21). Also, land covered by large slash piles is unable to produce trees for quite some time. Langenau et al. (1980) found similar results, where deer hunters in Northern Lower Michigan were concerned over the amount of slash left along roadways in mechanical operations. Most hunters complained that slash and other debris left along roadways was unpleasant to look at, that it made removal of a downed moose from cutovers difficult, and that the wood could be put to better use. The last point is being further considered by OMNR in recommendation 70 from the Round Table discussions: to ensure that timber supplies are better used, it was proposed that all mature harvested timber be used to its fullest extent (OMNR 1999b).

Respondents reported that not enough conservation officers patrolling during the season negatively affected their hunting experience (mean = 3.41). Based on the response frequencies for this question (see Appendix II, Table A.3), almost 68% of respondents reported at least some negative effect from not having enough conservation officers patrolling, and of these respondents, almost 43% reported a negative effect. In written comments, many respondents noted that increasing the number of conservation officers patrolling would help improve hunter behaviour, protect wildlife and other natural resources, and improve conservation officer/hunter relationships. According to recommendation 140 of the Consolidated Recommendations of Ontario's Round Tables (OMNR 1999b, 26), OMNR should study the feasibility and benefits of a conservation officer assistant's program, in which members of the public could accompany conservation officers to assist them in their duties. As well, OMNR has recently announced changes to the existing Deputy Conservation Officers program, and has announced a new Fish and Wildlife Guardian Program (OMNR 1999b, 26). According to the results of this study, it appears that such endeavours by OMNR would receive ample support from the moose hunting community in the District of Thunder Bay. However, hunter involvement during the planning process would likely be essential for maximum support and understanding of such initiatives.

Areas are often closed to hunting due to timber-harvest operations or to protect the moose resource from potential local over-harvests. Such controls imposed on hunters have the potential to affect one's hunting experience in a variety of ways. Thus, respondents were asked if areas closed to hunting negatively affected their hunting experience. Results suggest that respondents in the District of Thunder Bay are not completely against areas being closed to hunting (mean = 3.15). In fact, of all potential effects listed, respondents rated closing areas to hunting as the least negative effect. Thus, if managers believe a moose population in an area would benefit from closure to hunting, it appears that such a measure would be quite acceptable to the hunting community. In contrast, Pierce et al. (1996) reported that Colorado hunters were strongly opposed to closing public areas to hunting. However, survey results here did not give an indication of what the negative effect would be with respect to the size of the area closed or the length of closure. Therefore, when considering closing an area to hunting, managers should actively seek hunters' opinions as well as provide ample notice and justification for the proposed closure.

5.6 Hunter Involvement in Moose Management

Agencies have become cognizant of the fact that wildlife management from a strictly biological point of view is no longer valid or socially acceptable (Heberlein 1991). Therefore, when respondents were asked if OMNR should actively seek hunters' opinions when developing management proposals, 3% did not respond, 2% replied "no" and 95% responded in favour of hunter involvement. Several wildlife professionals (Cumming 1974, Ritcey 1974, Timmermann and Gollat 1986, Crichton 1988, Timmermann 1987, 1992) have stressed the need for attitude and public preference surveys when formulating management proposals and new regulations. Research of hunters' attitudes towards and preference for proposed rule changes and new regulations prior to their implementation should help managers identify and formulate regulations that not only manage moose, but also recognize the concerns of the hunters who must abide by them. Moose management that incorporates hunters' attitudes in the planning process[21] will strive to place a moral responsibility on hunters. Thus, the responsibility of moose management will be shared by the hunters and the wildlife managers. OMNR has recently announced its efforts to promote and support new partnerships with hunter groups as well as to increase the management responsibilities of local hunters (OMNR 1999c). It appears that hunters within the District of Thunder Bay would welcome the opportunity to participate actively in moose management.

5.7 Harvest Registration

"Determining the effectiveness of a harvest strategy should be an ongoing process so that adjustments can be made if necessary to meet stated goals. The benefits of a

[21] A policy guideline of Ontario's Moose Management Policy (OMNR 1980a, 2), states that "public participation is to occur in the planning and management of moose".

harvest system can only be fully assessed if hunter kill can be determined with reasonable accuracy" (Timmermann 1987, 574). At present, Ontario moose hunters have never had to submit to a mandatory kill registration. Submitting a jaw or hide was done voluntarily[22]. In contrast, 16 of the other 21 jurisdictions across North America, that actively manage moose, list harvest registration as compulsory (Timmermann and Buss 1995). Hansen (1995), in a province-wide study of Ontario moose hunters, asked if moose harvest information should be collected from licensed hunters and if hunters would support filing mandatory moose harvest reports. Both questions were supported, especially collecting moose harvest information from licensed hunters.

This study builds on Hansen's (1995) work by asking hunters if they would support any one of three modes of mandatory registration (Table 5.16). The most supported means of registration was by phone (64.7%)[23], although almost as many hunters supported postcard registration (62.6%). Submitting the lower jaw of one's kill was still supported by a majority of respondents (54.5%)[24].

Table 5.16 Hunter support for three different modes of registration

		Yes
Phone registration:	N=573	64.7
Post card registration:	N=572	62.6
Lower jaw:	N=576	54.5

The value of hunter-submitted kill records was discussed recently by Timmermann and Rempel (1998), who examined the age and sex structure of moose harvested in

[22] A hunter's only incentive for participating was to obtain a crest or hat from OMNR, or simply the opportunity to participate in population management.
[23] In a chi-square test, younger hunters were found to be more supportive of phone registration than older hunters (χ^2=11.152, df=2, $p<0.05$) (see Appendix II, Table A.4).
[24] Hunters who did not receive an adult tag for either of the last two years consistently reported lower support for phone registration χ^2=5.290, df=1, $p<0.05$ (Appendix II, Table A.5) and post card registration χ^2=8.237, df=1, $p<0.05$ (Appendix II, Table A.6); while no difference was found between support of lower jaw submissions and receiving an adult tag.

Northcentral Ontario from harvest records[25] (1971-1992) voluntarily submitted by moose hunters. They discovered that since implementation of the selective harvest system, mean age of harvested cows decreased significantly from 4.3 to 3.9 years, and calf harvests increased almost 100% (Timmermann and Rempel 1998). They concluded that the age and sex structure of Northcentral Ontario's moose harvest appears to have been altered significantly since the introduction of a controlled selective harvest strategy in 1983 (Timmermann and Rempel 1998, 27). Yet such discoveries would not be possible without the backing of years of voluntarily submitted moose jaws from successful hunters. As well, wildlife managers would be unable to assess the effectiveness of management strategies or practice adaptive management without such information. Furthermore, OMNR's ability to measure changes and adjust hunter harvests in a timely manner in all WMU's is limited by shrinking budgets and changing priorities (Timmermann and Whitlaw 1992, 157).

5.8 Hunter Safety Apprenticeship Program (HSAP)

Ontario's Minister of Natural Resources, John Snobelen, announced a new program that would allow apprentice hunters, 12 to 14 years of age, to hunt with a mentor in the 1998 fall hunting season; the program is called Hunter Safety Apprenticeship Program (HSAP)[26]. The program is designed to introduce prospective hunters to hunting by learning from an experienced mentor. According to the OMNR (OMNR 1998, 1), the program is to foster the following traditional values in the future hunter: "ethics; fair

[25] Harvest records consisted primarily of voluntarily submitted jaws of moose harvested from 14 WMUs in the North Central Region of Ontario (Timmermann and Rempel 1998).
[26] OMNR has accepted recommendation 128 of the Consolidated Recommendations of the Round Tables (OMNR 1999b) to establish and support the HSAP.

chase; respect and responsibility towards the quarry, the land, companions and others; maintaining the element of challenge in the hunt; knowledge of conservation from the hunter perspective; and an understanding of hunting as a cultural and social heritage for the individual as well as his or her community." However, the public has expressed mixed reviews for the program.

As a result, respondents to this survey were asked if they supported the program, and were at the same time given the opportunity to express any comments or concerns regarding the program. The HSAP was supported by two thirds (66.3%) of the respondents[27] and accompanied by an abundance of written comments. On the positive side, many respondents wrote that the program was long overdue, made legal what was going on anyway (children hunting with parents), allowed for younger siblings to hunt with older brothers or sisters (as a family), and would generally improve future hunters because of the hands-on experience. However, respondents also expressed concern that 12 to 14 years of age was possibly too young, that some of the mentors may not be mature, responsible or ethical hunters themselves, and that possibly bad habits of mentors could be passed on to the apprentice.

A similar program has been in place in the State of New York for years. The program is reported as being successful based on long-term evaluations by Enck (1994), who identified potential shortcomings and suggested actions to correct them. It appears relevant that Ontario's HSAP should also undergo long-term monitoring to correct any shortcomings that may befall the program. This study is an early contribution towards this goal.

[27] Results of the chi-square test, between age and HSAP support indicated a significant difference between hunter age and support χ^2=12.980, df=2, p<0.05 (Appendix II, Table A.7). Younger hunters were the greatest supporters of the program, while older hunters were less supportive.

5.9 Hunting in Recently Sprayed Areas

Where necessary, herbicides are used in Northern Ontario to reduce competition between preferred conifer species and faster growing nonconiferous species. There still exists, however, a great deal of public concern over the potential effects of herbicides on the natural environment and human health (OMNR 1993). According to a report published by OMNR (OMNR 1993, A-11), for the Vegetation Management Alternatives Program (VMAP), "the existing evidence is overwhelming in demonstrating public opposition in general to herbicide use. But there does not appear to have been any in-depth exploration of the reasons for these views, how firmly they are held, and under what circumstances, if any, herbicide use might be tolerated." Therefore, respondents were asked if they would continue to hunt in their moose hunting area if it were recently sprayed; respondents were also given the opportunity to provide any additional comments about the use of herbicides in writing.

Almost two thirds (64.4%) of hunters reported that they would no longer hunt in their moose hunting area if it were recently sprayed with herbicides[28]. In written comments, respondents expressed concern over the potential effects of herbicides on moose (reduced browse availability and consumption), water quality, the environment in general, and the potential effects on human health from consuming meat from moose harvested in sprayed areas. The most frequently reported concern was moose leaving the area due to the lack of browse available.

According to Monsanto (1993), Vision®, one of the most widely used herbicides in the world, does not cause cancer, birth defects, mutagenic effects or nerve damage. In

[28] In a chi-square test, younger hunters were found to be more likely to hunt in recently sprayed areas compared to middle-aged and especially elderly hunters (χ^2=9.390, df=2, $p<0.05$) (see Appendix II, Table A.8).

fact, Vision© is less toxic than nicotine, aspirin, and even table salt and is also renowned for its binding ability to soil particles, which restricts its ability to leach into ground water (Monsanto 1993). Extensive research has determined that Vision© does not cause significant adverse effects to wildlife and because of such confidence some organizations are using Vision© to restore natural wildlife habitats in many different areas of North America (Monsanto 1992). As previously mentioned in section 5.5, OMNR's acceptance of recommendation 80, to improve public understanding of the impacts of commercial forest use in Ontario, should help to alleviate some of the concerns hunters have expressed regarding herbicide use.

5.10 Tourism and Moose Hunting Issues

It was announced in early September 1998 that tourist outfitters would be permitted to sell moose hunting packages to non-resident hunters in local WMU's around Thunder Bay and to the west. Previously, these WMU's were reserved for use by resident hunters only. However, outfitters had a difficult time marketing expensive moose hunting packages to Ontario residents since anyone can simply purchase a license and apply for an adult tag[29]. Thus, not all tags allocated to the tourist industry were being used. These changes allowed outfitters to market tags to non-resident hunters who are more willing to pay for expensive moose hunting packages compared to Ontario residents (Beebe 1998, pers. comm.). These changes outraged Ontario resident hunters because it was thought that the number of adult tags allocated to residents was decreasing while the number allocated to tourist outfitters was increasing. What surfaced was an obvious

[29] In contrast to Ontario residents, all non-resident hunters are required to use the services of a tourist outfitter in order to legally hunt moose in the province.

difference in opinion over tag allocations between resident hunters of Ontario and tourist outfitters. As well, numerous other issues such as access and land-use became apparent as the debate continued. Therefore, a section of the questionnaire was dedicated to exploring hunters' opinions regarding various issues related to resource-based tourism in Northern Ontario (see Table 5.17).

5.10.1 Access Related Issues

Based on the mean response, respondents strongly believed they have the right to access and hunt on all of Ontario's Crown Lands (mean = 4.47). The vast majority of hunters surveyed (85%) either agreed or strongly agreed with such a right. Access is a fiercely debated issue between tourist outfitters in remote or semi-remote locations and other participants in the forest management planning process. Since hunters use access roads constructed by timber companies to hunt for moose, they inevitably become a part of the discussion. According to Ontario's Living Legacy Land Use Strategy (OMNR 1999c), remote-access Enhanced Management Areas (EMA) will not permit public use of new roads, but only permit the continued use of existing roads. Based on the survey results of this study, it appears that moose hunters in the District of Thunder Bay may not support such restrictions. However, newly proposed Resource Stewardship Agreements (RSA), in Ontario's Living Legacy, permit, in addition to tourism operators and forest license holders, other stakeholders to be involved in the agreements.

