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Economic Effects of Environmental Quality Change on Recreational Hunting in Northwestern Saskatchewan

by

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The undersigned certify that they have read, and recommended to the Faculty of Graduate Studies and Research for acceptance, a thesis entitled ECONOMIC EFFECTS OF ENVIRONMENTAL QUALITY CHANGE ON RECREATIONAL HUNTING IN NORTHWESTERN SASKATCHEWAN submitted by KAREN MORTON in partial fulfilment of the requirements for the degree of MASTER OF SCIENCE in FOREST ECONOMICS.

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Abstract

This study was undertaken to provide some of the social values for the non-timber component of the Millar Western-NorSask Forest Management Licence Agreement. This study estimates the changes in the value of a recreational hunting experience as one, or a combination of several, of the following items change in the forest environment: i) road access; ii) game populations; iii) congestion; and iv) travel distance.

There are several unique aspects of this study. It extends traditional contingent valuation analysis by evaluating multiple quality changes at once. A variation on the contingent valuation method, called the contingent behaviour method, was developed to examine these tradeoffs; the payment vehicle used in this model is travel cost.

The data used in this study were obtained from two mail surveys of Saskatchewan hunters: one of whitetail deer hunters and one of moose hunters. Using these data, a binary choice random utility model was developed. Using information on logging-wildlife interactions, a simulation of six post-timber harvesting scenarios were created for zone 69 in the Millar Western-NorSask FMLA area and the annual and capitalized welfare impacts on hunters were calculated.

The results show that an increase in the welfare of resident Saskatchewan whitetail deer and moose hunters can be expected from the harvesting of timber in the Forest Management Licence Agreement. The estimated annual increase in welfare ranged from $5 799.54 to $18 979.72 for whitetail deer hunters and it ranged from $4 247.22 to $ 19 409.98 for moose hunters.

The highest welfare impacts were obtained from scenarios where game populations were increased and congestion was decreased, suggesting that people may prefer avoiding areas with forestry operations unless the area offers increased hunting attributes (e.g. game).

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TABLE OF CONTENTS

CHAPTER I INTRODUCTION 1
A. The Situation 1
B. Background Information 4
1. Hunting in Saskatchewan 4
2. Environmental Quality Changes 5
C. Study Plan 5

CHAPTER II THEORETICAL BACKGROUND 7
A. Benefit Measurement and Recreational Demand Models 7
1. Introduction 7
2. Non-Timber Valuation 7
3. Valuing Non-Timber Benefits: Direct vs. Indirect Methods 9
4. Contingent Valuation & Contingent Behaviour 11
B. Individual Choice Behaviour 16
1. Introduction 16
2. Consumer Theory 17
3. Discrete Choice Theory 18
4. Random Utility Models 19
5. Binary Choice Models 20
C. Welfare Theory 23
D. Wildlife-Logging Interactions 26
E. Summary 28

CHAPTER III THE DATA 30
A. Data Collection and Survey Design 30
B. The Contingent Behaviour Question 33

CHAPTER IV MODEL DEVELOPMENT, ESTIMATION, AND RESULTS 36
A. Model Development 36
1. Introduction 36
2. Specification of Binomial Logit Model of Whitetail Deer and Moose Hunting 36
3. Variable Definitions 39
B. Estimation and Model Results 40
1. Model Estimation and Results 40
2. Sensitivity to Model Complexity 46
3. Predictive Ability 46
C. Application of Results 47
1. Welfare Measures 47
2. Post-Harvesting Simulation 51
a. Introduction 51
b. Simulation Results - Whitetail Deer Hunters 55
c. Simulation Results - Moose Hunters 56
d. Discussion of Simulation Results 57

CHAPTER V SUMMARY AND CONCLUSIONS 59
A. Summary 59
B. Limitations 61
C. Future Research Needs 62
D. Conclusions 63

CHAPTER VI LITERATURE CITED 64

APPENDIX A: The Data Collection Surveys 67

APPENDIX B: Sample Sizes and Contingent Behaviour Question Summary 92

LIST OF TABLES

Table 3.1 Sample Size, Response and Response Rates for the Surveys 32
Table 3.2 Variations of Hunting Site Attributes 35
Table 4.1 Site Attribute Values 38
Table 4.2 Binomial Logit Estimates: Whitetail Deer Hunter Model 1 43
Table 4.3 Binomial Logit Estimates: Whitetail Deer Hunter Model 2 43
Table 4.4 Binomial Logit Estimates: Whitetail Deer Hunter Model 3 44
Table 4.5 Binomial Logit Estimates: Moose Hunter Model 1 44
Table 4.6 Binomial Logit Estimates: Moose Hunter Model 2 45
Table 4.7 Binomial Logit Estimates: Moose Hunter Model 3 45
Table 4.8 Frequencies of Correct Predictions of the Whitetail Deer and Moose Hunter Models 47
Table 4.9 Per Trip Welfare Impacts on Whitetail Deer Hunters 50
Table 4.10 Per Trip Welfare Impacts on Moose Hunters 51
Table 4.11 Annual Welfare Impact From Environmental Changes on Whitetail Deer Hunters 56
Table 4.12 Capitalized Welfare Impact From Environmental Changes on Whitetail Deer Hunters 56
Table 4.13 Annual Welfare Impact From Environmental Changes on Moose Hunters 57
Table 4.14 Capitalized Welfare Impact From Environmental Changes on Moose Hunters 57
Table B-1 Sample Sizes for Survey Versions 93
Table B-2 Contingent Behaviour Question Summary 93

LIST OF FIGURES

Figure 1.1 Millar Western-NorSask Forest Management Licence Agreement Area in Northwestern Saskatchewan 3
Figure 4.1 Hunting Zones in the Millar Western-NorSask Forest Management Licence Agreement Area 54

CHAPTER I INTRODUCTION

A. The Situation

Millar Western Pulp (Meadow Lake) Ltd. and NorSask Forest Products Inc. are partners in the harvesting of timber from a large tract of land in Northwestern Saskatchewan. Mistik Management Ltd. is the firm hired to manage the Millar Western-NorSask Forest Management Licence Agreement (FMLA). To fulfil the FMLA obligations, a Twenty Year Forest Management Plan and Environmental Impact Assessment must be prepared which describes proposed operations. The Saskatchewan Environment and Public Safety department further requires that the Twenty Year Forest Management Plan must "identify how the plan will take into consideration other forest users and how the concept of integrated resource management was included in the development of the plan . . . and discuss the socio-economic implications of the plan" (Mistik Management Ltd., 1992 p.2).

Increasingly, Canadians are voicing concern over the loss of wilderness due to resource extraction and they are demanding responsible management of the country's natural resources. Integrated resource management is a term used to describe a management philosophy that considers managing the forest for more than simply a fibre supply for lumber or pulp production. Mistik Management Ltd. defines integrated resource management :

> The Integrated Forest Resource Management Planning Process is the tool to derive a forest management plan that provides a predictable supply of forest based resource benefits from the FMLA through management of the forest structure. This process considers nontimber resource supply benefits (i.e. wildlife habitat, forest biodiversity, recreational/tourism opportunities, and vegetation nonwood products) simultaneously with the planning of the timber management benefits (i.e. wood supply). In addition, special values (i.e. heritage sites, human structures, critical wildlife habitat such as fish spawning sites, raptor nests, and exclusions) are managed by appropriate guidelines (Mistik Management, 1992 p.2).

For an integrated resource forest management plan to be successfully designed, social values for the non-timber component must be recognized. The purpose of this study is to quantify some of the non-timber resource supply benefits from the Millar Western-NorSask FMLA and to apply known techniques to examine the economic effects of forest structure changes on these benefits, and apply the methodology to the FMLA. Specifically, this study examines the changing economic benefits of recreational whitetail deer and moose hunting in the FMLA under a changing forest structure due to timber harvesting operations. The information and methods presented in this study may be incorporated into the Forest Management Plan being developed for the FMLA.

Wilman (1984) and Hammitt et al. (1989) state that hunting satisfaction is influenced by both the success of the hunt and the environment in which the hunters recreate. Wilman examined forest management practices influencing deer populations, while Hammitt et al. included social factors such as crowding and actions of other hunters, as these contribute to a quality hunting experience. This study will be examining how hunters make tradeoffs among such environmental and social factors. An econometric model will be developed to explain these tradeoffs and the model results will be used to determine the welfare effects of such changes in the hunting environment such as: game populations, road access, hunter congestion and travel cost.

The Millar Western-NorSask FMLA which consists of 3.3 million ha of land area in northwestern Saskatchewan (Figure 1.1). It extends along the Alberta-Saskatchewan border and includes the following Wildlife Management Zones: 69 and 73 and parts of 68, 67 and 66.

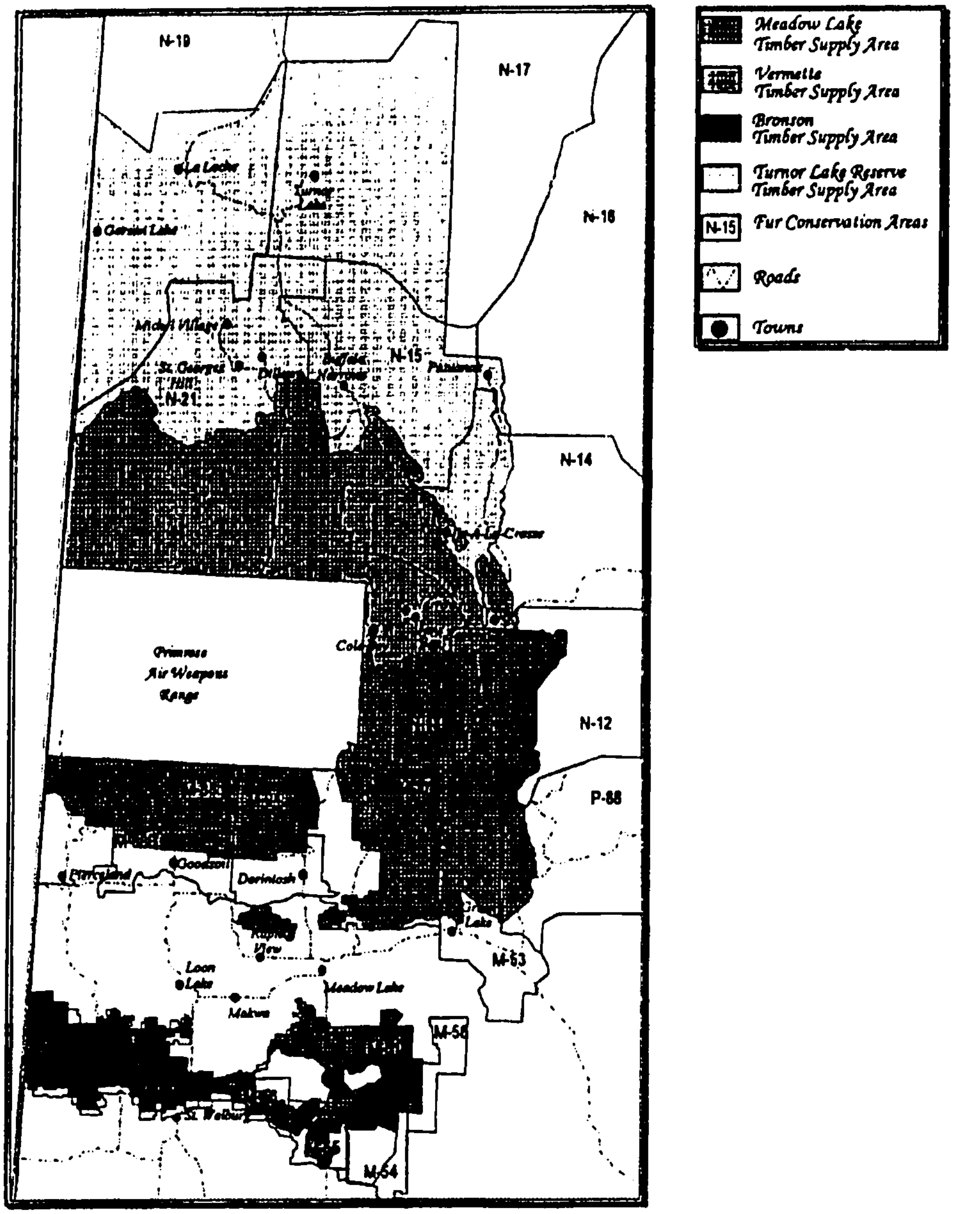

Figure 1.1 Millar Western-Norsask Forest Management Licence Agreement Area in northwestern Saskatchewan
Source: Mistik Management (1993)

No copyright involved

B. Background Information

1. Hunting in Saskatchewan

The *Survey on the Importance of Wildlife to Canadians During 1991* shows that hunting is an important recreational activity in Saskatchewan (Canadian Wildlife Service/Statistics Canada, 1993). Thirty one percent of Saskatchewan residents have hunted wildlife at least once. In 1991, 74 159, or 10.3% of Saskatchewan residents participated in hunting wildlife.

Saskatchewan department of Environment and Resource Management[1] estimates there were approximately 102 028 big game hunting licences purchased for the 1992/93 hunting season, with over 95 612 participants. The big game species include whitetail deer, mule deer, moose, elk, bear and antelope. Revenue from these big game licences was $4 380 581.69; a further $356 876.80 was received from game bird licences. Of the amount spent on big game hunting licences, $2 122 156.76 came from whitetail deer licence sales and $411 695.31 came from moose licence sales. *The Survey on the Importance of Wildlife to Canadians in 1991* states that there were 54 955 big game hunters, and that the mean total expenditure on big game hunting was $590.38 per participant. This indicates that $32 444 332 was spent on hunting by Saskatchewan residents. The *Survey on the Importance of Wildlife to Canadians During 1991* also shows that the total amount of consumer surplus, for those survey participants with a consumer surplus, for hunting large mammals in 1991 was $246 091.00, or $145.74 per participant. Furthermore, the survey also stated that Saskatchewan hunters spent over 540 917 days hunting large mammals in Saskatchewan: an average of 9.9 days per participant. Clearly, hunting is an important recreational activity in Saskatchewan, and whitetail deer and moose hunting play an important role in recreational hunting in this province.

[1] All references to Saskatchewan department of Environment and Resource Management refer to personal communication with R.B. Crouter of Saskatchewan Environment and Resource Management, 24 March, 1993.

2. Environmental Quality Changes

This study is concerned with examining the relationship between timber harvesting and hunting quality. Efforts were made to consult with biologists, outfitters and forest managers to compile a list of factors arising from forestry operations that are known to affect hunting quality. For example, access to hunting sites will change once forest operations begin. Sand and gravel roads will be constructed to reach areas for harvesting and replanting. The roads will be maintained by the forest products companies during harvesting. By opening up areas previously inaccessible with a two-wheel or four-wheel drive vehicle, hunters may begin to enjoy new hunting areas. Increasing hunter traffic into previously secluded areas may increase hunter congestion and increase the likelihood of a hunting party encountering other parties in the same area. On the other hand, opening up new areas for hunting might disperse hunters. Also, the very presence of forestry operations in the area also changes the forest environment and its aesthetics. Replanting and natural regeneration of trees will increase edible vegetation for species like whitetail deer and moose resulting in an increase in the population size of these two species in a particular area. Combining varying levels of the above mentioned environmental qualities may increase the hunting quality in the area or decrease it. This study will examine how hunters make tradeoffs between hunting sites with the changes in the levels of the environmental qualities discussed above.

C. Study Plan

Chapter II provides background information on non-timber valuation, followed by a discussion of the literature on direct and indirect valuation techniques. A detailed description of a "discrete choice random utility model" is given and a discussion on "welfare theory" is presented in order to calculate the benefits of the changes in environmental quality. A brief discussion of the post-harvesting evolution and wildlife interactions will be presented.

Chapter III discusses the data used for the model estimation and the design of the Saskatchewan Hunting surveys.

Chapter IV examines model development, estimation and results. Welfare measures using the model results are calculated and are used to determine the welfare effects of changes in the hunting environment in the FMLA area. Using information on logging-wildlife interactions, a simulation of post-harvesting conditions is created for a hunting zone in the Millar Western-NorSask FMLA area, and the welfare impact on hunters is calculated.

Conclusions and directions for future research considerations are presented in Chapter V.

CHAPTER II THEORETICAL BACKGROUND

A. Benefit Measurement and Recreational Demand Models

1. Introduction

The purpose of this chapter is to review and analyze the literature on non-timber valuation methods. The analysis will begin with a discussion on non-timber values and their place in integrated resource management. There are two major categories of non-timber[2] valuation methods: direct and indirect. The differences between the direct and the indirect methods of non-market valuation will be briefly discussed. Due to space considerations, only a basic overview of two indirect methods will be given. The analysis of their estimation methods and drawbacks will not be discussed. The focus of this chapter will be on one of the direct methods, contingent behaviour, which stems from the contingent valuation method. Consumer choice theory will be examined in a random utility framework, which will lead the reader into the empirical issues of applying the theory to operational economic models. The literature review will end with a discussion of welfare measurement.

2. Non-Timber Valuation

In addition to being a source of fibre for timber and paper products, forests provide a wide range of non-timber goods and services. Non-timber goods and services include: animals, birds, forest biodiversity, wildlife habitat, and recreation. As stated earlier, the goal of integrated resource management is to manage the forest for more than a supply of fibre; forest managers must take into consideration the benefits associated with the non-timber services in addition to the timber supply benefits. Economic tools such as benefit-cost analysis can aid the forest manager in deriving the

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[2] Not all non-timber values are non-market values. This study is concerned with non-timber values that are non-market values as well.

optimum mix of timber and non-timber services supplied from the forest. The use of an economic tool such as benefit-cost analysis requires that a monetary value be placed on the non-timber services to facilitate the comparison of the timber and non-timber benefits and costs.

Adamowicz (1992) explains the three categories into which non-timber services (and corresponding values) may fall: user services (use value), non-user services (non-use value) and environmental control services (environmental control value). Use value arises from enjoyment in participating in an activity associated with the forest, for example: hunting, fishing, birdwatching, or hiking. Non-use values arise from an enjoyment of the forest that does not require participation in an activity in the forest, for example: maintenance of endangered species or forest biodiversity, and "knowing it is there". Bishop (1987) further explains that "nonuse values are generated when management decisions affect possibilities for future use or impinge on people's altruistic concerns" (Bishop, 1987 p. 27). Environmental control value arises from services provided by the forest for flood and climate control, soil erosion control, or water quality regulation.

Use values can be further broken down into consumptive values (e.g. hunting and fishing) and non-consumptive values (e.g. hiking and birdwatching). Cocheba (1987) explains that the terms consumptive and non-consumptive use values are misleading since non-hunting activities such as hiking or birdwatching can, indeed, be consumptive in nature when wildlife habitat is destroyed or disrupted. Furthermore, hunting does involve non-consumptive activities such as: enjoying the outdoors, viewing wildlife and shooting at an animal and missing.

When providing both timber and non-timber services from the forest, the manager responsible must frequently make tradeoffs between the allocation of resources to the production of timber and/or non-timber services from the forest. Tradeoffs between the production of timber and non-timber services are not always necessary; their production may be complimentary or compensating in nature. Benefit-cost analysis is used to evaluate the most economically efficient allocation of resources[3].

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[3] Benefit-cost analysis assumes complete knowledge of the significance of the effects of man's actions.

Economic efficiency is concerned with allocating resources to their "highest value and best use". One needs a monetary valuation of non-timber services to give a common basis for comparing the benefits and costs of timber services with non-timber services. Another reason for the valuation of non-timber services is to determine compensatory damages in the event of loss or destruction of environmental amenities.

The efficient allocation of resources is hampered by the lack of appropriate monetary valuations for non-timber resources. Values for timber resources may be imputed; wood products are exchanged in markets and its value is determined by the price that is negotiated between buyers and sellers. Non-timber services, on the other hand, may not be exchanged in markets especially if they are public goods. Public goods are non-rival and non-excludable in nature (Johansson, 1987). Since one cannot exclude another from consuming a public good, it cannot be traded in a market and a market price cannot be determined. Although hunters must purchase licences in order to hunt, the licence price does not reflect the true market value of a hunting experience since the licence price is an administratively set price by government authorities. Economists have developed techniques for estimating market values for public, or non-market, goods such as wilderness recreation experiences and for measuring the benefits of changes in environmental quality. The remainder of this chapter will examine theoretical and empirical developments in the area of non-market valuation measurement.