When asked if roads should be gated on Crown Lands to prevent access into tourism areas, respondents were not in favour of such restrictions (mean = 1.76). The vast majority, 70%, either strongly disagreed or disagreed with such restrictions on Crown

Table 5.17 Moose hunters' responses to statements pertaining to access, tag allocation and beliefs about tourism*

	N	Strongly disagree	Disagree	Neutral	Agree	Strongly agree	Mean	Standard error
Access Related								
Resident hunters have a right to access and hunt all of Ontario's Crown Lands	613	4.4	2.1	6.9	9.3	76.0	4.47	0.05
Roads should be gated on Crown Lands to prevent access into tourism areas	606	61.6	8.4	13.7	4.3	7.9	1.76	0.05
Existing roads should be maintained for hunters	610	17.5	11.6	35.4	13.4	19.3	2.98	0.07
Hunting may be restricted on Crown Lands but roads should not be closed to the public	607	28.7	6.3	16.8	14.3	33.9	3.15	0.06
Currently roadless areas should become road accessible to increase hunting opportunities	606	42.6	14.9	20.6	7.1	12.0	2.23	0.06
Forest harvesting should be restricted around high quality tourism areas	605	15.7	9.8	23.8	16.7	29.8	3.22	0.06
Tourist outfitters should have land set aside strictly for their uses only	611	61.5	7.2	10.6	4.4	11.3	1.82	0.06
OMNR Related								
Tourist outfitters should only be given moose tags in WMU's with a surplus of moose tags	610	13.9	7.9	18.7	17.5	38.5	3.49	0.06
Tourist outfitters should only provide moose hunting at remote (fly-in) destinations	614	11.9	8.6	21.3	15.5	38.8	3.49	0.06
Tourist outfitters are given too many moose tags	606	6.8	5.1	23.9	15.3	39.4	3.47	0.06
Beliefs about Tourism								
Tourist outfitters are important to Northwestern Ontario's economy	614	11.2	10.6	17.3	26.7	31.4	3.48	0.06
Tourism hunting opportunities are only undertaken by Americans	610	22.6	18.9	22.1	16.6	12.1	2.54	0.06
Tourism operations are owned primarily by Ontario residents	610	36.1	19.8	17.7	7.9	8.5	2.03	0.06

*Agreement or disagreement is expressed as percent of the total number of all hunters responding to each statement

Lands. According to the Timber Management Guidelines for the Protection of Tourism Values (OMNR 1987), gating of roads to prevent access into tourism areas is not mandatory, in fact, gating of roads and road closures rarely occur. As well, it is government policy that all roads built with grants or subsidies from OMNR must be open to public use (OMNR 1984, 15). However, most road construction today is not subsidized by government funding, yet respondents still believe they have the right to access and hunt all of Ontario's Crown Lands. OMNR has accepted recommendation 46 of the Consolidated Recommendations of the Round Tables (OMNR 1999b, 11), which states that the RSA's between tourism operators and forest license holders not restrict public access more than it would otherwise have been and that existing public use may continue (OMNR 1999b).

Once roads have been left open to the public for a considerable period of time while timber companies are completing their timber harvest and silvicultural work, the political pressure to keep roads open indefinitely is often extremely strong (OMNR 1984). Therefore, during all timber harvest and silvicultural work, areas may need to be closed to hunting to prevent hunters from becoming accustomed to using the area.

In general, respondents reported a neutral (mean = 2.98) rating when asked whether existing roads should be maintained for hunters. Upon closer review it was found that 19.3% of respondents strongly agreed with road maintenance while almost as many (17.5%) strongly disagreed. Combined, the results indicated that among respondents there are three distinct opinions over the issue of road maintenance: 1) a group strongly opposed to road maintenance, 2) a group neutral on the issue, and 3) a group strongly in favour of road maintenance for hunters. In written comments, some respondents questioned who would pay for maintaining roads, and how the areas that would receive road maintenance would be determined. Recommendations 109 and 110 of the Consolidated Recommendations of the Round Tables (OMNR 1999b, 21) have been accepted in principle by OMNR which require current access restrictions to be reduced by improving road maintenance and lifting closures as well as encouraging recreational user involvement in public access road maintenance partnerships.

When respondents were asked if hunting may be restricted on Crown Lands but roads should not be closed to the public, the mean response was neutral (mean = 3.15). However, again a polarization of opinions was found. Given that hunters are universally opposed to closing roads, is was discovered that virtually an equal percentage of hunters are agreeable (34%)/disagreeable (29%) to restricting hunting on Crown lands.

Overall, the statement "currently roadless areas should become road accessible to increase hunting opportunities" was not supported by respondents (mean = 2.33). Approximately 58% of respondents disagreed or strongly disagreed with the statement, indicating that if an area is not road accessible, they apparently do not desire to hunt there. Therefore, hunters do not demand new roads, but they are willing to use roads after they are built.

Overall, respondents' mean rating for timber harvest restrictions around high quality tourism areas was neutral (mean = 3.22). Yet, 46.5% of respondents agreed or strongly agreed that such restrictions should be in place to protect high quality tourism areas. Based on this result, recommendation 47 of the Consolidated Recommendations of the Round Tables (OMNR 1999b, 11) may have the support of a large proportion of moose hunters sampled here. OMNR accepted in principle recommendation 47 which would establish minimum guidelines for buffers around outpost camps; where no longer needed for resource access, tertiary roads within 1 km of a water body would be rehabilitated to a natural state. However, the rehabilitation of roads to a natural state is likely to receive a negative response from hunters based on their responses to questions about rights of access reported above.

Tourist outfitters favour timber harvesting restrictions around their establishments, to mitigate the various problems associated with logging operations (e.g. perceptual and real effects). Thus, respondents were asked if they agreed or disagreed with tourist outfitters having land set aside strictly for their use only. Overwhelmingly, respondents were not in favour of restricted land use for tourist outfitters only (means = 1.82). Over 68% of respondents disagreed or strongly disagreed with the statement. This apparent lack of support arises since most tourism establishments in Northern Ontario are located on Crown Lands and the right people perceive they have to access all of Ontario's Crown Lands, as discussed earlier.

5.10.2 OMNR Related Issues

Due to the negative response of hunters towards the announcement of opening previously resident-only WMU's to non-resident hunting, three statements pertaining to tourist outfitters allocation of moose tags were posed. Overall, respondents agreed slightly that tourist outfitters should only be allocated moose tags in WMU's with a surplus (mean = 3.49). Upon closer inspection, 56% of respondents agreed or strongly agreed with the statement compared to only 22% in disagreement. It appears that respondents believe they, as resident hunters, should have preference over other resource users when it comes to tag allocation. A similar preference was identified when OMNR held public meetings in 1979 (OMNR 1980b).

Respondents generally agreed with the statement that tourist outfitters should only provide moose hunting at remote (fly-in) destinations (mean = 3.49). Fifty-four percent of respondents strongly agreed (or agreed) with the statement, while only 20.5% disagreed. In written comments, some respondents expressed a dislike to encountering non-resident hunters from road-based tourist establishments. However, no respondent provided any detailed comments as to their rationale for disliking encounters with non-resident hunters.

Finally, respondents were asked if they agreed or disagreed with the following statement, "tourist outfitters are given too many moose tags." Respondents expressed opinions that were slightly in agreement with the statement (mean = 3.47). In fact, 39.4% strongly believed that tourist outfitters are given too many moose tags. Only a small percentage (11.9%) disagreed to any extent with the statement. During a major review of the moose management program in 1979, Ontario hunters supported a 10% allocation of adult moose tags to the tourist industry (OMNR 1980b). In recent years, as apparent from the results here, it appears as if moose hunters may want the 10% allocation reconsidered. One possible explanation for this change in hunter opinion since 1979 is that the total number of adult validation tags in northcentral Ontario has been reduced from 17,974 tags in 1983 to 9,561 in 1992 (Timmermann and Whitlaw 1992). Meanwhile, the number of hunters province-wide has steadily increased from less than 80,000 in 1980 to over 100,000 in 1998 (Bisset 1991, OMNR 1999a). As a result, there is now greater demand for hunting, while fewer adult tags are available. Resident hunters in the District of Thunder Bay apparently believe more tags should be allocated to them at the expense of the tourist operator. However, from the opposite perspective, Hunt et al. (1999 - in progress) surveyed tourist outfitters regarding the effects of timber management on their establishments. According to that study, outfitters felt that they were seriously disadvantaged in the allocation of moose tags; as a matter of fact, they evaluated this issue as less satisfactory than any other question, including timber management issues.

5.10.3 Beliefs about Tourism

As evident from previous sections and written comments, hunters appear to exhibit some resentment towards tourist outfitters in Northern Ontario. It is generally believed that much of this resentment stems from misconceptions derived from lack of pertinent information. Thus, three statements were posed to gain insight into beliefs respondents held regarding tourist outfitters in Northern Ontario. If misconceptions are present, identifying them is the first step towards alleviating them.

Respondents generally agreed that tourist outfitters are important to Northwestern Ontario's economy (mean = 3.46). In 1996, total touristic activity generated $1.16 billion in Northern Ontario, of which $461.7 million was spent by visitors involved in resource-based activities such as moose hunting (Ministry of Economic Development, Trade and Tourism 1998, 3). Moreover, in 1993, resident and non-resident moose hunters combined to contribute almost $60 million to Ontario's economy (Legg 1995).

During the debate over the opening of previously resident-only WMU's to non-resident hunting, some hunters expressed concern that American residents seeking hunting opportunities in Northern Ontario were doing so at the expense of the resident hunter. Therefore, respondents were asked if they believed that tourism hunting opportunities were only undertaken by Americans. Respondents disagreed (mean = 2.54), with almost 23% strongly disagreeing. However, approximately thirty percent

(28.7%) agreed with the statement, indicating that perceptions vary greatly over the origin of most non-resident hunters.

Within the same debate, hunters also expressed concern over who were the primary owners of tourism operations in Northern Ontario. Therefore, respondents were asked if they agreed or disagreed with the following statement, "tourism operations are owned primarily by Ontario residents." Results indicated that most respondents disagreed that tourism establishments were primarily owned by Ontario residents (mean = 2.03), with 36% strongly disagreeing with the statement. As well, this statement received numerous written comments from respondents, many of whom believed that tourist operations in Ontario were primarily owned by Americans or are being bought by Americans because of the low value of the Canadian dollar. However, according to one official of the Ministry of Economic Development, Trade and Tourism (Van Wagoner 1999, pers. comm.), all tourist operations are licensed businesses of Ontario, and according to a conservative estimate, 95% are owned by Ontario residents.

5.11 Present Hunting Environment

According to Thomas et al. (1976, 500), understanding the behaviour of hunters is as important in game management as knowing game and its habitat. Thus, to understand better where and why people choose to hunt moose, respondents were asked to describe the major characteristics of their current moose hunting area. Results obtained are well suited for comparisons between users and environmental attributes. Therefore, several comparisons are made in subsequent sections to explore hunters' present hunting environments with successfully harvesting a moose, the evidence of moose in one's area, and a comparison of present hunting environments between respondents in WMU's 13 and 15B. First, a brief discussion of the most frequently reported variables by respondents will take place (see Table 5.18).

5.11.1 Most Common Hunting Environment

Almost 70% of respondents hunted at a location less than 150 kilometres from home, while only 3% hunted 250 kilometres or more from home. Approximately 50% of respondents reported the type of vehicle requirement that best represented the access situation in one's moose hunting area was a two-wheel-drive (2wd) vehicle that could access 70% of the area[30]. Not surprising, only a small percentage (4.4%) of respondents hunted in an area that is only accessible by boat. This small percentage illustrates the overwhelming popularity of road-accessible hunting environments. On an average hunting day, 86% of respondents reported seeing evidence of at least one moose every two or more days or evidence of 1 to 2 moose per day. On a normal day, during the first 3 weeks of the moose hunting season, over 30% of respondents encountered 4 to 6 other hunting parties in their hunting area. Encounters decreased for the remainder of the season, for which a large majority (68%) reported encountering only 1 to 3 other hunting parties in the area. When asked to think about one's moose hunting area, and the kinds of cutovers typically found there, 62% reported most frequently hunting in cutovers that were 5 years old or less. To respondents, the height of regeneration typically found in these cutovers corresponds well to the age of the cutover. According to 71% of hunters sampled, the typical height of vegetation regenerating in cutovers most frequently hunted in was 2 m in height or less. The majority of respondents (62%) hunted in cutovers where the primary forest type regenerating was mixedwood. Surprisingly, more respondents

Table 5.18 Present hunting environments of hunters sampled

a) One way distance from home N=626	Percent
Less than 150 km	68.8
150-200 km	19.6
200-250 km	8.1
250-300 km	2.2
Greater than 300 km	1.1
b) Access within hunting area N=615	
70% by 2wd	47.2
50% by 2wd	31.2
30% by 2wd	16.7
Area only accessible by boat	4.4
Area only accessible by aircraft	0.5
c) Evidence of moose in area N=620	
1-2 moose every two or more days	49.8
1-2 moose per day	36.1
3 or more moose per day	14.0
d) Encounters during the first 3 weeks of the season N=618	
0-3 other hunting parties	27.3
4-6 other hunting parties	32.7
7-9 other hunting parties	14.4
10 or more other hunting parties	25.6
e) Encounters during the rest of the season N=570	
No other hunting parties	17.9
1-3 other hunting parties	68.4
4 or more other hunting parties	13.7
f) Age of cutovers in area N=621	
No cutovers or logging activity	3.9
1-2 years old	16.3
2-5 years old	46.5
5-10 years old	24.5
More than 10 years old	8.9
g) Height of regeneration in area N=611	
Less than 1 m	26.7
1-2 m	44.8
2-3 m	15.9
Greater than 3 m	7.0
Mature forest	5.6

[30] Four-wheel-drive (4wd) vehicles were said to be able to access 100% of the hunting area, regardless of road condition or terrain.

Table 5.18 Present hunting environments of hunters sampled (cont'd)

h) Forest type in regeneration area N=612	Percent
Conifer	28.9
Hardwood	8.4
Mixedwood	62.4
i) Herbicide treatment N=614	
Unsure	31.9
All cutovers hunted are treated	3.6
Some cutovers hunted are treated/untreated	39.9
All cutovers hunted are untreated	24.6
j) Distance covered in one day while driving N=604	
Less than 20 km	31.6
20-40 km	30.5
40-60 km	14.2
Greater than 60 km	23.7
k) Distance covered while walking when hunting N=598	
Less than 2 km	12.9
2-5 km	52.3
6-10 km	30.3
Greater than 10 km	4.5
l) Hunt alone or in a group N=625	
Hunt alone	13.8
Hunt in a group	86.2
m) Number of members in your group N=527	
2-4 group members	78.9
5-8 group members	19.2
9-12 group members	1.9

hunted cutovers regenerating in conifer rather than hardwood; the former are of less use to moose during early stages of growth compared to hardwood stands[31].

A relatively high percentage of respondents (32%) were unsure if the cutovers they hunted in had been treated with herbicides. However, of those respondents that reported no knowledge, 40% still hunted in areas with cutovers that were both treated and

[31] Recent hardwood cutovers typically provide moose with an abundance of low-growing, palatable browse. In contrast, conifer cutovers become of greater use to moose when regeneration provides adequate cover from environmental elements (e.g. deep snow) as well as an abundance of browse from shade tolerant browse species.

untreated with herbicides. When asked to indicate the approximate distance that one typically traveled while driving and on foot during a day hunting moose, 60% of respondents were evenly split between less than 20 km and 20 to 40 km of driving; meanwhile over 50% of respondents traveled between 2 and 5 km per day on foot. Finally, respondents were asked if they hunted moose alone or in a group, and if they hunted in a group, with how many hunters. Overwhelmingly, 86% of hunters hunt in a group in which 79% reported hunting with 2 to 4 group members.