3. Valuing Non-Timber Benefits: Direct vs. Indirect Methods

There direct and indirect approaches to valuing non-timber, or non-market, goods and services. The direct approach involves surveys, written or oral, to determine how people make economic decisions or value a particular good or service. The indirect approach involves observing a person's behaviour. With the direct method, the researcher creates a hypothetical situation to elicit a person's willingness to pay (WTP) for, or willingness to accept (WTA) compensation to give up a non-market good or service. This method will be discussed in more detail in the following section. Relying on the economic assumption of "weak complementarity" between the non-market good (e.g.

a visit to a park) and a market good (e.g. expenditures on gas to travel to the park), indirect methods link the observable choice to visit a park with a commodity that has a market price. Due to the nature of the indirect approach, it can only be used in determining use values, since non-use involves no expenditures on market goods, and therefore, leaves no behavioural trail.

The travel cost method is an indirect method first conceived by Hotelling (1949). It was developed by Clawson (1959) and later refined by Knetsch (1963) and Clawson and Knetsch (1966). The travel cost method utilizes the fact that people live in different places and therefore incur different travel costs to reach a given recreation site. The travel cost is used as a proxy for the price of visiting the site; as the travel cost increases, people can be expected to visit the recreation site less often. A demand function for trips to the recreation site can be formed from the relationship between the number of visits and the travel cost and consumer surplus[4] can be calculated.

The travel cost model has a number of statistical and theoretical drawbacks which are discussed in Fletcher et al. (1990). One of the drawbacks of the basic travel cost model is that the data used in travel cost analyses are cross-sectional and as Adamowicz (1992) points out: "temporal site quality changes are ignored" (Adamowicz, 1992 p.18). Therefore, the basic travel cost model cannot be used for valuing environmental quality changes. A number of methods have been developed to incorporate quality effects into the travel cost model. Such methods include: the Varying Parameter Model (Smith and Desvousges, 1986), the Hedonic Travel Cost Model (see Brown and Mendelsohn, 1984), and the Discrete Choice or Random Utility Model (Ben-Akiva and Lerman, 1985).

Another indirect method for valuing non-market goods and services is a hedonic price method. This method also employs the assumption of weak complementarity. The hedonic price method can be used to estimate the value of specific attributes of a good or service, including environmental quality. Paraphrasing Smith's (1989) example, a researcher can observe a choice to

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[4] Consumer surplus is an individual's willingness to pay for a good or service over and above his or her expenditures.

purchase a house and the purchase price of the house. The researcher then, will reconstruct what he or she believes the consumer perceived he or she was getting with the house, for example land area (lot size) or proximity to a park. The value of the environmental amenities associated with the house is included in its price and statistical techniques are employed to determine the contribution of the market aspects (land area) and non-market aspects (proximity to a park) and their implicit prices. Adamowicz and Phillips (1983) and Adamowicz (1992) discuss the assumptions required for estimation, and the benefits and drawbacks of the hedonic price method.

4. Contingent Valuation & Contingent Behaviour

The direct method of valuing non-market goods and services is also called contingent valuation (CV); the valuation of the non-market good (e.g. a day of recreational hunting) is contingent on there being a market (hypothetical) for the good or service. Typically, the researcher uses surveys or interviews to create a hypothetical situation to elicit a person's WTP for, or WTA to give up, some of that non-market good or service. As Smith (1989) points out, CV requires that the respondents anticipate their reactions to situations that have not yet occurred. CV questions can be open-ended or closed-ended; a series of questions or a single question. Open-ended CV questions ask the respondent: "What would you be willing to pay for . . . ?". A series of open-ended CV questions would result in an auction process or bidding games. Closed-ended CV questions ask the respondent: "Would you be willing to pay $X for . . . ?". In a single closed-ended CV question, the respondent simply votes on whether or not the value stated is acceptable for the situation or change suggested. An extension of the closed-ended CV question is a multiple question format or a series of referendum questions. Contingent valuation is the only method used for the valuation of both use and non-use goods and services, and quality changes.

The CV method assumes that the respondent *can* assign an accurate value to the non-market good or service he or she is being asked. The value being sought is their *maximum* WTP or *minimum*

WTA, not simply a "fair" price. Adamowicz (1992) gives criteria for theoretically correct welfare measurements using CV. In order for the respondent to be able to offer an accurate value, it is necessary that the interviewer or survey question give an accurate description of the current level or status of the good or service (base level). It is necessary that the respondent fully understand the base level explained and he or she must fully understand the nature of the good or service being valued and change in quality or quantity being suggested (if applicable). The interviewer or survey question must be clear as to the time dimension related to the change in quality or quantity and it must be clear how the payment is to be made. Finally, there must be full understanding of what the payment amount represents: *maximum* WTP or *minimum* WTA. Full understanding and clear communication of the situation is critical for the success of a CV question.

A poorly designed or poorly communicated CV question yields the potential for a number of biases[5], such as strategic behaviour, measurement bias, embedding and hypothetical effects. Bishop and Heberlein (1979) discuss strategic behaviour in CV. They state that:

> "... perceiving that they will not actually have to pay and that their responses may influence the supply of an extra market good or bad, people may respond in way that are more indicative of what they would like to see done than how they would behave in an actual market" (Bishop and Heberlein, 1979 p.927).

Mitchell and Carson (1989) identify several types of measurement bias possible in the design of CV questions including: implied value cues (starting point bias, anchoring bias, relational bias), situation misspecification (amenity misspecification, payment vehicle bias) and sampling problems. The wording of the question may bias the values given. Starting point bias occurs when a starting bid suggests (incorrectly) to the respondent an appropriate range for the value amount. Thus, the values for the good can change depending on the magnitude of the starting bid. Bidding cards often suffer

[5] Strictly speaking, the term *biases* implies there is some error-free measure for WTP or WTA. The WTP and WTA values obtained in CV questions are sensitive to the following issues: strategic behaviour, measurement bias, embedding and hypothetical effects.

from anchoring biases; the range of values on the card gives information to the respondent as to suggested values. Relational bias occurs when a related good is inadvertently included in the question, confusing the respondent into valuing both goods. One type of situation misspecification is amenity misspecification where the perception by the respondent differs from theoretical specification. Since perceptions are what people make decisions upon, it is crucial that the theoretical and the respondent's perceptions coincide. Another potential for situation misspecification arises in the choice of payment vehicle (i.e. taxes, higher prices in other market goods, donation to a charitable organization, entrance fees). For example, a payment vehicle of higher taxes may result in protest bids and under-reporting of true WTP by respondents with aversions to higher taxes or a dislike of the government. Sampling problems include non-response bias and sample selection. Non-response bias is concerned with the differences between people who do answer surveys and people who do not. The sample selection issue is concerned with people who do answer surveys; if they have a stake in the issue being studied they may have a higher WTP. All of these forms of measurement bias will affect the values obtained in CV experiments.

Some authors are critical of the use of CV in non-use valuation. Kahneman and Knetsch (1992) pointed out various problems such as embedding, "warm-glow giving" and the disparity between WTP and WTA. Embedding deals with situations where the respondent is being asked for WTP for a succession of services in which subsequent services may be subsets of the previous one. Kahneman and Knetsch (1992) suggest that the researcher can obtain any value for WTP depending on how the questions are ordered, or by reducing the number of subsets for the respondent to value. Furthermore, in situations where a researcher is trying to elicit a value for an environmental good the problem of 'warm-glow giving' may arise. Kahneman and Knetsch (1992) suggest that true WTP is not being captured, but rather a purchase of "moral satisfaction" or good feelings towards the good or service. Although economic theory states that WTP and WTA should be similar, empirical evidence has consistently yielded alarming disparities between the two measures for the same good. Studies have revealed WTA estimates that are three to ten times the magnitude of WTP estimates.

For example, Bishop and Heberlein's (1979) goose hunting study yielded WTA values of $101 and WTP values of $21 for goose hunting permits. Some researchers such as Kahneman and Knetsch (1992) attribute the differences between WTP and WTA to an "endowment effect" or loss aversion, or a kinked utility function for gains versus losses. Bishop and Heberlein (1979) suggest that WTP be used as a lower bound and WTA be used as an upper bound. In valuing environmental goods, researchers tend to use WTP rather than WTA because WTP values are easier to elicit than values for WTA. This goes back to the question of whether or not respondents *can* assign values to such abstract goods that they are not used to pricing, such as: ozone, the prevention of a 50 000 gallon oil spill, or a 15% increase in the Spotted Owl population. For a detailed discussion of CV biases and problems see Cummings, Brookshire and Schulze (1986) and Mitchell and Carson (1989).

Clearly, there are serious concerns regarding the validity of values obtained from CV questions and the reliability of the CV method. Much of the criticism of the CV method arises from its use in valuing non-use goods and services and from poorly designed questions. In some cases, such as the valuation of non-use goods and services, the CV method is the only one available to researchers; the travel cost method or hedonic pricing cannot offer any information as to existence values, for instance. Furthermore, as Smith (1989) points out, these methods cannot help economists understand how people make tradeoffs between goods and services. "Without knowing how people perceive the resource, even if it did affect choices of other observable things, this impact would be difficult (if not impossible) to detect from their selections of the purchased goods and services" (Smith, 1989 p. 875). Some researchers like Regens (1991), Smith (1993) and Bishop and Heberlein (1979) are confident of the accuracy of CV results when used in circumstances of valuing goods or services in which respondents are familiar, such as asking hunters to value a day of recreational hunting. Bishop and Heberlein (1979) used CV to value goose hunting permits and compared the values obtained from hypothetical markets with values obtained in actual markets: the CV results were a good predictors of the actual market transactions.

Cameron's (1992) study on the valuation of a non-market good examined demand for access to a recreational fishery. In this study, Cameron combined CV and travel cost data to produce a joint model of utility and demand to provide a more complete picture of preferences.

In my study, the changes in benefits to recreational hunters from the alteration of the forest environment from timber harvesting will be determined. Timber harvesting indirectly affects recreational hunting via its direct affect on vegetation and wildlife. It is my goal to determine how the value of a recreational hunting experience changes as one, or a combination of several, of the following items change in the forest environment: i) road access (road quality); ii) game populations; iii) congestion; and iv) travel distance (cost). A variation on the CV method was used to examine these tradeoffs; the payment vehicle used in this model is travel cost. This extension on the CV method can be called contingent behaviour (CB) rather than CV because the respondent is not asked "would you be willing to pay $X to hunt in a new zone?", instead, he or she is being asked if they would be willing to *visit* a new hunting site which has an implicit price. Each question gave two forest hunting scenarios. The first scenario was a "base case", which represented a mixed forest in northwestern Saskatchewan with no apparent forestry operations, limited access, low game populations and low hunter congestion. The second scenario altered levels of access (road quality), game populations, or congestion of hunters and contained a randomly generated cost factor. Each question asked respondents in which site they would prefer to hunt.

The impetus for developing the CB method was to examine how hunters make tradeoffs between differing levels of environmental qualities and to avoid payment vehicle bias in the WTP values.

The harvesting of timber is a fairly recent development in Northwestern Saskatchewan. Saskatchewan hunters have been accustomed to having recreational opportunities in the old-growth forest and, not surprisingly, some perceive the harvesting of the timber in this area will not be beneficial to them. Question 18, on page 8, in the survey (see Appendix A for copies of the surveys) asked the respondent to what extent a variety of environmental factors (e.g. increased game, privacy, road access, presence of forestry operations) increased or decreased their hunting experience. It is easy for a researcher to report, for example that hunters prefer more game to less, or they prefer no logging to having logging in the area. This survey was designed to examine how the respondents would **tradeoff** varying levels of environmental factors.

The CB question was designed to illustrate to the respondent the existing forest structure and to illustrate how harvesting may change hunting conditions (i.e. altering levels of several environmental qualities, not just one quality at a time). We were aware of the strong possibility of an endowment effect in the choice between the two sites: a new hunting site with increased access and game (and increased travel costs) may not be able to compensate for the loss of an unlogged, old-growth forest. Assuming that a typical respondent would be able to see, and believe, the benefits of the new (post-logging) scenario, it was crucial to derive a payment vehicle that would not upset the respondent so as to make him or her reject the new site as a protest over the method of payment. An increase in travel costs to the new (post-logging) site became the payment vehicle. Thus, this experiment does not simply ask the respondent if he or she would be willing to pay for an increase in access, or an increase in game population, the respondent is being asked if he or she would be willing to change his or her behaviour. The respondent must evaluate the two sites, with different combinations of quality levels and make tradeoffs between the different qualities.

B. Individual Choice Behaviour[6]

1. Introduction

The previous section discussed the contingent behaviour method of valuing non-timber services. The purpose of this section is to discuss the theory used in developing an operational economic model to describe the survey respondents' choices between Zone A and Zone B in the contingent behaviour questions of the Saskatchewan hunting surveys. Although the goal of this study

[6] Sections 1 to 4 are largely based on Ben-Akiva and Lerman (1985) pages 31-98.

is to model the tradeoffs of a large group of people (hunters, in this case), it is individual decisions that are at the core of any model of behaviour. A brief overview of neoclassical consumer theory of individual choice behaviour will be presented followed by the application of the theory presented for situations where the consumer faces a discrete set of alternatives. The random utility approach to analyzing discrete choices will be examined and extended to the special case where the consumer's choice set contains exactly two alternatives.

2. Consumer Theory

Consumer theory explains how an individual consumer allocates his or her income among the numerous commodities available. It is generally assumed that consumers are *rational*; that is, their preferences are consistent and transitive. Consumer theory can be briefly outlined with a few points.

i) The individual chooses a consumption bundle

$$Q = \{q_1,\ldots,q_L\} \qquad (1)$$

where $q_1,\ldots,q_L$ are the quantities of goods or services, $l=1,\ldots,L$. These goods or services are generally continuous and non-negative.

ii) The individual has a fixed income, I, which limits the consumption possibilities. Prices are fixed at $p_1,\ldots,p_L$ and the budget constraint the individual faces is:

$$\sum_{l=1}^{L} p_l q_l \le I \qquad (2)$$

Note there is no treatment of attributes other than the quantities of the goods or services.

iii) The individual's utility function is expressed as follows:

$$U = U\{q_1,\ldots,q_L\} \qquad (3)$$

The utility function expresses the individual's preference ordering. If the individual prefers commodity bundle Q_i to Q_j (i.e. $Q_i \succeq Q_j$), then $U(Q_i) \ge U(Q_j)$.

iv) The individual chooses the commodity bundle which maximizes his or her utility subject to the budget constraint. The indirect utility function is the maximum utility that than be achieved by the individual under the given prices and income. The individual's indirect utility function is expressed as follows:

$$U = U(p_1,\ldots,p_L,I) \qquad (4)$$

3. Discrete Choice Theory

Discrete choice theory follows the same concepts as the consumer theory outlined above, except that it allows for consumption of discrete quantities of goods and services rather than a continuous set. If the set of goods and services is not continuous (i.e. consumption of one or more goods or services is zero) then "corner" solutions may result. Discrete choice theory retains the notion of the rational consumer; and, the analysis relies heavily on the theory of indirect utility functions.

Consider a set of all alternative recreation sites, denoted by C. Goods such as trips to recreational areas are mutually exclusive because one cannot visit two recreation sites simultaneously. The individual consumer will choose only one site, per trip, from the set of alternative sites. The various exogenous factors that individual *n* faces, such as awareness or availability of all sites included in C, reduces his or her set of alternatives to C_n, where $C_n \in C$. The utility of choosing i for individual *n* is represented as:

$$U_{in}, \quad where\ i \in C_n \qquad (5)$$

Alternative $i \in C_n$ is chosen only if $U_{in} > U_{jn}$, for all $j \neq i, j \in C_n$.

The indirect utility functions can be represented as functions of the attributes of the alternatives

$$U_{in} = U(z_{in}) \qquad (6)$$

where $\mathbf{z}_{in}$ is a vector of the attributes of alternative i as perceived by individual *n*. Since C is restricted by various exogenous constraints, these constraints can be included in the indirect utility function.

Ben-Akiva and Lerman state that "generally, in empirical applications we will introduce into the utilities a vector of socioeconomic characteristics that explains the variability of tastes across the portion of the population of which our model of choice behaviour applies" (Ben-Akiva and Lerman, 1985 p. 48). Therefore, the indirect utility function is:

$$U_{in} = U(z_{in}, S_n), \tag{7}$$

where S_n is a vector of characteristics of individual n.

Early choice experiments yielded observations that violated the axioms of consistency and transitivity. Therefore, in order to explain such behaviour, probabilistic choice mechanisms were developed. One such probabilistic choice mechanism is random utility.

4. Random Utility Models

The random utility approach to modelling choice behaviour states that the observed inconsistencies noted above are due to researcher observational errors. Ben-Akiva and Lerman state that "the individual is always assumed to select the alternative with the highest utility. However, the utilities are not known to the analyst with certainty and are therefore treated by the analyst as random variables" (Ben-Akiva and Lerman, 1985 p.55). The underlying sources of the randomness, identified by Ben-Akiva and Lerman (1985) are: i) unobserved attributes; ii) unobserved taste variations, i.e. fluctuations in an individual's preferences; iii) measurement errors; and iv) instrumental variables. The overall utility can be represented as the sum of a systematic and a random component.

$$U_{in} = V(z_{in}, S_n) + \varepsilon(z_{in}, S_n) = V_{in} + \varepsilon_{in} \tag{8}$$

The probability that individual *n* will choose alternative i is equal to the probability that the utility received from alternative i is greater than or equal to the utility received from any other alternatives in C_n.

$$\begin{aligned} P(i \mid C_n) &= Pr[U_{in} \geq U_{jn} \text{ , } all \ j \in C_n] \\ &= Pr[V_{in} + \varepsilon_{in} \geq V_{jn} + \varepsilon_{jn} \text{ , } all \ j \in C_n] \end{aligned} \tag{9}$$

Choice probabilities are derived by assuming a joint probability distribution for the set of random utilities $\{U_{in}, i \in C_n\}$.

It is important to note that utility is measured in ordinal, rather than cardinal, terms. This means that U_{in} and U_{jn} may be shifted with any monotonic transformation and the relative ranking of each consumption alternative in the individual's choice set is unaffected. Therefore, any monotonic transformation of the utility functions will not affect the probabilities of choosing alternative i or j.

Equation 10 illustrates that the probability of choice is dependent upon the differences in utility.

$$\begin{aligned} Pr(i \mid C_n) &= Pr(V_{in} + \varepsilon_{in} \geq V_{jn} + \varepsilon_{jn}) \\ &= Pr(\varepsilon_{jn} - \varepsilon_{in} \leq V_{in} - V_{jn}) \end{aligned} \quad \textbf{(10)}$$

In order to estimate the utility functions, one must make an assumption about the structure of the deterministic and random components of the indirect utility function. This will be considered in the context of a binary choices in the following section.

5. Binary Choice Models

This section considers the situation where an individual is faced with exactly two alternatives to choose from. Using the contingent behaviour question from the Saskatchewan hunting surveys as an example, the random utility model will be developed into a binary choice model where the individual respondent must chooses between two hunting zones: Zone A and Zone B. The dependent variable, y, takes on the value 1 if the individual chooses Zone B (altered state with additional travel cost) and 0 if they choose Zone A (base state).

$$y_{in} = \begin{cases} 0 & \textit{if person n chose Zone A} \\ 1 & \textit{if person n chose Zone B} \end{cases} \quad \textbf{(11)}$$

The probabilities of an individual choosing Zone A or choosing Zone B can be written as follows:

$$Pr(Zone\ A) = Pr(y=0) = Pr(\varepsilon_{1n} - \varepsilon_{0n} \leq V_{0n} - V_{1n})$$
$$Pr(Zone\ B) = Pr(y=1) = Pr(\varepsilon_{0n} - \varepsilon_{1n} \leq V_{1n} - V_{0n}) \quad (12)$$

A framework for predicting these probabilities is needed. Some functional forms, or structures, for the deterministic and random components of the indirect utility function must be specified. Most researchers specify linear utility functions of the following form for the deterministic component:

$$V_{in} = \beta' z_{in} + \gamma_i' S_n \quad (13)$$

where z_{in} is a vector of site attributes and S_n is the vector of the socio-economic or demographic attributes of the individual. β and γ are vectors of unknown parameters. Ben-Akiva and Lerman state that "if the preferences or tastes of different members of the population vary systematically with some known socioeconomic attribute, we can define some of the elements in x [the indirect utility function] to reflect this" (Ben-Akiva and Lerman, 1985 p.64). Although estimation of the model only requires consideration of the differences in utility and the individual's characteristics such as age, or years of hunting experience do not change between the choice of hunting in Zone A or hunting in Zone B, these characteristics may play an important role in determining which hunting zone (area) the individual prefers and therefore should be included in the model.