5.11.2 Hunter Success

To explore the data further, responses to all 12 questions were subjected to chi-square tests against success (in 1997) to determine if there was any relationship between characteristics of a hunting location and success[32]. A statistically significant difference emerged between the amount of moose evidence observed in one's area (χ^2=19.298, df=2, $p<0.05$) and success. Forty-two percent of respondents who reported evidence of three or more moose per day in their hunting area successfully harvested a moose, compared to 26.4% and 19.0% of respondents with evidence of 1 to 2 moose per day and 1 moose every two or more days respectively. More than 36% of successful respondents hunted in cutovers with regeneration 2 to 3 m in height (χ^2=9.773, df=4, $p<0.05$), followed by 26.5% in cutovers with regeneration less than 1 m in height. Similar results were found by Lyon and Burcham (1998), where Colorado elk hunters also prefer to hunt in areas where the hiding cover is low and visibility is high.

It has been proposed by many that restricting access into new cutovers until suitable cover for moose is available will not only reduce moose vulnerability to hunters

[32] All Chi-square tests for section 5.11.2 are found in Appendix II, Tables A.10 to A.12.

but is essential to protect the moose resource from potential local over-harvests and to increase the moose population in many areas (Eason et al., 1981; Tomm et al., 1981; Timmerman and Gollat, 1983; Eason, 1985; Ferguson et al., 1989; Rempel et al., 1997). However, hunters' support for such restrictions was tested by Simmons (1998) who found that moose hunters were not willing to support such restrictions.

Although other chi-square tests were not significant, some expected and unexpected trends in the data are noteworthy[33]. Thirty-one percent of respondents who hunted in 1 to 2 year old cutovers successfully harvested a moose in 1997, followed by 27.2% and 23.0% of hunters in cutovers 5 to 10 and 2 to 5 years old respectively. Finally, 30% of all hunters sampled who hunted in cutovers with hardwood regeneration were successful, compared to 24.4% and 24.1% in mixedwood and conifer regenerating cutovers.

5.11.3 Evidence of Moose

In addition to an aerial census, the OMNR uses moose hunter sightings to determine if moose populations are increasing or decreasing (Timmermann and Rempel 1998). Thus, the evidence of moose in one's hunting area may be used to gain insight into where more moose are seen based on the environmental attributes of a hunter's present hunting environment.

Seventy-seven percent of respondents who reported evidence of 3 or more moose per day hunted in cutovers 2 to 5 (50%) or 5 to 10 (26.7%) years old. The most frequently reported height of regeneration where 3 or more moose per day were seen was in cutovers containing 1 to 2 m regeneration (37.6%). Cutovers with less than 1 m

[33] The relevant Chi-square tables are not included in the thesis.

(28.2%) and 2 to 3 m (24.7%) regeneration also reported relatively high observations of three or more moose per day. Overwhelmingly, almost 70% sightings of 3 or more moose per day occurred in cutovers where the predominant forest type regenerating is mixedwood.

Lastly, a significant difference was found between frequent moose sightings and herbicide treatment (χ^2=13.099, df=6, $p<0.05$) (see Appendix II, Table A.12). Significantly more respondents who reported evidence of 3 or more moose per day hunted in cutovers that either have no herbicide treatment or only some treatment. In a study area north-east of Thunder Bay, Connor and McMillan (1988) found that moose preferred non-sprayed control areas to treated areas. They also found that after one growing season, "the amount of browse removed from controls was 12 times greater than that from treated areas… and estimated densities of moose were nearly 3 times greater on the controls" (Connor and McMillan 1988, 141). Several other studies support these results that herbicide-treated cutovers have a noticeable reduction in available foods used by moose over a relatively short period of time (0-4 years) (Kennedy and Jordan 1985, Cumming 1989, Newton et al. 1989, Kelly and Cumming 1992, 1994), potentially resulting in moose migrating to higher quality patches where browse is of greater abundance.

5.11.4 Comparison of Hunting Environments by Wildlife Management Unit

This section compares respondents' present hunting environments for the two most frequented WMU's by respondents of this study, WMU's 13 and 15B. Significantly more respondents in WMU 15B hunted in a group compared to hunters in WMU 13

(χ^2=8.717, df=1, p<0.05)[34]. Also, the size of the group was greater in WMU 15B (χ^2=13.946, df=2, p<0.05)[35], in which 66.7% of respondents hunted in a group of 2 to 4 hunters, 29.5% with 5 to 8 other hunters, and 3.8% in a group of 9 to 12 other hunters. In contrast, more respondents from WMU 13 hunted in smaller groups of 2 to 4 hunters (83.0%), with 16.2% and only 0.9% in groups of 5 to 8 and 9 to 12 other hunters, respectively.

Reflecting upon respondents' success in WMU's 13 and 15B, respondents from WMU 15B were slightly more successful than their counterparts. When success was compared against group size to determine if hunters in larger groups were more successful, a chi-square test confirmed this hypothesis (χ^2=11.154, df=2, p<0.05). Crichton (1993) found similar results with Manitoba moose hunters.

Hunters' responses to encounters during the first 3 weeks of the season, age of cutovers, height of regeneration in cutovers, forest type and herbicide use in their area were all significantly different between the two WMU's. Respondents in WMU 15B encountered a greater number of hunting parties during the first 3 weeks of the season compared to respondents in WMU 13 (χ^2=12.020, df=3, p<0.05). Respondents in WMU 15B hunted more often in cutovers 2 to 5 and 5 to 10 years old, whereas those in WMU 13 spent more time in cutovers that are greater than 10 years old or where there is no logging activity (χ^2=11.358, df=4, p<0.05). Seventy-nine percent of WMU 15B respondents hunted in cutovers with regeneration 2 m in height or less compared to only 68.0% in WMU 13 (χ^2=12.818, df=4, p<0.05). More respondents in WMU 13 hunted in cutovers where the predominant forest type regenerating is mixedwood (χ^2=6.727, df=2,

[34] See Appendix II, Tables A.13 to A.20 for all chi-square tables comparing the two WMU's and the various aspects of the present hunting environments.

p<0.05). In contrast, WMU 15B respondents hunted more often in cutovers with conifer regeneration. Lastly, more respondents in WMU 13 hunted in cutovers that have not been sprayed with herbicides, compared to WMU 15B (χ^2=10.696, df=3, p<0.05).

Differences between the two WMU's are explored further in section 5.12.3, where the responses to the choice experiment are analyzed by WMU. But first, the general DCE and some basic segmentation will be presented, and significance of the findings with regards to moose and forest management and to land use planning will be discussed.

5.12 Discrete Choice Experiment

Moose hunters' preferred forested environments were also investigated using a discrete choice experiment, which provides a means to model hunters' tradeoffs between a variety of environmental and social attributes. The study considered the following attributes: distance from home, moose populations, varying levels of crowding and access, presence of lakes, and forestry-related impacts (see Table 4.1).

The multinomial logit choice model was estimated using the maximum likelihood technique supplied with NTELOGIT, version 2.0 (Intelligent Marketing Systems Inc. 1993) software. A general model was estimated for the entire sample, and segmented models were estimated for the two WMU's, and two age groups. First, results from the general model are discussed, followed by comparisons between segmented models. Finally, the discussion will assess these results in the context of moose and forest management as well as land-use planning.

[35] Chi-square test was significant, however, the expected cell count exceeded the 20% minimum requirement for acceptance in this study.

5.12.1 General Model

The results of the general model can be found in Table 5.19, where the parameter estimates, their standard errors, and t-values are listed[36]. According to Ben-Akiva and Lerman (1985, 29), the t-values in multinomial logit choice models relate to the informal (or quasi) t-test, in which values greater than +2 or less than -2 indicate significance of the respective parameter at the 0.05 level. A high rho-square value ($\rho^2 = 0.758$) for the general model indicates a highly reliable fit. Furthermore, the estimated coefficients of the parameters have the expected signs. The likelihood ratio test (G^2), a joint test of the goodness-of-fit of several parameters, exceeded the χ^2 value allowing for the rejection of the null hypothesis that all the parameters are simultaneously equal to zero. Appendix III contains the results of the statistical test used to determine if the IIA had been violated. The test suggested that IIA was not violated. A detailed discussion of each variable follows.

The intercept (constant) compares the 0-scenario (all parameter estimates set to 0) with the base alternative of not going moose hunting in the choice experiment. The utility associated with the constant is negative, suggesting that hunters would react negatively to not going hunting, which makes intuitive sense.

The most important attribute of the choice experiment was the linear estimate of distance from home to the hunting area[37]. An increase in distance decreases the probability of that site being chosen. Given the cost in terms of dollars and time for travel this is to be expected. Furthermore, approximately 50% of all hunters sampled hunted in

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[36] Parameters for the third variable levels were calculated in the following ways: estimate = the negative sum of the other two estimates; standard error = the average of the other two standard errors (this parctice is an approximation only, but acceptable for generic DCE's); and the t-value is calculated by dividing the estimate by the standard error.

[37] In all model runs, the quadratic distance estimate was not significant and therefore cannot be calibrated in the final model.

Table 5.19 General model of all respondents

Attribute levels[38]	Estimate[39]	Std Error	t-stat*
intercept	-0.284	0.033	**-8.58**
distance-lin (km from home)	-0.799	0.029	**-27.24**
access (~70% by 2wd)	0.043	0.031	1.39
access (~50% by 2wd)	0.026	0.032	0.83
access (~30% by 2wd)	-0.069	0.031	**-2.23**
encounters (4+ groups)	-0.545	0.033	**-16.49**
encounters (1-3 groups)	-0.003	0.032	-0.12
encounters (0 groups)	0.548	0.032	**17.13**
lakes (many)	0.295	0.035	**9.09**
lakes (few)	0.126	0.032	**3.93**
lakes (none)	-0.421	0.034	**-12.38**
moose (3+ per day)	0.347	0.032	**10.92**
moose (1-2 per day)	0.146	0.032	**4.57**
moose (<1 per day)	-0.493	0.032	**-15.41**
regeneration (>2 m in height)	-0.241	0.033	**-7.31**
regeneration (1-2 m in height)	0.036	0.032	1.14
regeneration (<1 m in height)	0.205	0.032	**6.40**
forest type (hardwood)	0.071	0.033	**2.13**
forest type (conifer)	-0.071	0.033	**-2.13**

LL (0)	=	-1238.72
LL (B)	=	-286.29
G^2	=	1904.87
AIC	=	600.57
Rhosq	=	0.769
Rhosq^{A}	=	0.758

*Significant t-stat values are in bold

WMU 13, located immediately adjacent to the City of Thunder Bay, contributing further to the strong disutility of distance. McLeod (1995) noted that hunters want to arrive at their hunting area as quickly as possible to begin their activities (set up camp, scout area, begin hunting, etc.). A negative utility associated with increasing distance from home was also found by Morton (1993) and Boxall et al. (1996).

[38] See Table 4.1 for complete attribute level definitions.
[39] The third estimate is calculated by taking the negative sum of the other two estimates.

Small parameter estimates and insignificant t-values indicate that an abundance of access (70% and 50% by 2-wheel drive) was not important in the site selection process. However, sites with limited access (30% access by 2wd) were significant and yielded a negative utility. This suggests that although an abundance of access may not be important, a point is reached when the level of access becomes too restrictive. It should be noted that the most frequently used vehicle by moose hunters during the hunt was a 4-wheel-drive vehicle[40], and according to the choice scenarios, all areas were assumed to be accessible by 4-wheel-drive vehicle. This may explain why overall access does not appear to be an important part of the site selection process.

As previously discussed in section 5.3.2, an important locational characteristic for hunting site selection was to have an uncrowded area to hunt. Therefore, not surprisingly, the highest crowding level in the choice experiment, encountering 4 or more other hunting parties, yielded a large negative utility. Such conditions severely decrease the probability of a respondent choosing to hunt at that site. Intuitively, respondents do not desire to be surrounded by other hunters unless they are members of their party. Some hunters are not willing to tolerate others who hunt in the same area as them, acting almost territorial (Thomas et al. 1973). Respondents may also believe that with increasing number of encounters with other hunters, the likelihood of being successful decreases. However, when the number of encounters with other hunting parties during the first three weeks of the season was compared against hunter success, no difference was found[41].

[40] See Table A.21 in Appendix II for table of most frequently used vehicle by moose hunters during the hunt.
[41] No statistical difference was found in a Chi-square test between success in 1997 by encounters with other hunting parties during the first three weeks of the season (χ^2=0.717, df=3, p<0.869) (see Appendix II, Table A.22).

During the rut and early in the moose hunting season, moose are typically found near bodies of water. Therefore, a three-level variable pertaining to the presence of lakes in an area was included in the choice to determine if respondents focused on areas that contained an abundance of water bodies. Sites in which many lakes were present yielded a positive utility, suggesting that respondents preferred to have an abundance of water present in the area they chose to hunt moose.

The third most important variable was the perception of moose population in the area, expressed in encounters of moose sightings per day. Respondents were more likely to select an area if it had evidence of a large moose population present compared to other areas where moose populations were lower. Intuitively, all respondents would like to hunt in areas where moose abound, however, few areas exist in Northern Ontario. Yet, where moose are abundant, such areas are likely to attract many hunters producing crowded conditions, a condition which previously resulted in a negative utility. In contrast to McLeod (1995), and to a lesser extent Morton (1993), respondents in this study did not place as much importance on a large moose population[42].

According to previously discussed results, approximately 95% of all respondents hunted in cutovers. Often, the height of regeneration determines the visibility of moose to hunters, which can influence hunters' preference of cutovers. It was found that as regeneration height in cutovers increased, the likelihood of respondents choosing to hunt there decreased. Regeneration greater than 2 m in height yielded a highly negative utility; in contrast, when cutover regeneration was found to be less than 1 m in height, a positive utility was found. Model results illustrate that respondents preferred to hunt where the height of regeneration would allow them plenty of visibility into cutovers. It has been

[42] Hunters selecting hunting sites for reasons other than game was also found by Thomas et al. (1976).

proposed by many that restricting access into new cutovers until suitable cover for moose is available will not only reduce moose vulnerability to hunters but is essential to protect and increase the moose population in many areas (Eason et al., 1981; Tomm et al., 1981; Timmerman and Gollat, 1983; Eason, 1985; Ferguson et al., 1989; Rempel et al., 1997). However, according to Simmons (1998), hunters are not willing to support restrictions on moose hunting in new cutovers and using new forest roads. It appears that the results of this study support the findings of Simmons (1998).