The last component of the binary choice model is the disturbance terms, the ε_{in}'s. As with the systematic components V_{in} and V_{jn}, the specification of a binary choice model need only consider the difference ε_{in}-ε_{jn}. Ben-Akiva and Lerman suggest that "usually the most convenient assumption is that all the disturbances have zero means . . . In addition to the mean of the disturbances we must ensure that their scale is consistent with that of the V's. Again, any strictly monotonic transformation of the utilities U_{in} and U_{jn} will not affect the choice probabilities" (Ben-Akiva and Lerman, 1985 p.65). They further suggest restricting the variance of ε_{in}-ε_{jn} equal to 1. "The choice is entirely arbitrary, and we usually use a scale that is analytically or computationally convenient" (Ben-Akiva and Lerman, 1985 p.65). A common choice for many researchers is to assume that the individual disturbances are Weibull Type I extreme value distributed. If the errors are distributed in this manner, then their difference is logistically distributed.

Under this assumption the probability that an individual chooses alternative i is given by

$$P(y_{in}=i) = \frac{e^{(V_{in}-V_{jn})}}{1+e^{(V_{in}-V_{jn})}} \tag{14}$$

Incorporating the deterministic component of the V_{in}'s from (13), we get

$$P(y_{in}=i) = \frac{e^{\beta'(z_{in}-z_{jn})+(\gamma_i-\gamma_j)'S_n}}{1+e^{\beta'(z_{in}-z_{jn})+(\gamma_i-\gamma_j)'S_n}} \tag{15}$$

In this study, the data were set up such that the differences in the attributes were recorded, i.e. the z_{in}'s are, in fact, the differences between the attributes of Zone A and Zone B. For example,

$$\begin{aligned} z_A &= \alpha_A + \beta(D_A) \\ z_B &= \alpha_B + \beta(D_A+\theta) \\ z_A - z_B &= \beta(\theta) \end{aligned} \tag{16}$$

Therefore,

$$z_n \equiv z_{0n} - z_{1n} \tag{17}$$

The probability of an individual choosing Zone B ($y_{in}=1$) is then:

$$P(y_{in}=1) = \frac{e^{\beta' z_n + (\gamma_i-\gamma_j)'S_n}}{1+e^{\beta' z_n + (\gamma_i-\gamma_j)'S_n}} \tag{18}$$

The probability of an individual choosing Zone A ($y_{in}=0$) is:

$$P(y_{in}=0) = \frac{1}{1+e^{\beta' z_n + (\gamma_i - \gamma_j) S_n}} \tag{19}$$

The binary logit model is estimated using maximum likelihood techniques. Let N denote the sample size (n=1,...,N), then the likelihood function for a binary choice model is

$$\begin{aligned} L &= \prod_{y_{in}=0} \left[\frac{1}{1+e^{\beta' z_n + (\gamma_i-\gamma_j)' S_n}} \right] \cdot \prod_{y_{in}=1} \left[\frac{e^{\beta' z_n + (\gamma_i-\gamma_j)' S_n}}{1+e^{\beta' z_n + (\gamma_i-\gamma_j)' S_n}} \right] \\ &= \prod_{y_{in}}^{N} \left[\frac{1}{1+e^{\beta' z_n + (\gamma_i-\gamma_j)' S_n}} \right]^{1-y_{in}} \cdot \left[\frac{e^{\beta' z_n + (\gamma_i-\gamma_j)' S_n}}{1+e^{\beta' z_n + (\gamma_i-\gamma_j)' S_n}} \right]^{y_{in}} \end{aligned} \tag{20}$$

Taking the natural log of equation (19) results in the log-likelihood function, $\mathfrak{L}$:

$$\mathfrak{L} = \sum_{n=1}^{N} \left\{ (1-y_{in}) \ln\left(\frac{1}{1+e^{\beta' z_n + (\gamma_i-\gamma_j)' S_n}} \right) + y_{in} \ln\left(\frac{e^{\beta' z_n + (\gamma_i-\gamma_j)' S_n}}{1+e^{\beta' z_n + (\gamma_i-\gamma_j)' S_n}} \right) \right\} \tag{21}$$

The maximum likelihood estimators of the β's are found by maximizing $\mathfrak{L}$ with respect to each of the β's and setting the partial derivatives equal to zero. Ben-Akiva and Lerman (1985) show that the likelihood function is globally concave and a unique maximum will exist. The maximum likelihood estimates of the β's are consistent, asymptotically efficient and asymptotically normal.

C. Welfare Theory

It is necessary to determine whether the hunters will be better off or worse off, in terms of welfare, in the post-logging scenario. Therefore, the hunters responding to the contingent behaviour question in the survey were asked about their willingness to visit a new hunting site, which based on the choices provided resulted in higher travel costs for altered environmental qualities. Recall that the environmental attributes being examined are: i) road access, ii) game populations, iii) congestion, and iv) travel distance.

There are two methods of assigning dollar values to a change in utility: compensating variation (CV) and equivalent variation (EV). CV and EV compare the welfare of the individual in the present situation (e.g. hunting in Zone A) with that provided by an alternative situation (e.g. hunting in Zone B). Johansson (1987) defines CV as: "the maximum amount of money that the individual is willing to pay to secure an increased provision of public goods" (Johansson, 1987 p. 78). CV represents the amount of money needed to make the individual as well off as he or she was before the change occurred. The EV measure keeps the individual at his or her final level of satisfaction and represents the amount of money needed to be as well off as after the change. If there are no income effects, as assumed in this study, CV and EV will be equivalent. The binary choice model presented above can be used to estimate a value of the change in welfare associated with the value of recreational hunting in Zone B. Hanemann (1984) illustrated how to obtain equivalent variation welfare measures from discrete response WTP data.

Following Hanemann's (1984) and Cooper and Loomis' (1992) analysis of WTP for hunting permits, the parameters of the indirect utility function developed in the previous section are used to calculate the welfare measures. Cooper and Loomis (1992) state: "an individual is willing to pay $C for, say, an increase in the quality of an environmental amenity if the individual's utility at the new level of the amenity and lower income is at least as great as at the initial state" (Cooper and Loomis, 1992 p. 212), i.e., if $U(0,y;S) \leq U(1,y-C;S)$, where 0 is the base state; 1 is the post-logging state with an increase in environmental quality[7]; y is individual *n*'s income; and S is a vector of characteristics of the individual that affect the WTP decision. In this study, the increase in travel costs For Zone B relative to Zone A, P is used as the WTP. U is unknown to the researcher and is estimated using $V_{in}(i,y,S)+\varepsilon_{in}$.

[7] Section D of this chapter provides a brief overview of wildlife-logging interactions and discusses why the post-logging state is assumed to be an improvement in environmental quality.

One approach to calculating the WTP welfare measurement, used by Hanemann (1984) and Cooper and Loomis (1992), is the mean or expected WTP, E(WTP), of the following distribution:

$$E(WTP) = \int_0^\infty [1 - Pr(WTP \leq P)]dP \tag{22}$$

If the distribution in equation (21) is logistic, then

$$Pr(WTP \leq P) = \frac{e^{\beta' Z_n + (\gamma_i - \gamma_j)' S_n}}{1 + e^{\beta' Z_n + (\gamma_i - \gamma_j)' S_n}} \tag{23}$$

as expected from (20). If the indirect utility function takes on the following form:

$$V_i = \beta_0 + B_1(P) + B_2(z_2) + \ldots + B_K(z_K) + \gamma_1(S_1) + \ldots + \gamma_M S_M , \tag{24}$$

and

$$\alpha = \beta_0 + \sum_{k=2}^{K} \beta_k \bar{z}_k + \sum_{m=1}^{M} \gamma_m \bar{S}_m \tag{25}$$

then, following Cooper and Loomis (1992), the mean WTP can be calculated as follows:

$$P^- = \frac{1}{-\beta_1} \ln(1 + e^{\alpha}) \tag{26}$$

A second approach used by Hanemann (1984) and Cooper and Loomis (1992) is the median of the distribution. Hanemann defines the median WTP as the cost of going to Zone B "when the individual is just at the point of indifference" (Hanemann, 1984 p.335) between going to Zone A and Zone B, i.e. there is a 50:50 chance that the individual would be willing to incur the extra cost to visit Zone B. The median WTP can be calculated as follows

$$P^* = \frac{\alpha}{-\beta_1} \tag{27}$$

The estimates for α and β are derived from the maximum likelihood estimation.

D. Wildlife-Logging Interactions

Tomm et al. (1981) state "it is widely held that logging has contributed to the present-day diversity and abundance of big game in North America. Forest practices often serve to supplant wildfires as the major recurring cause of vegetational heterogeneity" (Tomm et al., 1981 p. 606). After timber harvesting takes place the forest environment will evolve over time, and the benefits to recreational hunters should be expected to change over time as well. A brief discussion of the post-harvesting evolution and wildlife interactions will be given. The purpose of this section is to provide an understanding of wildlife-logging interactions and provide a basis for the interpretation of the welfare measures derived in the previous and next sections of this study.

The information presented draws on several sources including: Terrestrial and Aquatic Environmental Management Ltd. ecologist, Matt Besko in northwestern Saskatchewan and studies of wildlife-logging interactions in Alberta by J.G. Stelfox (1988) and Tomm et al. (1981). Although the latter studies concern logging and wildlife interactions in Alberta, the basic analysis of animal behaviour can be extended to northwestern Saskatchewan. The presence and populations of cervids (deer, elk, moose) in the forest is related to tree type and age[8]. Stelfox (1988) reports that "deer, elk and moose prefer some optimum combination of cover and forage" (Stelfox, 1988 p.29) and that cover (security and thermal) determines habitat use more than the availability of forage.

In the first ten years after clear-cut harvesting one can expect grass and herb biomass to increase significantly with increased species diversity in the clear-cut area. The increase in forage results in increased summer use by deer. Stelfox (1988) observed in his study that "whitetail deer quickly moved into the clear-cuts whereas they were not observed in mature forests prior to logging" (Stelfox, 1988 p.33). Big game use of cutblocks during this time is virtually all summer use. Stelfox states that "studies have shown that food supplies generally increase following logging, but that

[8] Personal interview with Matt Besko, April 1993.

thermal and security cover is often lacking during early post-logging periods because the shrubs and trees are too low. For this reason cervids fail to exploit increased forage in young clear-cuts" (Stelfox, 1988 p.1). Cervids will not venture far from security cover, therefore, it is essential that a clear-cut area be surrounded by stands old enough to provide security cover. Towards the end of the first ten years, deciduous cover may be adequate to provide some summer security cover. Minimal winter thermal cover for deer occurs "when 75% of the forest area is covered by conifers at least 2m tall" (Stelfox, 1988 p.31). Furthermore, in the winter the forage may be too far beneath the blanket of snow to be available for cervids to eat. "Mature coniferous blocks, at least 100m wide, were essential for winter thermal and security cover during the first 12-20 years following logging of the pine forest and the first 25 years following logging of spruce and mixedwood forests" (Stelfox, 1988 p.42).