Lastly, the type of vegetation regenerating in cutovers often influences cutover use by moose. Fresh hardwood cutovers typically provide moose with an abundance of short, palatable browse plants, whereas conifer cutovers become more useful to moose when regeneration heights provide moose with adequate cover. Consequently, respondents attributed a positive utility to cutovers with hardwood regeneration, and evaluated conifer regenerating cutovers negatively.

5.12.2 Segmentation Based on Hunters using WMU's 13 and 15B

The information collected in earlier sections of the questionnaire can be used to split the total sample into behavioural subgroups. The respective estimates derived from modelling the choice behaviour of different subgroups are comparable among each other (Haider 1991, 119). Model estimates can be compared with the asymptotic t-test of equality of individual coefficients devised by Ben-Akiva and Lerman (1985, 202)[43]. Once

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[43] Asymptotic t-test values greater than +2 or less than -2 indicate significant differences between respective parameters at the 0.05 level (1.96 for the two-tailed test to be precise). Asymptotic t-test values are derived from the following formula:

$$t_{equ} = \frac{E_1 - E_2}{\sqrt{s_1^2 + s_2^2}}$$

where,
E_1, E_2 are the two estimates and s_1, s_2 are the respective standard errors.

differences between estimates are identified by the asymptotic t-test, comparing estimates of the identified attribute helps to explain the findings.

Two models were estimated using respondents who hunted in WMU's 13 (N=294) and 15B (N=146), the two most popular WMU's in this study. Both models have good fits, with McFadden's rho-square values of ρ^2=0.70 and ρ^2=0.62 respectively[44].

A comparison between the two WMU models produced significant differences in five of the 19 estimates (Table 5.20). Respondents from WMU 13 were much less sensitive to the base option of not going hunting compared to their counterparts in WMU 15B. The model suggests that hunters from WMU 15B are much more reluctant to abandon the activity of moose hunting, as illustrated by a large negative utility.

Respondents from WMU 13 were more sensitive to the distance parameter than their counterparts, likely attributed to the fact that WMU 13 is located directly adjacent to the City of Thunder Bay. In contrast, the closest hunting opportunities in WMU 15B are located at least 100 km north of the city (see Figure 1).

In section 5.11, respondents from WMU 15B were reported to encounter a greater number of hunting parties compared to their counterparts; thus WMU 15B hunters may be more tolerant of frequent encounters. Therefore, if previous results are correct and respondents from WMU 13 do not encounter as many hunters, the model would predict that these respondents are more sensitive to crowding. As it turns out, the stated choice model produced the same results, in that respondents from WMU 13 were more sensitive to crowding while respondents from WMU 15B were less sensitive.

Lastly, respondents from WMU 15B showed greater preference for hunting in

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[44] Both models also have parameters with expected signs, have likelihood ratio test values greater than χ^2 values, and do not violate the IIA test.

Table 5.20 Estimated models for WMU's 13 and 15B and asymptotic t-test of equality between models*

Attribute levels	WMU 13 Model Estimate	WMU 13 Model Std Error	WMU 13 Model t-stat	WMU 15B Model Estimate	WMU 15B Model Std Error	WMU 15B Model t-stat	Asymptotic T-test^
intercept	-0.060	0.047	-1.36	-0.742	0.076	**-9.81**	**7.63**
distance-lin (km from home)	-0.901	0.043	**-20.82**	-0.717	0.060	**-12.00**	**-2.49**
access (~70% by 2wd)	0.047	0.047	0.99	-0.029	0.063	-0.47	0.97
access (~50% by 2wd)	0.000	0.047	-0.01	0.052	0.065	0.80	-0.65
access (~30% by 2wd)	-0.047	0.047	-1.00	-0.023	0.064	-0.36	-0.30
encounters (4+ groups)	-0.605	0.050	**-12.07**	-0.420	0.067	**-6.27**	**-2.21**
encounters (1-3 groups)	0.030	0.048	0.62	-0.111	0.065	-1.71	1.75
encounters (0 groups)	0.575	0.049	**11.73**	0.531	0.066	**8.05**	0.54
lakes (many)	0.215	0.050	**4.35**	0.433	0.066	**6.52**	**-2.63**
lakes (few)	0.149	0.048	**3.10**	0.100	0.067	1.51	0.59
lakes (none)	-0.364	0.049	**-7.43**	-0.533	0.066	**-8.08**	**2.06**
moose (3+ per day)	0.338	0.047	**7.06**	0.365	0.065	**5.64**	-0.34
moose (1-2 per day)	0.203	0.048	**4.22**	0.159	0.066	**2.43**	0.54
moose (<1 per day)	-0.541	0.047	**-11.51**	-0.524	0.065	**-8.06**	-0.21
regeneration (>2m in height)	-0.216	0.049	**-4.34**	-0.181	0.066	**-2.72**	-0.43
regeneration (1-2m in height)	0.007	0.048	0.14	-0.013	0.064	-0.21	0.25
regeneration (<1m in height)	0.209	0.048	**4.35**	0.194	0.065	**2.98**	0.19
forest type (hardwood)	0.075	0.047	1.60	0.176	0.076	**2.32**	-1.13
forest type (conifer)	-0.075	0.047	-1.59	-0.176	0.076	**-2.30**	1.13

	WMU 13 Model	WMU 15B Model
LL (0)	-679.76	-428.19
LL (B)	-193.33	-151.180
G^2	972.87	554.010
AIC	414.65	330.360
Rhosq	0.716	0.647
Rhosq^	0.695	0.615

*Significant t-stat and Asymptotic T-test values in bold.

^Bold Asymptotic T-test values indicate significant differences between model estimates.

areas with an abundance of lakes. This particular relationship is difficult to explain because of the vast number of lakes found in Northern Ontario. However, in general, respondents in WMU 13 receive about half the utility from areas with many lakes compared to respondents in WMU 15B.

5.12.3 Segmentation Based on Hunter Age

Throughout this project many analyses have been conducted by age to test if age had any influence on behaviour or attitude. To determine if this premise applies to site preference, two models were developed using respondents' age; 1) a 'younger' model that contained site preferences of respondents 45 years of age and younger (N=350), and 2) an 'older' model containing respondents' site preferences of hunters 46 years of age or older (N=272)[45]. Both models have good fits, with a McFadden's rho-square of ρ^2=0.72 for the younger model, and ρ^2=0.62 for the older model[46] (Table 5.21). Four of the 19 estimates were significantly different at the 0.05 level.

Not surprisingly, older respondents showed less of a negative response to the base option of not hunting compared to younger respondents. This relationship may be explained by the evolutionary stages proposed by Jackson and Norton (1979), according to which younger hunters are more harvest oriented, thus placing greater emphasis on the hunt (or at least participation in the hunt). In contrast, older hunters are more motivated by other experiences, placing less emphasis on the hunt. Another difference

[45] Age categories were reduced from three to two in order to maintain reasonable sample sizes for the respective segments.
[46] Both models also have parameters with expected signs, likelihood ratio test values greater than χ^2 values and do not violate the IIA test.

Table 5.21 Estimated models for Younger and Older age segments and asymptotic t-test of equality between models*

	Younger Model			Older Model			
Attribute levels	**Estimate**	**Error**	**t-stat**	**Estimate**	**Error**	**t-stat**	**Asymptotic T-test^**
intercept	-0.380	0.046	**-8.32**	-0.159	0.049	**-3.26**	**-3.29**
distance-lin (km from home)	-0.840	0.040	**-21.19**	-0.740	0.044	**-16.73**	-1.68
access (~70% by 2wd)	0.011	0.043	0.26	0.069	0.046	1.49	-0.92
access (~50% by 2wd)	0.003	0.043	0.07	0.062	0.047	1.32	-0.93
access (~30% by 2wd)	-0.014	0.043	-0.33	-0.131	0.046	**-2.85**	1.86
encounters (4+ groups)	-0.593	0.045	**-13.21**	-0.489	0.050	**-9.83**	-1.55
encounters (1-3 groups)	-0.029	0.043	-0.68	0.029	0.048	0.60	-0.90
encounters (0 groups)	0.622	0.044	**14.14**	0.460	0.049	**9.39**	**2.46**
lakes (many)	0.303	0.045	**6.79**	0.282	0.048	**5.86**	0.32
lakes (few)	0.131	0.044	**2.96**	0.120	0.048	**2.52**	0.17
lakes (none)	-0.434	0.044	**-9.86**	-0.402	0.048	**-8.38**	-0.49
moose (3+ per day)	0.423	0.044	**9.72**	0.273	0.047	**5.79**	**2.33**
moose (1-2 per day)	0.184	0.044	**4.21**	0.098	0.048	**2.06**	1.32
moose (<1 per day)	-0.607	0.044	**-13.80**	-0.371	0.047	**-7.89**	**-3.67**
regeneration (>2m in height)	-0.278	0.045	**-6.21**	-0.200	0.049	**-4.05**	-1.17
regeneration (1-2m in height)	0.040	0.043	0.94	0.041	0.047	0.87	-0.02
regeneration (<1m in height)	0.238	0.044	**5.41**	0.159	0.048	**3.31**	1.21
forest type (hardwood)	0.102	0.046	**2.22**	0.047	0.049	0.96	0.82
forest type (conifer)	-0.102	0.046	**-2.21**	-0.047	0.049	-0.96	-0.82

Younger Model			Older Model		
LL (0)	=	-873.79	LL (0)	=	-487.56
LL (B)	=	-230.28	LL (B)	=	-171.450
G^2	=	1287.02	G^2	=	632.210
AIC	=	488.57	AIC	=	370.910
Rhosq	=	0.737	Rhosq	=	0.648
$Rhosq^{\wedge}$	=	0.720	$Rhosq^{\wedge}$	=	0.619

*Significant t-stat and Asymptotic T-test values in bold.

^Bold Asymptotic T-test values indicate significant differences between model estimates.

was found between encounters with other hunting parties and respondents' age. Younger respondents placed more emphasis on hunting areas where they were likely to encounter fewer hunters, possibly stemming from a belief that hunting in areas where one encounters many other hunting parties will lower one's chances of harvesting a moose. Older respondents in contrast, who placed less emphasis on harvesting a moose, may be more willing to tolerate increased encounters because they are less concerned about success. Young respondents indicated a negative preference for areas with few moose but were extremely attracted to areas with an abundance of moose. In previous sections, younger respondents were more motivated towards the hunt and indicated greater preference for areas with a good chance to harvest a moose[47]. In contrast, older respondents rated similar motivations and locational characteristics not as high as their younger counterparts.

[47] See section 5.3 for motivational and factors deemed important when deciding where to hunt moose.

CHAPTER 6 - CONCLUDING REMARKS

Moose hunting is an important recreational activity in Northern Ontario, and is likely to continue to be so in the future. However, as demands on Ontario's land base continue to grow from an increasing number of competing user groups, hunting will likely be subject to even stricter regulations. In this study, human dimensions research was used to gather information that related directly or indirectly to Ontario's Living Legacy Land Use Strategy (1999), Term and Condition 80 of the Reasons for Decision and Decision - Class Environmental Assessment by the Ministry of Natural Resources for Timber Management on Crown Lands in Ontario (Ontario Ministry of the Environment 1994), the Crown Forest Sustainability Act (1995), moose hunting regulations, and biological issues in moose management. Never before have the stewards of our natural resources found it so necessary to include stakeholders' attitudes and opinions in the planning process; human dimensions research is one way of doing so. The hunting public has become increasingly involved in formulating new policy objectives and management strategies, and holds those responsible for managing our natural resources accountable in a court of law if necessary. Therefore, incorporating various forms of human dimensions research into the planning process should produce land-use and management strategies that are more likely to be widely accepted by the hunting community.

The primary objectives of this study were to examine hunters' attitudes, preferences, and support for a variety of hunter and management-related issues. As well, for the first time in Ontario, a discrete choice experiment was used to explore how changes in environmental and social attributes influenced hunter site selection.

6.1 Summary of Primary Research Findings

6.1.1 Registration

Hunters' support for mandatory registration was first documented during a series of public meetings held by OMNR in 1979 (OMNR 1980), and again by Hansen (1995). Here, respondents supported all three modes of registration proposed, especially registration by phone or postcard. OMNR has accepted recommendation 129 of the Consolidated Recommendations of Ontario's Round Tables to develop, maintain, and keep current a wildlife database that would allow staff to use the best available information to make sound planning and management decisions (OMNR 1999b, 24). OMNR has also accepted, or accepted in principle, several other recommendations to work with stakeholders (e.g. hunters) to monitor harvests and collect harvest data (recommendation 124), review big game population targets (recommendation 121), ensure that recreational harvests of game are within sustainable limits (recommendation 122), and that field staff take appropriate action to achieve those targets (recommendation 121) (OMNR 1999b, 23-24). Since OMNR has stated that enhanced data management is a Ministry priority (OMNR 1999b, 24), the results of this study should confirm the willingness of hunters to contribute biological data essential for population management.

6.1.2 Issues of Concern to Hunters and Managers

It is likely that most moose hunters conduct their hunts in an acceptable manner. However, a small portion do not, which in turn compromises the legitimacy of hunting in Ontario. Survey results indicated that respondents had virtually no tolerance for improper hunter behaviour afield. In addition, management-related issues such as insufficient conservation officers afield, the Selective Harvest System, and a variety of forestry-related impacts, all impose some negative effect on respondents' hunting experience. Results provide managers and enforcement officers with some indication of hunters' perceptions of potentially negative effects on the hunting experience. As well, several of the Consolidated Recommendations of Ontario's Round Tables (recommendations 70, 74, 80, 140) have the potential to address and resolve many of the issues presented in this study.

6.1.3 Herbicide Use

To the best of my knowledge, this is the first study in Ontario to document the concerns of a specific resource user group regarding the forest industry's use of herbicides. The breadth of moose hunters' concerns, and in some cases misconceptions, demonstrated that so far, management has failed to provide hunters with adequate information to alleviate any such concerns or misconceptions. A major objective of the Vegetation Management Alternatives Program (VMAP), a component of the early 1990's sustainable forestry initiative within the OMNR, is public education (OMNR 1993). Since VMAP is designed to provide research into public attitudes regarding vegetation management and herbicide use in forestry, the program will likely play an important role in society's education and acceptance of various methods of vegetation management. Recommendation 80 of the Consolidated Recommendations of Ontario's Round Tables (OMNR 1999b) should also help as they are designed to educate the public in the forest industries' use of our forests.

6.1.4 Hunter Safety Apprenticeship Program (HSAP)

OMNR has accepted recommendation 128 of the Consolidated Recommendations of the Round Tables (OMNR 1999b) to establish and support the HSAP. This is the first detailed study to document the concerns of a group that is directly affected by the program. One could argue that there is no better segment of the public to consult with than those who use the program themselves. Although most support the HSAP, several issues need to be addressed. If the HSAP is to be successful, review of hunters' concerns identified here is possibly the first step in ensuring the program contributes to the development of competent young hunters.

6.1.5 Tourism Related Issues

This study explored moose hunters' attitudes and perceptions towards a variety of issues linked to resource based tourism in Northern Ontario. With regard to moose tag allocation and hunting opportunities, the majority of respondents strongly believe that tourist outfitters 1) receive too many adult tags, 2) should only be allocated tags in WMU's where a surplus exists, and 3) should only provide moose hunting opportunities at remote (fly-in) destinations. OMNR has accepted recommendation 132 in principle that tourism operators and hunters competing for the same resources should cooperate in negotiating resource-sharing agreements (OMNR 1999b). Such a recommendation appears significant in light of the aforementioned results.

Ontario is presently involved in a major land-use strategy that outlines the directions government is to take for all the provinces' Crown Lands. Based on survey results, respondents overwhelmingly supported the right to access and hunt all of Ontario's Crown Lands, whereas restrictions such as gating to prevent access into tourism areas were not supported. Resource Stewardship Agreements (RSA), proposed in Ontario's Living Legacy Land Use Strategy,[48] suggest that in addition to tourism operators and forest license holders, other stakeholder groups should be involved in the development of the agreements. Thus, if RSA's are to represent effectively and truly the concerns of all stakeholders involved, moose hunters' opinions should be considered. This information also provides OMNR managers responsible for the development of remote access EMA's some insight into the likely public reaction to restrictions on use of new access roads. Finally, respondents' opinions varied greatly over road maintenance, suggesting that if OMNR is to consider the implementation of recommendations 109 and 110 seriously, it would likely necessitate additional research into the opinions of other user groups[49].

6.1.6 Discrete Choice Experiment

A major objective of this study was to examine how site selection of hunters changed as the quality of the following social and environmental attributes describing the hunting site changed; distance, access, frequency of encounters with other hunting parties, presence of lakes, moose populations, predominant forest type, and height of regeneration in cutovers. Using the aforementioned attributes, a discrete choice experiment (DCE) examined how changes in these attributes (and their levels) affected site selection of Thunder Bay District moose hunters. The model yielded negative utilities

[48] OMNR has accepted recommendation 46, which states that the RSA's between tourism operators and forest license holders not restrict public access more than it would otherwise have been and that existing public use may continue (OMNR 1999b).

[49] Recommendations 109 and 110 of the Consolidated Recommendations of the Round Tables (OMNR 1999b, 21) have been accepted in principle by OMNR. They require current access restrictions be reduced by improving road maintenance and lifting closures as well as encouraging recreational user involvement in public access road maintenance partnerships.

for increases in distance, frequency of encounters, height of regeneration and predominantly conifer regeneration cutovers. In contrast, increases in moose populations, presence of lakes and access yielded positive utilities.

The discrete choice experiment provided a variety of data which can be used to investigate the tradeoffs of possible forest-use decisions (timber harvests), wildlife management initiatives (enforcement, access restrictions, hunting opportunities and regulation changes) and other policy objectives (Lands for Life, Term and Condition 80), which would particularly affect the quality of moose hunting environments. Below, several examples are provided to illustrate the relevance of this study and the survey technique to moose and forest management and to Ontario's Living Legacy Land Use Strategy.

According to Ontario's Living Legacy (OMNR 1999b, 24), OMNR has accepted recommendation 129 to develop, maintain, and keep current databases that support the identification, evaluation, and implementation of enhanced hunting opportunities. This study provided a first-hand look at moose hunters' present hunting environments, and identified in the DCE, quality social and environmental attributes that are most important to hunters when deciding where to hunt moose. Thus, if OMNR is to support effectively the identification and evaluation of quality moose hunting opportunities, first the salient attributes of a moose hunting environment as perceived by hunters must be identified. Second, it is relevant to know what locational characteristics hunters deem important when deciding where to hunt moose[50]. These results provide OMNR with the foundation upon which to evaluate (or develop research projects from which to evaluate) the quality of existing moose hunting opportunities. Therefore, if existing hunting opportunities are evaluated and found to be satisfactory, OMNR can take steps to ensure that such

[50] Factors important when deciding where to hunt moose are previous discussed in section 5.3.

opportunities will be provided in the future. However, if it is discovered that existing hunting opportunities are not adequate, OMNR can develop various regulations or policies (e.g. closing or limiting access into preferred areas may be required) to conserve the moose resource from potential over-exploitation that would lead to a decrease in quality hunting opportunities. Such initiatives would permit Ontario's moose population to remain at sustainable levels and would ensure that hunters continue to return for future hunting trips. If new or enhanced hunting opportunities are to be developed, OMNR can take necessary steps to improve (enhance) the social and environmental attributes deemed important by hunters in this study.

OMNR has also accepted in principle recommendation 108 to ensure that within each WMU, there exists a mix of road-accessible and remote hunting experiences (OMNR 1999b). Moreover, accepted recommendation 130 states that "OMNR should survey hunters on their preferences for road-accessible and remote experiences, so that future planning can better reflect demand" (OMNR 1999b, 24). This study provides specific references to three different types of road-accessible hunting experiences. The degree to which the amount of road access within a hunting area influences site selection provides managers with insight into hunters' preferences for road-accessible experiences. As well, the DCE technique lends itself well to exploring such experiences and potential demands.

In addition to the aforementioned recommendations, OMNR has accepted in principle recommendations 176 and 179 to ensure that subregional planning 1) considers how roads would affect resource activities and uses, and 2) identifies areas for future recreational opportunities mainly by Ontario residents (OMNR 1999b, 34). The results of this study could be used to assess the effect of roads on resource activities and users. Road access restrictions, decommissioning proposals, and policy initiatives could be tested for public support prior to their implementation. As well, the quality hunting environments defined by respondents in this study could aid subregional planners in their search for future hunting opportunities for Ontario residents.

6.2 Directions for Future Research

In addition to the three modes of mandatory registration proposed in this study, hunters' willingness to provide additional biological data could be explored (e.g. kidneys or uterus). As well, a Global Positioning System (GPS) carried by a hunter could provide accurate spatial data of exact kill locations, distance travelled on and off roads, time spent moving or standing or spent in particular cutovers, and forest types[51]. All of the above could improve OMNR's ability to manage the moose resource effectively.

The Hunting Heritage/Hunting Futures Working Group has started the groundwork for a hunter code of ethics during workshops entitled "Developing a Template for Hunter Behaviour" (Lee 1998). Further research efforts could explore in greater detail the possibilities of developing a hunter code of ethics. As well, such research might complement or become an integral part of the hunting policy objective of OMNR recommendation 106. A code of ethics could be used to improve hunter behaviour afield and in the community, foster the values of "fair chase" and respect for the quarry, the land, companions and others. As well, a code could be especially useful to new or young

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[51] Lyon and Burcham (1998) used GPS to track Montana elk hunters to determine elk vulnerability to hunting. They used GIS to determine the effects of road densities, hunter numbers, topography, and cover quality on hunter success and behaviour.

hunters during development so that the key points listed above become ingrained in hunter behaviour at an early stage.

This study provides valuable information about moose hunters' attitudes and opinions towards various tourism-related issues likely to be considered in land use strategies. Additional research could explore many of the recommendations presented in Ontario's Living Legacy Land Use Strategy. As well, the DCE technique used in this study lends itself well to studying tradeoffs between potential management policies and predicting hunter support.

A desirable application of the results of the choice experiment is to use the estimates to drive a PC-based interactive decision support system (DSS). This application rests on the fact that for any one of the more than one million moose hunting scenarios that can be constructed by combining the attribute levels of the design, a probability of choice can be calculated. If programmed appropriately, one can instantly and interactively evaluate any of these scenarios. The resulting output of the DSS is in the form of probabilities of choice in analogy to the two choice alternatives presented in the experiment. These results can be used to predict future demand for various moose hunting opportunities that may resemble land use planning and policy options. Currently, these types of DSS's are employed across Canada in several fields of resource management and have proven useful during resource planning, marketing and environmental policy initiatives (Adamowicz et al. 1993, Hunt and Haider 1998).

The results of this study[52], as well as future research using GPS, have the potential to be incorporated into a geographic information system (GIS) for spatial analyses. Forest companies, private landowners, tourist outfitters and even OMNR, who may want

[52] Referring to both hunters' present hunting environment and results of the DCE.

to market potentially attractive hunting environments to moose hunters, could link the results of this study with existing forest resource inventory (FRI) maps, watershed maps, and existing and planned road networks to identify preferred areas. The potential benefit of linking these results with GIS is that, if programmed appropriately, predictions could be made on future forest management plans to give some indication as to where hunters would be most likely to spend their future hunting efforts. Moose managers may attempt to explore if relationships exist between hunter success and the preferred environmental attributes of a hunting site or overlay past and present moose densities onto layers containing moose hunters' preferred hunting environments to determine if moose densities are in any way affected by where hunters choose to hunt moose, or vice versa.

Once the salient attributes of moose hunters' preferred hunting environments are identified, managers could decide which attributes would benefit from improvement to enhance the quality of hunting opportunities. In addition, restricting access into preferred hunting sites may be required to protect the moose resource to ensure existing or future hunting opportunities remain sustainable or increase.

Results from many sections of this study, including the DCE technique, could be used to evaluate recommendation 130 (OMNR 1999b, 24), which states that "OMNR should survey hunters on their preferences for road-accessible and remote experiences, so that future planning can better reflect demand". While this study focused on road-based hunters living in one northern Ontario area only, it should be obvious that the discrete choice experiment technique is well suited to explore possible enhancements of existing opportunities as well as non-existing hunting opportunities elsewhere.

Lastly, conducting similar studies across the province would allow for comparisons between regions and possible identification of different market segments. Such an endeavour would likely prove valuable to Ontario's Living Legacy Land Use Strategy.

6.3 Concluding Remarks

Potter et al. (1973, 229) predicted that: "In the future, management for people in a much broader context will become an increasingly important element of game management." According to Crichton (1988, 1), "as moose biologists we find ourselves before a large forest with a single option; proceed as best we can, avoiding the pitfalls and wrong turns. There are no freeways, no paved roads, no trees blazed, only windfalls, areas to be avoided and those where we must tread cautiously." Human dimensions research allows wildlife managers to incorporate basic information on what clients desire from the resource into the planning process, so that valid management objectives can be formulated. Wildlife managers have stressed the need for research into hunters' attitudes and preferences for proposed rule changes prior to their implementation, an area of research in which Ontario is lacking seriously.

Today, wildlife management is a much more complex endeavour than simply providing game or ensuring adequate hunter-days afield; it is a complex process that involves careful thought and appropriate research. In the future, hunting will likely be subject to even stricter regulations and thus the potential exists to substantially affect hunter satisfaction and participation. Therefore, collecting information concerning hunter behaviour, satisfaction, and motivations for hunting will aid wildlife managers when introducing new regulations that could seriously affect the hunting experience.

Recognizing the need for human dimensions research, wildlife managers have begun to develop and use expertise that allows them to assess the social component of decisions as much as they assess the biological consequences of wildlife decisions (Donnelly and Vaske 1995, 307). The use of DCE's in wildlife management is increasing in North America and is recognized as a powerful tool for wildlife managers (Erickson and Anderson 1995). However, wildlife management in Ontario has yet to see its use. All too often, new ideas and initiatives are laid aside because of perceived adverse peer or public reaction and the perceived risk associated with that introduction; the result is lost initiative (Crichton 1988). The time has passed when our natural resources were managed in only the traditional sense giving way to a situation best reflected in the words of Oliver Wendell Holmes: "The great thing in this world is not so much where we stand, as in what direction are we moving?" (Crichton 1988, 1).

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APPENDIX I

QUESTIONNAIRE

Thunder Bay Moose Hunter Survey

THUNDER BAY MOOSE HUNTER SURVEY

Your answers to the following questions will help us improve our understanding of hunter attitudes and preferences. This information will contribute to more effective management of moose and natural resources in general. Your answers will be kept in **absolute confidence** and will **never** be related to your name.

1. How many years of general hunting experience do you have? _____ years

2. How many years have you been moose hunting? _____ years

3. In which WMU is your preferred moose hunting area located? _____ WMU

4. For how many years have you hunted moose in this WMU? _____ years

5. Did you receive an adult moose tag this season (1998)? ❑ yes ❑ no

6. Did you receive an adult moose tag last season (1997)? ❑ yes ❑ no

7. Were you successful last season (1997) in harvesting a moose? ❑ yes ❑ no

8. Please indicate the number of days you have hunted moose thus far in 1998. _____ days

9. For the remainder of the season, how many more days to you expect to hunt. _____ days

10. What mode of transportation do you use **most often** when hunting moose? (eg. 4-wheel drive, ATV, on foot)

____

Factors Important for Hunting Moose

11. How important are each of the following reasons for you when deciding to hunt moose? (*please use the scale provided below*)

	Not important		Somewhat important		Very important
to shoot a trophy moose	1	2	3	4	5
to enjoy physical exercise	1	2	3	4	5
to appreciate nature/being outdoors	1	2	3	4	5
to spend time with friends/family	1	2	3	4	5
to escape from the everyday routine	1	2	3	4	5
to test hunting skills	1	2	3	4	5
to put meat on the table	1	2	3	4	5
to experience the challenge of a hunt	1	2	3	4	5
to relax	1	2	3	4	5

12. How important is each of the following factors for you in deciding **where** to hunt moose? (*Please use the scale provided below*)

	Not important		Somewhat important		Very important
I own a camp in the area	1	2	3	4	5
I know someone who owns a camp in the area	1	2	3	4	5
I am familiar with the area	1	2	3	4	5
I know the area will not be crowded	1	2	3	4	5
I hunt with friends/family there	1	2	3	4	5
I pursue other recreational opportunities there	1	2	3	4	5
I have a good chance of harvesting a moose	1	2	3	4	5
I have a good chance of harvesting a trophy	1	2	3	4	5
well established road network	1	2	3	4	5
lots of new access roads and cutovers	1	2	3	4	5
other (*please specify*):______________	1	2	3	4	5

13. If you were not restricted by a tag system, which kind of moose would you prefer to shoot the most? (*please check only one*)

- ❑ calf
- ❑ yearling cow
- ❑ yearling bull
- ❑ adult cow
- ❑ adult bull
- ❑ trophy bull
- ❑ no preference