Besko defines "excellent" habitat for deer and moose as an area of predominantly mature deciduous trees intermixed with white spruce for cover, a water source, variability in the ecosystem, and lots of edge, a characteristic found in cut blocks two to five years old[9]. "Good" habitat for deer and moose would be an area that is mostly deciduous (predominantly aspen for moose), with less than 10% coniferous trees intermixed, some variability in the ecosystem and some edge (some cutblocks).

In the shrub stage, 11 to 20 years after clear-cutting, deciduous trees may reach heights of about 1.5 to 2.5m, providing security cover in summer and forage year-round for big game animals. Stelfox (1988) reported in his study in Alberta that during this stage "conifers were still too small to provide adequate winter cover for big game, except in pine clear-cuts where their density and height were providing minimum winter cover during the later part of this period" (Stelfox, 1988 p. 57).

The amount of winter thermal and security cover increases through the young growth stage (15 to 25 years after clear-cutting). The winter use of the cut-block area by cervids during the winter will also increase. Browse forage can be expected to peak in this period and grass and forb cover will decrease in the immature stand period (25 to 50 years after clear-cutting) (Stelfox, 1988). Since thermal and security cover influences cervid use of the clear-cut area more than the availability of

[9] Personal interview with Matt Besko, April 1993.

forage, the populations of cervids will be even greater in this period. In Stelfox's (1988) study, deer were most abundant, followed by moose, and winter use by deer was 1.9 times greater than summer use.

Besko suggests that depending on harvesting practices employed in the forest area, the "excellent" habitat created for cervids could stay "excellent" into the future or decline to "fair" or "poor" cervid habitat[10]. "Fair" habitat occurs in mature coniferous and mixed-wood forests with little or no edge; i.e. no clear-cut openings. "Poor" habitat occurs in a mature, solid coniferous forest, i.e. prior to clear-cutting. It is evident that without harvesting the area again, the area will decline to "fair" and then "poor" whitetail deer and moose habitat. Continued harvesting in the forest area can maintain the "excellent" habitat for whitetail deer and moose as they migrate through the forest, browsing in clear-cuts and seeking shelter in the surrounding older stands.

It may be important to note the importance of road access and human congestion in the area. Stelfox (1988) reported that the use of clear-cuts by big game animals such as whitetail deer and moose was reduced by the presence of roads and that human harassment also affected the presence of these animals.

E. Summary

The purpose of this study was to develop a methodology that can be used to examine the changing economic benefits of recreational whitetail deer and moose hunting in the a forest management licence agreement under a changing forest structure due to timber harvesting operations. This chapter outlined the theory of non-timber valuation, model development and benefit estimation.

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[10] Personal interview with Matt Besko, April 1993.

Two approaches to valuing non-timber goods and services were discussed: indirect and direct. The focus of this chapter was on a direct method that was developed for this survey to examine the tradeoffs between varying levels of environmental quality for recreational hunting; the payment vehicle used in this model is travel cost. This extension on the contingent valuation (CV) method is called contingent behaviour (CB) because the respondent is not asked "would you be willing to pay $X to hunt in a new zone?", he or she is being asked if they would be willing to *visit* a new hunting site which involves an increase in travel cost.

Consumer theory was discussed in the development of an economic model for analyzing the responses to the CB question. The random utility approach for analyzing situations where the consumer consumes discrete quantities of goods or services was the method employed for analyzing individual behaviour because it was derived from utility theory and it facilitated the estimation of theoretically correct benefit estimates.

Section D presented a description of post-harvesting forest evolution and wildlife-logging interactions for the purpose of providing a basis for the interpretation of the welfare measures that will be calculated in Chapter IV.

The following chapter discusses the data and the data collection survey. The model and welfare measurement techniques developed in this chapter are used with these data to examine the changing economic benefits of recreational whitetail deer and moose hunting in the FMLA under a changing forest structure. The model estimation, results and welfare measures are discussed in Chapter IV.

CHAPTER III THE DATA

A. Data Collection and Survey Design

The data for this study were obtained from two mail surveys of Saskatchewan hunters: one of whitetail deer hunters and one of moose hunters. Individuals at the University of Alberta and Forestry Canada, in Edmonton, Alberta, developed and implemented the surveys. The surveys were specific to the 1992 hunting season, and were conducted during the winter of 1992/1993. Copies of the surveys are included as Appendix A. The purpose of the surveys was to collect data on the characteristics of hunters and their attitudes and perceptions of hunting in Saskatchewan.

The first section of the survey asked respondents about factors which are important in selecting a hunting site. Respondents were asked to give their expenditures on hunting for the 1992 season. From a list of items that change the forest environment, they were asked to which extent each item would increase or decrease their hunting enjoyment. The surveys also contained two dichotomous choice contingent behaviour questions. Respondents were asked to decide between two hunting sites: a base scenario and a second scenario with altered levels of access (road quality), game populations, or congestion of hunters and a randomly generated cost factor. The final section of the survey requested various socio-economic information of the respondents. Morton et al. (1993) presents details of the survey, methodology, and descriptive statistics.

A mailed pretest was not used for this survey. The survey was circulated among peers in the Department of Rural Economy and Forestry Canada for initial examination. Members of Saskatchewan Environment and Resource Management and the Saskatchewan Wildlife Branch reviewed the survey. Comments and suggestions concerning the survey design and question wording were incorporated into the survey. There were concerns regarding the contingent behaviour questions, specifically in the description of realistic hunting sites and game populations for a northwest

Saskatchewan forest. A focus group of Alberta Moose hunters also examined the survey and discussed their perceptions of quality hunting sites and game populations. The survey was passed on to an outfitter in Meadow Lake, Saskatchewan for comments. This was followed up by taking a revised version of the survey to Meadow Lake for more detailed discussions with the outfitter, a local biologist and hunters. These discussions helped with the finer details for the contingent behaviour questions.

The samples of Saskatchewan hunters for the surveys were obtained from the hunting licences sold in the 1991 hunting season. The Saskatchewan Wildlife Branch provided names and addresses from hunting licence information from 1991. The survey was scheduled to be mailed out just prior to the close of the 1992 whitetail deer hunting season (season closed December 5, 1992). Since hunting licences could be purchased up to the last day of the hunting season, the 1992 licence information had not yet been collected by the Saskatchewan Wildlife Branch and was not in their computer database. We assumed most 1992 whitetail deer and moose hunters would be repeat hunters; therefore, in the absence of 1992 data, we used 1991 licence information.

The survey concentrated on hunting in Northwest Saskatchewan. It was important to get a large sample of both hunters living in the Northwest region of Saskatchewan and hunters living in other parts of the province. Two population samples for both whitetail deer and moose hunters were selected randomly from the computer database of hunting licences. The first sample, referred to as the provincial sample, was drawn from the entire population of hunters. The second sample, the western sample, was drawn from the set of hunters living on the west side of the province, north of Swift Current, Saskatchewan. Members of the Wildlife Branch felt that hunters living in this area had a higher probability of hunting in the Northwest than hunters living elsewhere in the province. Furthermore, the whitetail deer hunter samples were drawn primarily from those who purchased a Second licence, as this licence is required for hunting in the provincial forest.

The survey was quite lengthy (12 pages), for a mail survey, with a detailed hunting trip log to be completed and two hypothetical contingent behaviour questions. To help maximize the response rates for the surveys we used the Total Design Method developed by Dillman (1978). Table 1 below illustrates the response rates for the completed mailings for the provincial and western whitetail deer and moose surveys.

The responses from the surveys were entered into a computer using SPSS (Statistical Package for the Social Sciences) software package at the University of Alberta. Using SPSS, the data set was then reduced to those respondents who completed all relevant information to the modelling requirements of this study (i.e. cases in which missing values were recorded for variables used in the economic model were eliminated).

Table 3.1 Sample Size, Response and Response Rates for the Surveys

Mailed	Number Sent	Number Returned Unopened	Percent Returned Unopened	Effective Sample Size	Number Completed	Percent of Effective Completed
Provincial Whitetail Deer	543	10	1.8	533	327	61.4
Western Whitetail Deer	1059	15	1.4	1044	608	58.2
Total Whitetail Deer	1602	25	1.6	1577	935	59.3
Provincial Moose	533	6	1.1	527	273	51.8
Western Moose	1013	14	1.4	999	514	51.4
Total Moose	1546	20	1.3	1526	787	51.6

B. The Contingent Behaviour Question

Before discussing model development, estimation and results, it may be beneficial to discuss the contingent behaviour question in detail. As mentioned above, each survey contained two similar contingent behaviour questions. The site characteristics for the contingent behaviour question were varied to produce six different site-choice questions, giving three versions of both the whitetail deer and moose surveys. The base scenario (Zone A) was the same for all three versions and was meant to represent a mixed forest in Northwestern Saskatchewan with no apparent forestry operations. The characteristics of this zone were as follows:

i) forest trails that are passable in dry weather with a two-wheel drive vehicle, but in foul or wet weather, access is difficult even with a four-wheel drive vehicle (limited access);

ii) on a typical hunting day there will be evidence of six to ten whitetail deer, or two moose (low game populations);

iii) a hunting party will not encounter another hunting party (low congestion).

The alternate scenario (Zone B) was meant to represent the same area after logging operations have taken place. The access, game populations and hunter congestion were varied to give a variety of post-harvesting circumstances. The respondents were told that the roads were maintained by the forest products company during harvesting and the road was easily passable in dry weather with a two-wheel drive vehicle, but in foul or wet weather, access was difficult even with a four-wheel drive vehicle. A scenario with improved access to the area also had forest trails that are passable with a two-wheel drive vehicle. The post-harvesting scenario did not always include replanting of the area. We assumed that in those scenarios where replanting occurred, the increased vegetation increased game numbers. Increased hunter congestion in the post-harvesting scenario was represented by stating that the respondent and his or her party would encounter another hunting party unfamiliar to them. The post-harvesting scenario always involved an increase in travel distance as a cost for the respondent.