14. Please indicate your most preferred time of season to hunt moose? (*please check only one*)

- ❑ early fall (September)
- ❑ early fall (October)
- ❑ late fall-before snow (November)
- ❑ late fall-after snow (November)
- ❑ early winter (December)
- ❑ no seasonal preference

15. During your moose hunting trips, which other game do you like to hunt for? (*please check all that apply*)

- ❑ none (only moose)
- ❑ deer
- ❑ waterfowl
- ❑ small game
- ❑ other (*please specify*) ____________________

16a. How frequently do you use any of the hunting techniques listed below when hunting moose? (*please use the scale provided below*)

	Use never	Use rarely		Use occasionally		Use very often
a) walking/stalking	0	1	2	3	4	5
b) calling and sitting/standing	0	1	2	3	4	5
c) setting up drives	0	1	2	3	4	5
d) following tracks	0	1	2	3	4	5
e) use motorized vehicles to cover large areas	0	1	2	3	4	5
f) other: ________________	0	1	2	3	4	5

16b. Of the above hunting techniques, which one has been the most productive for you? (*Please indicate by letter*) __________

Issues of Concern to Hunters and Management

17. A hunting experience may be affected negatively by the behaviour of other hunters, by resource managers, or by wildlife and forest management actions. For each of the possible effects listed below, please indicate if, or by how much, any one of these effects would negatively affect your hunting experience. (*Please use the scale provided below*)

	No negative effect	Minor negative effect		Some negative effect		Serious negative effect
Effects from hunters:						
hunters drinking while hunting	0	1	2	3	4	5
hunters blocking roads with vehicles	0	1	2	3	4	5
hunters crowding each other	0	1	2	3	4	5
hunters leaving garbage behind	0	1	2	3	4	5
hunters taking unsafe shots	0	1	2	3	4	5
hunters poaching	0	1	2	3	4	5
hunters using off-road vehicles excessively (*ATV's, snowmachines...etc.*)	0	1	2	3	4	5
Effects from management activities:						
CO's have poor attitudes towards hunters	0	1	2	3	4	5
not enough CO's patrolling during the season	0	1	2	3	4	5
selective harvest restrictions (no adult tag)	0	1	2	3	4	5
areas closed to hunting	0	1	2	3	4	5
herbicide spraying by forestry industry	0	1	2	3	4	5
clearcuts too large	0	1	2	3	4	5
slash and other debris left along roadways	0	1	2	3	4	5
slash burned during hunting season	0	1	2	3	4	5
other (*please specify*): _______________	0	1	2	3	4	5

18. Should OMNR actively seek hunters' opinions when developing management proposals? (ie. rule or regulation changes, changes to tag allocation...etc.)

❑ yes ❑ no

19. Ontario is the only jurisdiction in North America that does not require hunters to register their kill. If it were proposed that hunters register their kill, please indicate whether you would or would not support any of the following means of registration?

	I would support	I would not support
Phone in registration	❑	❑
Post card registration	❑	❑
Submit lower jaw of your kill to an OMNR drop box	❑	❑

20a. Do you support the recently introduced "Hunter Safety Apprenticeship Program", which allows apprentice hunters (12-14 years of age) to hunt under adult supervision?

❑ yes ❑ no

20b. If you have comments regarding the "Hunter Safety Apprenticeship Program" please list them below.

____

____

____

____

21a. If your moose hunting area were recently (1-2 years) sprayed with herbicides, would you still consider hunting there?

❑ yes ❑ no

21b. If you have any concerns about moose hunting in areas that have been sprayed with herbicides please list them below.

____

____

____

____

Tourism and Moose Hunting Issues

22. Please indicate your level of agreement/disagreement with the following statements about tourism and moose hunting in Northwestern Ontario. *(please use the scale provided below)*

Access Related	Strongly disagree		Neutral		Strongly agree	No opinion
Resident hunters have a right to access and hunt all of Ontario's Crown Lands	1	2	3	4	5	❑
Roads should be gated on Crown Lands to prevent access into tourism areas	1	2	3	4	5	❑
Existing roads should be maintained for hunters	1	2	3	4	5	❑
Hunting may be restricted on Crown Lands but roads should not be closed to the public	1	2	3	4	5	❑
Currently roadless areas should become road accessible to increase hunting opportunities	1	2	3	4	5	❑
Forest harvesting should be restricted around high quality tourism areas	1	2	3	4	5	❑
OMNR Related						
Tourist outfitters should only be given moose tags in WMU's with a surplus of moose tags	1	2	3	4	5	❑
Tourist outfitters should only provide moose hunting at remote (fly-in) destinations	1	2	3	4	5	❑
Tourist outfitters are given too many moose tags	1	2	3	4	5	❑
Tourist outfitters should have land set aside strictly for their uses only	1	2	3	4	5	❑
Beliefs about Tourism						
Tourist outfitters are important to Northwestern Ontario's economy	1	2	3	4	5	❑
Tourism hunting opportunities are only undertaken by Americans	1	2	3	4	5	❑
Tourism operations are owned primarily by Ontario residents	1	2	3	4	5	❑

Present hunting environment:

To better understand where and why people choose to hunt moose, please select from each of the questions below the category that best describes the area in which you presently hunt moose.

23a. Please indicate the one way distance from your home to your hunting area:
(*please check only one below*)

- ❑ less than 150 km (<95 miles)
- ❑ 150-200 km (95-125 miles)
- ❑ 200-250 km (125-155 miles)
- ❑ 250-300 km (155-185 miles)
- ❑ more than 300 km (>185 miles)

23b. Please indicate the type of vehicle requirement that best represents the access situation in your moose hunting area - please consider road condition and terrain. (*please check only one below*)

- ❑ 70% of area only accessible by 2wd, 100% of area is accessible by 4wd
- ❑ 50% of area only accessible by 2wd, 100% of area is accessible by 4wd
- ❑ 30% of area only accessible by 2wd, 100% of area is accessible by 4wd
- ❑ area only accessible by boat
- ❑ area only accessible by aircraft

23c. How many moose, or how much evidence of moose, do you see on an average hunting day. (*please check only one below*) Note: evidence of moose = seeing or hearing moose or seeing fresh sign such as tracks, browse, bush thrashing, rut pits or droppings

- ❑ evidence of 1 moose every two or more days
- ❑ evidence of 1 to 2 moose per day
- ❑ evidence of more than 3 moose per day

23d. Please indicate the frequency of encounters with other hunters, on a normal day, in your moose hunting area, that best represents the situation. (*please check **only one** from each group below, if applicable*)

First 3 weeks of season
- ❑ 0-3 other hunting parties
- ❑ 4-6 other hunting parties
- ❑ 7-9 other hunting parties
- ❑ 10 or more other hunting parties

Remainder of season
- ❑ NO other hunters
- ❑ 1-3 other hunting parties
- ❑ 4 or more other hunting parties

23e. Please think about your moose hunting area, and the kinds of cuts typically found there. From the list provided below, please check those attributes best representing the cutover type in which you most frequently hunt moose.

(*please check **only one** from each group below*)

age of cuts:

- ❑ no cuts or logging activity
- ❑ 1-2 years old
- ❑ 2-5 years old
- ❑ 5-10 years old
- ❑ more than 10 years old

Regeneration:

- ❑ regeneration less than 3 feet tall (<1m)
- ❑ regeneration 3-6 feet tall (1-2m)
- ❑ regeneration 6-10 feet tall (2-3m)
- ❑ regeneration more than 10 feet tall (>3m)
- ❑ mature forest

Forest type in regeneration area:

- ❑ Conifer regeneration (spruce, pine)
- ❑ Hardwood regeneration (birch, poplar)
- ❑ Mixedwood regeneration (combination of above)

Herbicide treatment:

- ❑ all cutovers hunted are treated (with herbicides)
- ❑ some cutovers hunted are treated and some are untreated (with herbicides)
- ❑ all cutovers hunted are untreated
- ❑ unsure

23f. Please indicate the approximate distance that you typically cover in one day while hunting moose. (*please check **only one** from each group below*)

Driving

- ❑ less than 20 km (<12 miles)
- ❑ 20-40 km (12-25 miles)
- ❑ 40-60 km (25-37 miles)
- ❑ more than 60 km (>37 miles)

Walking

- ❑ less than 2 km (<1.3 miles)
- ❑ 2-5 km (1.3-3.1 miles)
- ❑ 6-10 km (3.7-6.3 miles)
- ❑ more than 10 km (6.3+ miles)

23g. Do you usually hunt moose, (*please check only one*)

- ❑ alone
- ❑ in a group if so, how many hunters are in your group? __________

CHOOSE YOUR PREFERRED HUNTING AREA

Each of the following pages contains two hypothetical descriptions of moose hunting areas. Assume that the two areas presented in each set were the <u>only</u> two areas available for your next hunting trip. We want you to indicate for each choice set which hunting area you would choose. Note, that 'not hunting' is also a valid response if neither Area A or Area B are satisfactory to you.

Clarification of attributes:

- **hunting area accessibility** - the <u>amount</u> of hunting area accessible by 2wd/4wd vehicles.
- **frequency of encounters with other hunters** - the average number of encounters with other hunting parties during a normal day of hunting.
- **moose population** - seeing or hearing moose or seeing fresh evidence of moose
- **predominant forest regeneration** - the most common type of vegetation regenerating in cutovers (conifer = spruce/pine, hardwood = poplar/birch)

Example of how to answer question

Features of Hunting Area	Area A	Area B	
Distance from home to hunting area (one way)	150 kilometers	250 kilometers	Neither Site A or Site B I will not go moose hunting
Hunting area accessibility by vehicle type : 2wd **4wd (or ATV)**	50% by 2wd 100% by 4wd	70% by 2wd 100% by 4wd	
Frequency of encounters with other hunters	NO other hunters	1-3 other hunting parties	
Presence of lakes	few lakes	many lakes	
Moose population: evidence of	1 to 2 moose per day	one moose every 2 or more days	
Forest characteristics **Cutovers: height of new growth** **Predominant forest regeneration**	less than 3ft tall (<1m) conifer	3-6ft tall (1-2m) hardwood	
Check ONE and only one box	☐	☒	☐

↑

Check the box to indicate your choice
In this example the individual selected Site B

****Please complete all 9 scenarios that follow.**

24c. If you were to select a new hunting area, and these were the **ONLY** two options available, which one would you choose on your next hunting trip, if either?

Features of Hunting Area	Area A	Area B	1-3
Distance from home to hunting area (one way)	250 kilometers	250 kilometers	Neither Site A or Site B
Hunting area accessibility by vehicle type: 2wd 4wd (or ATV)	30% by 2wd 100% by 4wd	50% by 2wd 100% by 4wd	
Frequency of encounters with other hunters	1-3 other hunting parties	NO other hunters	
Presence of lakes	NO lakes	NO lakes	
Moose population: evidence of	3 or more moose per day	3 or more moose per day	I will not go moose hunting
Forest characteristics Cutovers: height of new growth Predominant forest regeneration	less than 3ft tall (<1m) conifer	more than 6ft tall (>2m) hardwood	
Check ONE and only one box	☐	☐	☐

24d. If you were to select a new hunting area, and these were the **ONLY** two options available, which one would you choose on your next hunting trip, if either?

Features of Hunting Area	Area A	Area B	1-4
Distance from home to hunting area (one way)	350 kilometers	250 kilometers	Neither Site A or Site B
Hunting area accessibility by vehicle type: 2wd 4wd (or ATV)	50% by 2wd 100% by 4wd	30% by 2wd 100% by 4wd	
Frequency of encounters with other hunters	NO other hunters	NO other hunters	
Presence of lakes	few lakes	NO lakes	
Moose population: evidence of	one moose every 2 or more days	1 to 2 moose per day	I will not go moose hunting
Forest characteristics Cutovers: height of new growth Predominant forest regeneration	more than 6ft tall (>2m) conifer	less than 3ft tall (<1m) hardwood	
Check ONE and only one box	☐	☐	☐

24a. If you were to select a new hunting area, and these were the **ONLY** two options available, which one would you choose on your next hunting trip, if either?

Features of Hunting Area	Area A	Area B	1-1
Distance from home to hunting area (one way)	150 kilometers	250 kilometers	Neither Site A or Site B
Hunting area accessibility by vehicle type: 2wd **4wd (or ATV)**	30% by 2wd 100% by 4wd	70% by 2wd 100% by 4wd	
Frequency of encounters with other hunters	NO other hunters	4 or more other hunting parties	
Presence of lakes	NO lakes	few lakes	
Moose population: evidence of	one moose every 2 or more days	one moose every 2 or more days	I will not go moose hunting
Forest characteristics **Cutovers: height of new growth** **Predominant forest regeneration**	less than 3ft tall (<1m) hardwood	less than 3ft tall (<1m) conifer	
Check ONE and only one box	☐	☐	☐

24b. If you were to select a new hunting area, and these were the **ONLY** two options available, which one would you choose on your next hunting trip, if either?

Features of Hunting Area	Area A	Area B	1-2
Distance from home to hunting area (one way)	350 kilometers	250 kilometers	Neither Site A or Site B
Hunting area accessibility by vehicle type: 2wd **4wd (or ATV)**	30% by 2wd 100% by 4wd	30% by 2wd 100% by 4wd	
Frequency of encounters with other hunters	4 or more other hunting parties	1-3 other hunting parties	
Presence of lakes	NO lakes	many lakes	
Moose population: evidence of	1 to 2 moose per day	1 to 2 moose per day	I will not go moose hunting
Forest characteristics **Cutovers: height of new growth** **Predominant forest regeneration**	less than 3ft tall (<1m) conifer	3-6ft tall (1-2m) hardwood	
Check ONE and only one box	☐	☐	☐

24g. If you were to select a new hunting area, and these were the **ONLY** two options available, which one would you choose on your next hunting trip, if either?

Features of Hunting Area	Area A	Area B	1-7
Distance from home to hunting area (one way)	250 kilometers	250 kilometers	Neither Site A or Site B I will not go moose hunting
Hunting area accessibility by vehicle type: 2wd **4wd (or ATV)**	70% by 2wd 100% by 4wd	50% by 2wd 100% by 4wd	
Frequency of encounters with other hunters	NO other hunters	1-3 other hunting parties	
Presence of lakes	many lakes	many lakes	
Moose population: evidence of	one moose every 2 or more days	3 or more moose per day	
Forest characteristics **Cutovers: height of new growth** **Predominant forest regeneration**	3-6ft tall (1-2m) conifer	less than 3ft tall (<1m) hardwood	
Check ONE and only one box	☐	☐	☐

24h. If you were to select a new hunting area, and these were the **ONLY** two options available, which one would you choose on your next hunting trip, if either?