The cost terms in each survey were randomly generated using a uniform distribution, bounded by $1.00 and $50.00. Previous hunting studies by Asafu-Adjaye et al. (1989) and Wilman (1984) provided an indication for the range of values used in the Saskatchewan hunting survey. Asafu-Adjaye et al.'s (1989) big game study in Alberta estimated a use value for big game of $240.06 per person per year with an average of 3 big game hunting trips per year, putting the use value of big game at approximately $68.00 per trip. Wilman's (1984) deer hunting study in South Dakota produced benefits of $99.00 to $124.00 per season from forest practices that provide desirable habitat for wildlife such as deer. If the average deer hunter in South Dakota also takes 3 deer hunting trips per season, the benefits would be $33.00 to $41.33 per trip.

The discussion of wildlife-logging interactions in Chapter II explained how the post-logging forest environment can be expected to evolve over time. This evolution was simplified for application to this study. Six post-harvesting scenarios were created for the study, however, they do not change over time. Table 3.2 below shows the variations of the hunting site characteristics for the three versions of the surveys.

Table 3.2 Variations of Hunting Site Attributes

Attributes	All Versions	Survey Version 1		Survey Version 2		Survey Version 3	
	Zone A	Zone B Q.1[1]	Zone B Q.2	Zone B Q.1	Zone B Q.2	Zone B Q.1	Zone B Q.2
Forestry Operations[2]	No	Yes	Yes	Yes	Yes	Yes	Yes
Access[3]	Limited	Limited	Improved	Improved	Improved	Limited	Improved
Game Populations[4]	Low	Increased	Low	Low	Increased	Increased	Increased
Congestion[5]	Low	Increased	Increased	Low	Increased	Low	Low
Cost[6]	No	Yes	Yes	Yes	Yes	Yes	Yes

1. Each survey contained two contingent behaviour questions: Question 1 (Q.1) and Question 2 (Q.2).

2. The description for Zone A does not indicate to the respondent that any forestry operations take place. The description for Zone B states that harvesting and replanting occurs in the zone and that a forest products company maintains the roads during harvesting.

3. Limited access is described as being easily passable in dry weather in a 2-wheel drive vehicle, but in foul or wet weather, access is difficult even with a 4-wheel drive vehicle. Improved access is the same as the limited access with the addition of old forest trails which are also passable with a 2-wheel drive vehicle.

4. Low whitetail deer populations is described as seeing or finding evidence (tracks, scrapes, rubs or droppings) of 6 to 10 whitetail deer on a typical day. Improved whitetail deer populations is described as seeing or finding evidence of 8 to 12 whitetail deer on a typical day. Low moose populations is described as seeing or finding evidence (tracks, droppings, rubs or wallows) of 2 moose on a typical day. Improved moose populations is described as seeing or finding evidence of 3 to 4 moose on a typical day.

5. Low congestion is defined as not encountering another hunting party on his or her trip. Increased congestion is defined as encountering another hunting party unfamiliar to the respondent on his or her hunting trip.

6. Zone A does not have a cost associated with hunting. Zone B, however, does have a randomly generated cost factor included; in order to hunt in Zone B, the respondent will have to travel further and it will cost him or her extra to get there.

CHAPTER IV MODEL DEVELOPMENT, ESTIMATION, AND RESULTS

A. Model Development

1. Introduction

Chapter III discussed the data used in the estimation of the economic model for this study. This chapter focuses on the estimation of a binary choice random utility model of the discrete choice problem of choosing between two hypothetical hunting zones in Northwestern Saskatchewan (Zone A and Zone B). Using the model presented in chapter II and the data described in chapter III the probability that an individual would be willing to hunt in Zone B can estimated.

A simulation of post-harvesting conditions in the forest will be presented and the model estimation results will be used to determine the welfare effects of the changes in forest structure in several post-harvesting scenarios. The tradeoffs between changes in access, game populations, congestion and travel cost can then be examined.

2. Specification of Binomial Logit Model of Whitetail Deer and Moose Hunting

The development of the binary choice model was outlined in Chapter II; the indirect utility function was separated into systematic and random components and these two components were specified. The random utility components (ε_{in}'s) were assumed to be Type I extreme value distributed and therefore, the difference ε_{in}-ε_{jn} was logistically distributed. A linear function was specified for the systematic components of the indirect utility function (V_{in}'s) for its convenience in estimating the unknown parameters. Following Ben-Akiva and Lerman's (1985) notation, a new vector of attributes, x, is defined which includes both z_{in} and S_n. $x_{in}=h(z_{in},S_n)$ and V_{in} is now defined as $V_{in} = V(x_{in})$. The indirect utility function is linear in the parameters and β is the a vector of K unknown parameters. The utility functions corresponding to Zone A and Zone B are as follows:

$$V_{0n} = \beta_1 x_{0n1} + \beta_2 x_{0n2} + \cdots + \beta_K x_{0nK}$$
$$V_{1n} = \beta_i x_{1n1} + \beta_2 x_{1n2} + \cdots + \beta_K x_{1nK} \qquad (26)$$

where 0 denotes Zone A and 1 denotes Zone B.

The final step in the specification of the binary choice model is the selection of the variables for inclusion in the indirect utility function. The selection of variables for inclusion in the model comes from *a priori* beliefs and a process of trial and error. Train (1979) expresses concern over the trial and error approaches to modelling where the researcher "plays" with the model specifications to obtain a model that fits the data and is consistent with *a priori* beliefs. He states that "this method of model specification allows one to "learn" from the data, but is open to the criticism that the resultant model simply reflects the relations which happen to exist in the sample, rather than capturing any true, behavioral relations among variables" (Train, 1979 p.11). This study uses a combination of *a priori* beliefs and trial and error. A number of variables based on *a priori* beliefs were initially selected and then other variables and different variable combinations were employed in the model and tested.

The binary choice model employs the differences in the attributes of the two zones (equation 18) to determine the probability of choosing a zone. Therefore, the initial variables chosen for the model were those variables that represented the differences in the attributes of the two zones: access, game populations, congestion and travel cost. As mentioned in Chapter II, the data were set up such that the differences in the attributes were recorded. These data were recorded as dummy variables taking on values of 0 for base or unimproved levels of quality and 1 for improved levels or quality. Table 4.1 shows the values of the attribute dummy variables for Zone A and the six different scenarios for Zone B.

Table 4.1 Site Attribute Values

Attribute	Zone A	Zone B					
		Version 1	Version 2	Version 3	Version 4	Version 5	Version 6
Access	0	0	1	1	1	0	1
Game Populations	0	1	0	0	1	1	1
Congestion	0	1	1	0	1	0	0

Preliminary analysis of the survey results (Morton et al. 1993) yielded the most important factors that hunters considered in selecting a hunting site and the effects of various environmental factors on their hunting enjoyment. The most important factors in considering a hunting site were: familiarity with the area, the opportunity to hunt with family and friends, naturalness or lack of development, privacy, and harvesting an animal. Encountering another hunting party, seeing or hearing logging equipment and road access to new sites decreased hunting enjoyment, while increased game and seeing previously logged areas replanted increased enjoyment for most hunters. These variables were considered part of the socio-economic characteristics (S_n) of the individual and were included in the various models, as suggested by Hanemann (1984) and Ben-Akiva and Lerman (1985). These data were collected as ratings on a 1-5 scale, they were changed to 0-1 dummy variables for modelling purposes, where 0 represented the variable was unimportant to the hunter or decreased hunting enjoyment and 1 represented the variable that was important to the hunter or increased hunting enjoyment. A number of models were estimated using different combinations of the variables discussed above. The variables or attributes (x_{in}) of the individual's utility function used in the final models are given below and their values are given in Table 4.1. The set of variables included in the individual's utility function was expanded from the initial set of the four attributes (Z_{in}) to include socio-economic characteristics of the individual (S_n) in an attempt to get the best fit possible, and a model that best predicted the site choices.

3. Variable Definitions

ACCESS — This variable is a dummy variable representing the quality of access to the hunting zone. 0 represents limited (base case) access consisting of roads that are easily passable in dry weather in a 2-wheel drive vehicle, but in foul or wet weather, access is difficult even with a 4-wheel drive vehicle. 1 represents improved access to the zone which consists of the roads similar to the limited access zones, but with the addition of forest trails that are easily passable with a 2-wheel drive vehicle.

GAME — This variable is a dummy variable representing the expected game populations in the area. 0 represents low game populations, i.e., seeing or finding evidence of 6 to 10 whitetail deer, or 2 moose, on a typical day. 1 represents improved game populations, i.e., seeing or finding evidence of 8 to 12 whitetail deer, or 3 to 4 moose, on a typical day.

CONGEST — This variable is a dummy variable representing the degree of privacy in the area. 0 represents low hunter congestion, i.e., the respondent's hunting party will not encounter another hunting party on their trip. 1 represents increased hunter congestion, i.e., the respondent's hunting party will encounter another hunting party, unfamiliar to them, on their trip.

COST — This variable is the cost associated with the increased travel distance to Zone B relative to Zone A.

EFFECTA — This variable is a dummy variable representing how encountering another hunting party affects the respondent's hunting enjoyment. This variable was created from the 1 to 5 rating scale from the survey data. If encountering another hunting party decreases hunting enjoyment (1,2,3) then EFFECTA became 0, and if it increases hunting enjoyment (4,5) then EFFECTA became 1.

EFFECTB — This variable is a dummy variable representing how road access to new sites affects the respondent's hunting enjoyment. This variable was created from the 1 to 5 rating scale from the survey data. If road access to new sites decreases hunting enjoyment (1,2,3) then EFFECTB became 0, and if it increases hunting enjoyment (4,5) then EFFECTB became 1.

EFFECTK This variable is a dummy variable representing how seeing a previously logged area replanted affects the respondent's hunting enjoyment. This variable was created from the 1 to 5 rating scale from the survey data. If seeing a previously logged area replanted decreases hunting enjoyment (1,2,3) then EFFECTK became 0, and if it increases hunting enjoyment (4,5) then EFFECTK became 1.

FACTORH This variable is a dummy variable representing the importance of privacy to the hunter. This variable was created from the 1 to 5 rating scale from the survey data. If privacy is not important to the hunter (1,2,3) then FACTORH became 0, and if it is very important (4,5) then FACTORH became 1.

Before the modelling and estimation process began, the data from the first and second mailings were examined for response bias using the demographic variables; no response bias was found.

B. Estimation and Model Results

1. Model Estimation and Results

The binary logit model was estimated using Maximum Likelihood estimation techniques with LIMDEP, version 6.0 (Greene, 1992). A number of models were estimated using different combinations of the variables discussed above.