Features of Hunting Area	Area A	Area B	1-8
Distance from home to hunting area (one way)	150 kilometers	250 kilometers	Neither Site A or Site B I will not go moose hunting
Hunting area accessibility by vehicle type: 2wd **4wd (or ATV)**	70% by 2wd 100% by 4wd	70% by 2wd 100% by 4wd	
Frequency of encounters with other hunters	4 or more other hunting parties	NO other hunters	
Presence of lakes	many lakes	NO lakes	
Moose population: evidence of	1 to 2 moose per day	one moose every 2 or more days	
Forest characteristics **Cutovers: height of new growth** **Predominant forest regeneration**	3-6ft tall (1-2m) conifer	3-6ft tall (1-2m) hardwood	
Check ONE and only one box	☐	☐	☐

24e. If you were to select a new hunting area, and these were the **ONLY** two options available, which one would you choose on your next hunting trip, if either?

Features of Hunting Area	Area A	Area B	1-5
Distance from home to hunting area (one way)	250 kilometers	250 kilometers	Neither Site A or Site B
Hunting area accessibility by vehicle type: 2wd **4wd (or ATV)**	50% by 2wd 100% by 4wd	50% by 2wd 100% by 4wd	
Frequency of encounters with other hunters	4 or more other hunting parties	4 or more other hunting parties	
Presence of lakes	few lakes	few lakes	
Moose population: evidence of	1 to 2 moose per day	3 or more moose per day	I will not go moose hunting
Forest characteristics **Cutovers: height of new growth** **Predominant forest regeneration**	more than 6ft tall (>2m) hardwood	3-6ft tall (1-2m) conifer	
Check ONE and only one box	☐	☐	☐

24f. If you were to select a new hunting area, and these were the **ONLY** two options available, which one would you choose on your next hunting trip, if either?

Features of Hunting Area	Area A	Area B	1-6
Distance from home to hunting area (one way)	150 kilometers	250 kilometers	Neither Site A or Site B
Hunting area accessibility by vehicle type: 2wd **4wd (or ATV)**	50% by 2wd 100% by 4wd	70% by 2wd 100% by 4wd	
Frequency of encounters with other hunters	1-3 other hunting parties	1-3 other hunting parties	
Presence of lakes	few lakes	many lakes	
Moose population: evidence of	3 or more moose per day	one moose every 2 or more days	I will not go moose hunting
Forest characteristics **Cutovers: height of new growth** **Predominant forest regeneration**	more than 6ft tall (>2m) conifer	more than 6ft tall (>2m) hardwood	
Check ONE and only one box	☐	☐	☐

24i. If you were to select a new hunting area, and these were the **ONLY** two options available, which one would you choose on your next hunting trip, if either?

Features of Hunting Area	**Area A**	**Area B**	**1-9**
Distance from home to hunting area (one way)	350 kilometers	250 kilometers	Neither Site A or Site B
Hunting area accessibility by vehicle type: 2wd **4wd (or ATV)**	70% by 2wd 100% by 4wd	30% by 2wd 100% by 4wd	
Frequency of encounters with other hunters	1-3 other hunting parties	4 or more other hunting parties	
Presence of lakes	many lakes	few lakes	
Moose population: evidence of	3 or more moose per day	1 to 2 moose per day	I will not go moose hunting
Forest characteristics **Cutovers: height of new growth** **Predominant forest regeneration**	3-6ft tall (1-2m) hardwood	more than 6ft tall (>2m) conifer	
Check ONE and only one box	☐	☐	☐

We would like to ask a few questions about your household. These questions will assist us in understanding how different hunters feel about the various issues. Again, your answers to these questions will be kept in absolute confidence and will never be related to your name.

25. Are you: ❑ Male ❑ Female

26. Please indicate your age (check one)

❑ 15-25 ❑ 36-45 ❑ 56-65
❑ 26-35 ❑ 46-55 ❑ 66+

27. Please indicate the highest level of education you have completed (*please check only one*)

❑ elementary/ jr. High (grades 1 to 9) ❑ trade school or technical college
❑ high school (grades 10-12) ❑ university degree

28. Are you a resident of

❑ Thunder Bay ❑ another town ❑ rural

29. Which of the following categories best represents your annual household income before taxes? (*please check only one*)

❑ less than $20 000 ❑ $40 001 - $60 000 ❑ $80 001 - $100 000
❑ $20 001 - $40 000 ❑ $60 001 - $80 000 ❑ over $100 000

THANK YOU for participating in the Thunder Bay Moose Hunter Survey, your answers to our questions are key to the success of this project. If you have any additional comments or concerns you would like to express please feel free to include them in the space provided below.

Request from OMNR Database

Request: A mailing list containing a random sample of names and addresses of 1000 moose hunters, selected from the general licence database. Specific postal codes for query are provided below.

Thunder Bay	P7A
	P7B
	P7C
	P7E
	P7G
	P7J
Armstrong	P0T 1A0
Dorion	P0T 1K0
English River	P0T 1T0
Kakabeka Falls	P0T 1W0
Murillo	P0T 2G0
Nipigon	P0T 2J0
Nolalu	P0T 2K0
Red Rock	P0T 2P0
Upsala	P0T 2Y0
Savant Lake	P0V 2S0

Cover Letter

Dear Sir or Madam;

Re: Thunder Bay Moose Hunter Survey

I am a masters student in the Faculty of Forestry, and I am also an avid moose hunter myself. My research focuses on the management of moose hunting in Northern Ontario by studying hunters' attitudes and preferences of management strategies and of moose hunting environments.

This study is being conducted under the auspices of the Faculty of Forestry at Lakehead University. As well, this study has been reviewed and is supported by the Board of Directors of the Northwestern Ontario Sportsmen Alliance and is funded by the Centre for Northern Forest Ecosystem Research.

You are one of approximately 1000 moose hunters from the Thunder Bay Area who have been randomly selected from moose hunting licences, to participate in this study. Your participation in this survey is completely voluntary and you can be assured of complete confidentiality. This survey has been mailed by the OMNR to ensure your confidentiality but OMNR will not have access to the returned surveys. A number has been placed on your questionnaire solely for the purpose of sending follow-up letters to any hunters who have not returned their survey.

Please return the questionnaire in the enclosed business reply envelope. When the study is completed your name will not be associated with any of the results and the questionnaires will be securely stored at Lakehead University for a period of at least seven years.

To show our appreciation, and to provide you with an added incentive to complete the questionnaire, **we will be conducting a draw for several prizes** among all completed and returned surveys. Prizes consisi of five $50 gift certificates (redeemable at Superior Sportsmen Inc.), to be awarded in January of 1999. To enter the draw, please complete the address form attached to the back of the survey form, detach it, and include it with the completed questionnaire in the return envelope. The draw forms will be immediately separated from the surveys prior to any analysis of the data.

We thank you in advance for your participation in this study. Your opinions are vital to our research. If you have any questions regarding the questionnaire, please write or call (807 343-4032).

Sincerely yours,

Brian Bottan
Survey Director

Wolfgang Haider, Ph.D.
Thesis Supervisor
Adjunct Professor
Lakehead University

Draw Form and Post Card

SAMPLE DRAW FORM

To show our appreciation, and to provide you with an added incentive to complete the questionnaire, we will be awarding a number of prizes. Prizes consist of five $50 gift certificates redeemable at Superior Sportsmen Inc. To enter the draw, please complete the address form below, detach it, and include it with the completed questionnaire in the return envelope.

Name: ______________________________ Postal code: __________

Address: ____

SAMPLE POST CARD

Dear Sir or Madam;

Re: Thunder Bay Moose Hunter Survey

One week ago a questionnaire seeking your attitudes and preferences regarding various aspects of the moose hunting experience was mailed to you. Your completion and return of the questionnaire is essential. If you have already completed and returned the survey, please accept our sincere thanks. If you haven't completed the questionnaire please do so and return it at your earliest possible convenience. Thank you again for your assistance in the study.

Sincerely yours,

Brian Bottan
Survey Director

Wolfgang Haider, Ph.D.
Thesis Supervisor
Lakehead University

Follow-up Letter

Dear Sir or Madam;

Re: Thunder Bay Moose Hunter Survey

Three weeks ago a questionnaire seeking your attitudes and preferences regarding various aspects of the moose hunting experience was mailed to you. As of today we have not received your completed questionnaire. If you have already completed and returned the survey, please accept our sincere thanks.

Your are one of approximately 1000 Thunder Bay Area moose hunters that have been asked to state their attitudes and preferences towards various moose hunting issues. In order for the results to accurately represent the opinions of Thunder Bay moose hunters, it is extremely important that your response be included in the study.

In the event that your original questionnaire has gone lost or misplaced, a replacement survey is enclosed. Please complete the questionnaire and the draw form and return it to the following address in the business reply envelope provided:

Tourism Effects Research Unit
Centre for Northern Forest Ecosystem Research
Lakehead University
955 Oliver Road
Thunder Bay, ON
P7B 5E1

Thank you once again for your assistance. Your cooperation is this matter is greatly appreciated.

Sincerely yours,

Brian Bottan
Survey Director

Wolfgang Haider, Ph.D.
Thesis Supervisor
Adjunct Professor
Lakehead University

APPENDIX II

SUPPLEMENTARY RESULTS TABLES

Table A.1 Gender of hunters by age

			Gender		
			Male	Female	Total
Age	Young (15-35)	Count	150	10	160
		% within Gender	27.2%	14.9%	25.8%
	Middle-Aged (36-55)	Count	287	45	332
		% within Gender	52.0%	67.2%	53.6%
	Elderly (56+)	Count	115	12	127
		% within Gender	20.8%	17.9%	20.5%
Total		Count	552	67	619
		% within Gender	100.0%	100.0%	100.0%

Pearson Chi-Square = 6.281, df = 2, $p < 0.05$

Table A.2 Annual household income of hunters sampled by age of hunter

			Age			
			Young (15-35)	Middle-Aged (36-55)	Elderly (56+)	Total
Income	<$20 000	Count	17	6	18	41
		% within Age	11.0%	2.0%	15.8%	7.2%
	$20 001 - $40 000	Count	49	49	48	146
		% within Age	31.8%	16.2%	42.1%	25.6%
	$40 001 - $60 000	Count	42	113	33	188
		% within Age	27.3%	37.4%	28.9%	33.0%
	$60 001 - $80 000	Count	28	76	12	116
		% within Age	18.2%	25.2%	10.5%	20.4%
	$80 001 - $100 000	Count	9	35	1	45
		% within Age	5.8%	11.6%	.9%	7.9%
	>$100 000	Count	9	23	2	34
		% within Age	5.8%	7.6%	1.8%	6.0%
Total		Count	154	302	114	570
		% within Age	100.0%	100.0%	100.0%	100.0%

Pearson Chi-Square = 82.085, df = 10, $p < 0.05$

Table A.3 Issues of concern to hunters: not enough CO's patrolling during the season

		Percent
Effect	No negative effect	9.9
	Minor negative effect	22.0
	Some negative effect	25.1
	Negative effect	43.0
	Total	100.0

N=609

Table A.4 Support for phone registration by age of hunter

			Age			
			Young (15-35)	Middle-Aged (36-55)	Elderly (56+)	Total
Phone	No-do not support	Count	37	115	46	198
		% within Age	24.3%	37.5%	42.6%	34.9%
	Yes-support	Count	115	192	62	369
		% within Age	75.7%	62.5%	57.4%	65.1%
Total		Count	152	307	108	567
		% within Age	100.0%	100.0%	100.0%	100.0%

Pearson Chi-Square = 11.152, df = 2, $p < 0.05$

Table A.5 Support for phone registration by adult tag status for 1997 and 1998

			Adult tag status		
			No tag in either (97/98)	Tag in either (97/98)	Total
Phone	No-do not support	Count	71	129	200
		% within No tag	42.3%	32.2%	35.1%
	Yes-support	Count	97	272	369
		% within No tag	57.7%	67.8%	64.9%
Total		Count	168	401	569
		% within No tag	100.0%	100.0%	100.0%

Pearson Chi-Square = 5.290, df = 1, $p < 0.05$

Table A.6 Support for post card registration by adult tag status for 1997 and 1998

			Adult tag status		
			No tag in either (97/98)	Tag in either (97/98)	Total
Post card	No-do not support	Count	79	133	212
		% within No tag	46.2%	33.5%	37.3%
	Yes-support	Count	92	264	356
		% within No tag	53.8%	66.5%	62.7%
Total		Count	171	397	568
		% within No tag	100.0%	100.0%	100.0%

Pearson Chi-Square = 8.237, df = 1, $p < 0.05$

Table A.7 Support for the HSAP by age of hunter

			Age			
			Young (15-35)	Middle-Aged (36-55)	Elderly (56+)	Total
HSAP	No	Count	41	103	58	202
		% within Age	26.3%	31.8%	46.0%	33.3%
	Yes	Count	115	221	68	404
		% within Age	73.7%	68.2%	54.0%	66.7%
Total		Count	156	324	126	606
		% within Age	100.0%	100.0%	100.0%	100.0%

Pearson Chi-Square = 12.980, df = 2, $p < 0.05$

Table A.8 Willingness to hunt in recently sprayed areas by age of hunter

			Age			
			Young (15-35)	Middle-Aged (36-55)	Elderly (56+)	Total
Hunt in sprayed area	No	Count	84	214	89	387
		% within Age	54.5%	66.0%	71.2%	64.2%
	Yes	Count	70	110	36	216
		% within Age	45.5%	34.0%	28.8%	35.8%
Total		Count	154	324	125	603
		% within Age	100.0%	100.0%	100.0%	100.0%

Pearson Chi-Square = 9.390, df = 2, $p < 0.05$

Table A.9 Hunters' preferred WMU to hunt moose

		Frequency	Percent
WMU	11B	23	3.8
	12A	16	2.6
	12B	44	7.2
	13	294	48.0
	14	8	1.3
	15A	51	8.3
	15B	146	23.8
	16B	2	.3
	16C	2	.3
	18A	1	.2
	19	1	.2
	21A	16	2.6
	21B	3	.5
	2	2	.3
	38	1	.2
	5	3	.5
	Total	613	100.0

Table A.10 Number of moose observed in area by success in 1997

			Number of moose in area			
			1-2 moose every two or more days	1-2 moose per day	3 or more moose per day	Total
Harvested a moose in 1997	No	Count	248	162	50	460
		% within Number of moose in area	81.0%	73.6%	58.1%	75.2%
	Yes	Count	58	58	36	152
		% within Number of moose in area	19.0%	26.4%	41.9%	24.8%
Total		Count	306	220	86	612
		% within Number of moose in area	100.0%	100.0%	100.0%	100.0%

Pearson Chi-Square = 19.298, df = 2, $p < 0.05$

Table A.11 Height of regeneration in the area by success in 1997

			Regeneration in the area					
			<1m tall	1-2m tall	2-3m tall	>3m tall	mature forest	Total
Harvested a moose in 1997	No	Count	119	213	61	32	26	451
		% within Regeneration	73.5%	79.5%	63.5%	74.4%	76.5%	74.8%
	Yes	Count	43	55	35	11	8	152
		% within Regeneration	26.5%	20.5%	36.5%	25.6%	23.5%	25.2%
Total		Count	162	268	96	43	34	603
		% within Regeneration	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%

Pearson Chi-Square = 9.773, df = 4, p < 0.05

Table A.12 Herbicide treatment by number of moose observed in area

			Number of moose observed in area			
			1-2 moose every two or more days	1-2 moose per day	3 or more moose per day	Total
Herbicide treatment	Unsure	Count	108	60	24	192
		% within moose observed	36.0%	27.4%	27.6%	31.7%
	treated	Count	8	6	5	19
		% within moose observed	2.7%	2.7%	5.7%	3.1%
	treated/untreated	Count	116	101	28	245
		% within moose observed	38.7%	46.1%	32.2%	40.4%
	untreated	Count	68	52	30	150
		% within moose observed	22.7%	23.7%	34.5%	24.8%
Total		Count	300	219	87	606
		% within moose observed	100.0%	100.0%	100.0%	100.0%

Pearson Chi-Square = 13.099, df = 6, p < 0.05

Table A.13 Hunting alone or in a group by WMU

			WMU 13	WMU 15B	Total
Hunt alone or in a group	Hunt alone	Count	53	11	64
		% within WMU	18.1%	7.5%	14.6%
	Hunt in a group	Count	240	135	375
		% within WMU	81.9%	92.5%	85.4%
Total		Count	293	146	439
		% within WMU	100.0%	100.0%	100.0%

Pearson Chi-Square = 8.717, df = 1, $p < 0.05$

Table A.14 Number of members in your group by WMU

			WMU 13 and 15B: 13	WMU 13 and 15B: 15B	Total
Number of members in your group	2-4	Count	195	88	283
		% within WMU	83.0%	66.7%	77.1%
	5-8	Count	38	39	77
		% within WMU	16.2%	29.5%	21.0%
	9-12	Count	2	5	7
		% within WMU	.9%	3.8%	1.9%
Total		Count	235	132	367
		% within WMU	100.0%	100.0%	100.0%

Pearson Chi-Square = 13.946, df = 2, $p < 0.05$
33.3% of cells have expected values less than 5

Table A.15 Success in 1997 by number of members in your group

			Number of members in your group			Total
			(2-4)	(5-8)	(9-12)	
Harvested a moose in 1997	No	Count	320	63	6	389
		% within members	78.2%	63.0%	60.0%	75.0%
	Yes	Count	89	37	4	130
		% within members	21.8%	37.0%	40.0%	25.0%
Total		Count	409	100	10	519
		% within members	100.0%	100.0%	100.0%	100.0%

Pearson Chi-Square = 11.154, df = 2, $p < 0.05$

Table A.16 Encounters during first 3 weeks of season by WMU

			WMU		Total
			13	15B	
Encounters during first 3 weeks of season	0-3 hunting parties	Count	95	22	117
		% within WMU 13 and 15B	32.8%	15.3%	27.0%
	4-6 hunting parties	Count	87	53	140
		% within WMU 13 and 15B	30.0%	36.8%	32.3%
	7-9 hunting parties	Count	36	22	58
		% within WMU 13 and 15B	12.4%	15.3%	13.4%
	10 or more hunting parties	Count	72	47	119
		% within WMU 13 and 15B	24.8%	32.6%	27.4%
Total		Count	290	144	434
		% within WMU 13 and 15B	100.0%	100.0%	100.0%

Pearson Chi-Square = 15.020, df = 3, $p < 0.05$

Table A.17 Age of cuts by WMU

			WMU		
			13	15B	Total
Age of cuts in area	no cuts or logging activity	Count	9	2	11
		% within WMU	3.1%	1.4%	2.5%
	1-2 years old	Count	51	23	74
		% within WMU	17.6%	15.8%	17.0%
	2-5 years old	Count	127	84	211
		% within WMU	43.8%	57.5%	48.4%
	5-10 years old	Count	73	32	105
		% within WMU	25.2%	21.9%	24.1%
	more than 10 years old	Count	30	5	35
		% within WMU	10.3%	3.4%	8.0%
Total		Count	290	146	436
		% within WMU	100.0%	100.0%	100.0%

Pearson Chi-Square = 11.358, df = 4, $p < 0.05$

Table A.18 Height of regeneration by WMU

			WMU 13 and 15B		
			13	15B	Total
Regeneration in the area	<1m tall	Count	63	54	117
		% within WMU	22.0%	37.0%	27.0%
	1-2m tall	Count	132	61	193
		% within WMU	46.0%	41.8%	44.6%
	2-3m tall	Count	54	17	71
		% within WMU	18.8%	11.6%	16.4%
	>3m tall	Count	22	7	29
		% within WMU	7.7%	4.8%	6.7%
	mature forest	Count	16	7	23
		% within WMU	5.6%	4.8%	5.3%
Total		Count	287	146	433
		% within WMU	100.0%	100.0%	100.0%

Pearson Chi-Square = 12.818, df = 4, $p < 0.05$

Table A.19 Forest type in regeneration area by WMU

			WMU 13 and 15B		
			13	15B	Total
Forest type in regeneration area	Conifer	Count	66	49	115
		% within WMU	22.9%	34.0%	26.6%
	Hardwood	Count	31	10	41
		% within WMU	10.8%	6.9%	9.5%
	Mixedwood	Count	191	85	276
		% within WMU	66.3%	59.0%	63.9%
Total		Count	288	144	432
		% within WMU	100.0%	100.0%	100.0%

Pearson Chi-Square = 6.727, df = 2, $p < 0.05$

Table A.20 Herbicide treatment by WMU

			WMU		
			13	15B	Total
Herbicide treatment	Unsure	Count	97	45	142
		% within WMU 13 and 15B	33.6%	31.0%	32.7%
	all cutovers hunted are treated	Count	7	9	16
		% within WMU 13 and 15B	2.4%	6.2%	3.7%
	some cutovers treated/untreated	Count	102	65	167
		% within WMU 13 and 15B	35.3%	44.8%	38.5%
	all cutovers hunted are untreated	Count	83	26	109
		% within WMU 13 and 15B	28.7%	17.9%	25.1%
Total		Count	289	145	434
		% within WMU 13 and 15B	100.0%	100.0%	100.0%

Pearson Chi-Square = 10.696, df = 3, $p < 0.05$

Table A.21 Mode of transportation used most often when hunting

		Frequency	Percent
Mode of transportation	On foot	297	51.8
	ATV/Snowmachine	44	7.7
	2 wheeldrive	40	7.0
	4 wheeldrive	174	30.4
	boat/canoe	18	3.1
	Total	573	100.0

Table A.22 Success in 1997 by encounters with other hunting parties during first 3 weeks of season

			Encounters during first 3 weeks of season				Total
			0-3 parties	4-6 parties	7-9 parties	10 or more parties	
Harvested moose in 1997	No	Count	128	154	62	117	461
		% within Encounters	76.6%	76.2%	72.1%	75.5%	75.6%
	Yes	Count	39	48	24	38	149
		% within Encounters	23.4%	23.8%	27.9%	24.5%	24.4%
Total		Count	167	202	86	155	610
		% within Encounters	100.0%	100.0%	100.0%	100.0%	100.0%

Pearson Chi-Square = 0.717, df = 3, $p < 0.869$

APPENDIX III

EQUATIONS USED TO ASSESS MODEL PERFORMANCE AND IIA OUTPUTS

Note: All definitions are quoted directly from Intelligent Marketing Systems 'NTELOGIT User's Manual' (Intelligent Marketing Systems 1993 6-11, 6-12)

Definition of terms:

LL(0) - This is the log likelihood sample value for the random choice model (i.e. each alternative assumed equally likely to be chosen).

LL(B) - This is the log likelihood value at convergence for the estimated parameters.

G^2 = -2[LL(0) - LL(B)] - This is the likelihood ratio test statistic for the hypothesis that all the parameters are simultaneously equal to zero. This statistic is asymptotically chi-squared distributed with degrees of freedom equal to the number of free parameters in the model.

AIC = -2[LL(B) - #parameters in model] - This is the Akaike Information Criterion, often utilized to evaluate non-nested models for the same data set (the model with a "significantly" smaller value of AIC is to be preferred).

Goodness-of-fit measures:

Rhosq - This is a goodness-of-fit measure, akin to R^2 in regression. In the table below are suggested ranges of Rhosq for different evaluations of model fit.

$$\text{Rhosq} = 1\text{-LL(B)/LL(0)}$$

General Evaluation	Rhosq range
Poor	0.0...0.2
Poor-Reasonable	0.2...0.3
Reasonable-Good	0.3...0.5
Good-Excellent	0.5...0.8
Excellent	0.8...1.0

Rhosq (AIC) - This is a goodness-of-fit measure that corrects for the degrees of freedom used by the estimated parameters.

$$\text{Rhosq (AIC)} = 1\text{-(LL(B)-K)/LL(0)},$$

where K is the number of parameters in the model. The same ranges given for Rhosq apply to this statistic.

T-Test of Equality:

This formula simply compares the differences between two estimates with their pooled standard error, and a resulting t-value of greater than +2 or less than -2 strongly suggests the population parameters are different.

$$t_{equ} = \frac{E_1 - E_2}{s_1^2 + s_2^2}$$

where,
E_1, E_2 are the two estimates,
s_1^2, s_2^2 are the respective standard errors

Likelihood Ratio Test:

This is the likelihood ratio test statistic for the hypothesis that all the parameters are simultaneously equal to zero. This statistic is asymptotically chi-squared distributed with degrees of freedom equal to the number of free parameters in the model.

$$G^2 = -2[LL(0) - LL(B)]$$

IIA Outputs

IIA Test - General model

SUMMARY REPORT FOR IIA TESTS:

Test	Excluded Alternatives	Number of Choice Sets	Number of Cases	S'	DF	ChiSq Pr(>S')
1	< 1 >	27	81	6.78	13	.91334
2	< 2 >	27	81	6.44	13	.92853
3	< 3 >	27	81	.12	1	.73114
4	< 1 >< 2 >	27	81	1.35	13	.99998
5	< 1 >< 3 >	27	81	6.94	14	.93702
6	< 2 >< 3 >	27	81	6.60	14	.94893

CLASSIFICATION TABLE

Observed Altern	Predicted Alternative 1	2	3	TOTAL
1	1403.00	475.000	179.000	2057.00
2	441.000	1497.00	187.000	2125.00
3	514.000	626.000	312.000	1452.00
% Correct	68.2061	70.4471	21.4876	57.0110

IIA Test - WMU 13

SUMMARY REPORT FOR IIA TESTS:

Test	Excluded Alternatives	Number of Choice Sets	Number of Cases	S'	DF	ChiSq Pr(>S')
1	< 1 >	27	81	6.47	13	.92752
2	< 2 >	27	81	6.09	13	.94279
3	< 3 >	27	81	.31	1	.57642
4	< 1 >< 2 >	27	81	2.19	13	.99962
5	< 1 >< 3 >	27	81	6.87	14	.93976
6	< 2 >< 3 >	27	81	6.48	14	.95296

CLASSIFICATION TABLE

Observed Altern	Predicted Alternative 1	2	3	TOTAL
1	601.000	147.000	135.000	883.000
2	174.000	610.000	191.000	975.000
3	229.000	264.000	286.000	779.000
% Correct	68.0634	62.5641	36.7137	56.7691

IIA Test - WMU 15B

SUMMARY REPORT FOR IIA TESTS:

Test	Excluded Alternatives	Number of Choice Sets	Number of Cases	S'	DF	ChiSq Pr(>S')
1	< 1 >	27	81	5.55	13	.96087
2	< 2 >	27	81	8.20	13	.83002
3	< 3 >	27	81	.00	1	.95916
4	< 1 >< 2 >	27	81	1.52	13	.99995
5	< 1 >< 3 >	27	81	5.56	14	.97634
6	< 2 >< 3 >	27	81	8.22	14	.87747

CLASSIFICATION TABLE

Observed Altern	Predicted Alternative 1	2	3	TOTAL
1	407.000	123.000	14.0000	544.000
2	130.000	378.000	19.0000	527.000
3	95.0000	119.000	29.0000	243.000
% Correct	74.8162	71.7268	11.9342	61.9482

IIA Test - Young Hunters

SUMMARY REPORT FOR IIA TESTS:

Test	Excluded Alternatives	Number of Choice Sets	Number of Cases	S'	DF	ChiSq Pr(>S')
1	< 1 >	27	81	5.58	13	.96020
2	< 2 >	27	81	6.71	13	.91624
3	< 3 >	27	81	.78	1	.37744
4	< 1 >< 2 >	27	81	1.99	13	.99978
5	< 1 >< 3 >	27	81	6.40	14	.95533
6	< 2 >< 3 >	27	81	7.67	14	.90602

CLASSIFICATION TABLE

Observed Altern	Predicted Alternative 1	2	3	TOTAL
1	816.000	242.000	109.000	1167.00
2	229.000	879.000	116.000	1224.00
3	258.000	330.000	162.000	750.000
% Correct	69.9229	71.8137	21.6000	59.1213

IIA Test - Old Hunters

SUMMARY REPORT FOR IIA TESTS:

Test	Excluded Alternatives	Number of Choice Sets	Number of Cases	S'	DF	ChiSq Pr(>S')
1	< 1 >	27	81	8.05	13	.84007
2	< 2 >	27	81	6.58	13	.92245
3	< 3 >	27	81	.03	1	.85336
4	< 1 >< 2 >	27	81	1.13	13	.99999
5	< 1 >< 3 >	27	81	8.07	14	.88579
6	< 2 >< 3 >	27	81	6.60	14	.94892

CLASSIFICATION TABLE

Observed	Predicted Alternative			
Altern	1	2	3	TOTAL
1	573.000	228.000	68.0000	869.000
2	208.000	598.000	71.0000	877.000
3	252.000	295.000	146.000	693.000
% Correct	65.9379	68.1870	21.0678	53.9975