The data were initially separated into four samples: (i) provincial whitetail deer hunters, (ii) western whitetail deer hunters, (iii) provincial moose hunters, and (iv) western moose hunters. The four samples were reduced to include only those respondents who completed all relevant information to the modelling requirements of this study, i.e. cases in which missing values were recorded for variables used in the economic model were eliminated. The final sample sizes were as follows:

provincial whitetail deer hunters - 283;

provincial moose hunters - 262;

western whitetail deer hunters - 558;

western moose hunters - 486.

See Table B-1 in Appendix B for the sample sizes for each survey version. The provincial and western data were determined to be not significantly different and the provincial and western samples were merged together. Models were estimated using the two data samples: whitetail deer hunters and moose hunters.

The results of the model estimations are shown in Tables 4.2 through 4.7. Three models for each data sample are shown. See Table B-2 in Appendix B for a summary of the actual results of the contingent behaviour question. The Chi-Squared statistic and significance level given in the tables show that all of the models are highly significant. The McFadden pseudo-R-squared[11] value has a range from 0.084 to 0.099 for the whitetail deer hunter models and it has a range of 0.096 and 0.098 for the moose hunter models.

In all models, the estimated coefficients of the parameters have the expected signs. ACCESS and GAME are positive, indicating that an increase in access or game populations in Zone B increases the probability that the hunter will choose to visit Zone B. Deer hunting studies by Wilman (1984) and Hammitt (1989) show that bagging game is an important contributor to the quality of a hunting experience. CONGEST and COST are negative, indicating that an increase in hunter congestion (decrease in privacy) in Zone B or an increase in travel costs to get to Zone B decreases the probability that the hunter will choose to visit Zone B. EFFECTB is positive, indicating that if road access to new sites, then the probability that the hunter chooses to visit Zone B will increase. EFFECTK is positive, indicating that if seeing previously logged areas replanted are increases hunting enjoyment, then the probability that the hunter will choose to visit Zone B increases. This follows

[11] The calculation for McFadden's Pseudo-R^2 is as follows: R^2=1-(Log-L of the unrestricted model / Restricted (Slopes=0) Log-L). For more information on McFadden's Pseudo-R^2 see Maddala (1983).

Wilman's (1984) findings that "vegetative characteristics that provide desirable habitat for game are likely to have some appeal for hunters" (Wilman, 1984 p.335). FACTORH is negative, indicating that if privacy is important in the selection of a hunting site, then the probability that the hunter chooses to visit Zone B decreases. EFFECTA is positive, indicating that if encountering another hunting party increases hunting enjoyment, the probability of the hunter choosing to visit Zone B increases.

In the whitetail deer hunter models all of the parameters, except ACCESS, have probabilities that show them to be significant at the 99 percent level. Although ACCESS is insignificant, even at the 80 percent level, it remains in the models because it is one of the essential attributes being compared between Zones A and B. Attempts were made to use a proxies for ACCESS from other survey data such as the factors considered in selecting a hunting site (question 1 in the survey) and effects of changing hunting conditions (question 18 in the survey). Two variables were used as proxies for ACCESS without success: Factor b (good access to region) and Effect b (road access to new sites). Interacting Factor b and Effect b with ACCESS was unsuccessful as well. Including Effect b (EFFECTB) in the model with ACCESS did improve the predictability and the significance of the model.

In the moose hunter models all of the parameters, except EFFECTA, in model 3, have probabilities that show them to be significant at the 95% level. EFFECTA is insignificant, even at the 80% level.

The welfare measures calculated in section C of this chapter are derived from model 2 for both the whitetail deer hunters and the moose hunters. Model 2 was selected, over models 1 and 3, for the significance of its variables, its higher Chi-squared and R-squared values, and its predictive ability (discussed below).

Table 4.2 Binomial Logit Estimates: Whitetail Deer Hunter Model 1				
Maximum Likelihood Estimates				
Log-Likelihood				-1034.926
Restricted (Slopes=0) Log-L				-1130.117
Chi-Squared (X)				190.3817
Significance Level				0.000000
N[0,1] used for significance levels				0.084
McFadden's Pseudo R^2				
Variable	Coefficient	Std. Error	t-ratio	Prob |t|<x
CONSTANT	-0.93774	0.2178	-4.306	0.00002
ACCESS	0.15236	0.1252	1.217	0.22349
GAME	0.88981	0.1331	6.685	0.00000
CONGEST	-0.75070	-0.1061	-7.076	0.00000
COST	-0.018605	0.003754	-4.956	0.00000
EFFECTB	0.76676	0.1107	6.924	0.00000
EFFECTK	0.47961	0.1292	3.712	0.00021

Table 4.3 Binomial Logit Estimates: Whitetail Deer Hunter Model 2				
Maximum Likelihood Estimates				
Log-Likelihood				-1018.174
Restricted (Slopes=0) Log-L				-1130.117
Chi-Squared (X)				223.8861
Significance Level				0.000000
N[0,1] used for significance levels				0.099
McFadden's Pseudo R^2				
Variable	Coefficient	Std. Error	t-ratio	Prob |t|<x
CONSTANT	-0.58023	0.2283	-2.542	0.01103
ACCESS	0.15249	0.1266	1.205	0.22834
GAME	0.88522	0.1344	6.585	0.00000
CONGEST	-0.73563	0.1072	-6.864	0.00000
COST	-0.019228	0.003804	-5.055	0.00000
EFFECTB	0.71650	0.1121	6.390	0.00000
EFFECTK	0.51170	0.1312	3.901	0.00010
FACTORH	-0.62219	0.1078	-5.769	0.00000

Table 4.4 Binomial Logit Estimates: Whitetail Deer Hunter Model 3				
Maximum Likelihood Estimates				
Log-Likelihood				-1028.204
Restricted (Slopes=0) Log-L				-1130.117
Chi-Squared (X)				203.8258
Significance Level				0.000000
N[0,1] used for significance levels				0.090
McFadden's Pseudo R^2				
Variable	Coefficient	Std. Error	t-ratio	Prob |t|<x
CONSTANT	-0.93601	0.2185	-4.283	0.00002
ACCESS	0.15171	0.1257	1.207	0.22730
GAME	0.90362	0.1338	6.755	0.00000
CONGEST	-0.76470	0.1067	-7.167	0.00000
COST	-0.019329	0.003778	-5.116	0.00000
EFFECTA	0.83101	0.2287	3.634	0.057041
EFFECTB	0.74892	0.1113	6.729	0.00065
EFFECTK	0.44306	0.1299	3.410	0.00028

Table 4.5 Binomial Logit Estimates: Moose Hunter Model 1				
Maximum Likelihood Estimates				
Log-Likelihood				-927.3082
Restricted (Slopes=0) Log-L				-1025.733
Chi-Squared (X)				196.8486
Significance Level				0.000000
N[0,1] used for significance levels				0.096
McFadden's Pseudo R^2				
Variable	Coefficient	Std. Error	t-ratio	Prob |t|<x
CONSTANT	-1.2417	0.2269	-5.473	0.00000
ACCESS	0.28225	0.1308	2.159	0.30880
GAME	1.3154	0.1444	9.111	0.00000
CONGEST	-0.72877	0.1117	-6.526	0.00000
COST	-0.0085726	0.003791	-2.261	0.02374
EFFECTB	0.73519	0.1343	5.476	0.00000
EFFECTK	0.41722	0.1317	3.168	0.00154

Table 4.6 Binomial Logit Estimates: Moose Hunter Model 2

Maximum Likelihood Estimates	
Log-Likelihood	-924.8737
Restricted (Slopes=0) Log-L	-1025.733
Chi-Squared (X)	201.7177
Significance Level	0.000000
N[0,1] used for significance levels	0.098
McFadden's Pseudo R^2	

Variable	Coefficient	Std. Error	t-ratio	Prob |t|<x
CONSTANT	-1.0705	0.2395	-4.470	0.00001
ACCESS	0.28165	0.1310	2.150	0.03155
GAME	1.3172	0.1446	9.107	0.00000
CONGEST	-0.72635	0.1119	-6.493	0.00000
COST	-0.0087642	0.003799	-2.307	0.02106
EFFECTB	0.70426	0.1353	5.207	0.00000
EFFECTK	0.43028	0.1322	3.255	0.00113
FACTORH	-0.26077	0.1182	-2.207	0.02733

Table 4.7 Binomial Logit Estimates: Moose Hunter Model 3

Maximum Likelihood Estimates	
Log-Likelihood	-926.6129
Restricted (Slopes=0) Log-L	-1025.733
Chi Squared (X)	198.2392
Significance Level	0.000000
N[0,1] used for significance levels	0.097
McFadden's Pseudo R^2	

Variable	Coefficient	Std. Error	t-ratio	Prob |t|<x
CONSTANT	-1.2544	0.2273	-5.519	0.00000
ACCESS	0.27380	0.1310	2.091	0.03656
GAME	1.3170	0.1445	9.116	0.00000
CONGEST	-0.72936	0.1117	-6.527	0.00000
COST	-0.0085165	0.003794	-2.245	0.02479
EFFECTB	0.70977	0.1359	5.223	0.00000
EFFECTK	0.42364	0.1319	3.213	0.00131
FACTORH	0.2878	0.2444	1.177	0.23900

2. Sensitivity to Model Complexity

Mo[illegible]2 which includes the variable FACTORH has a higher Chi-squared value and a higher McFadden pseudo-R-squared value in both the whitetail deer and moose hunter samples than model 3 which uses EFFECTA. Both model 2 and model 3, which have seven explanatory variables have higher Chi-squared values and higher R-squared values than model 1 which has one less explanatory variables. Train (1979) states that complex models have a greater predictability than models with simpler specification, suggesting that a model created through "learning" from the data reflects behaviour better than a model created from simply *a priori* beliefs.

3. Predictive Ability

It is useful to note how accurately the estimated model predicts hunter behaviour. The predictive ability of the six models is shown in Table 4.8. The models correctly predict both the whitetail deer and moose hunters' preferences approximately 67% of the time. Model 2 has a higher predictive ability for both the whitetail deer data than models 1 or 3. In the moose sample, however, model 2 has a slightly lower predictive ability than models 1 or 3. There appears to be a large difference in the frequencies of correct predictions of A's and B's, particularly with the whitetail deer models. The whitetail deer models correctly predict A's almost 50% more accurately than B's and the moose models correc[illegible]ly predict A's approximately 15% more accurately than B's. Attempts to introduce some non-linearity into the models by logging or squaring COST and interacting these terms with other variables had no effect on the predictive ability of the model.

The large difference in the frequencies of correct predictions of A's and B's is a very interesting result. From these results it appears that there is some factor that the respondents are perceiving in Zone B, such as the loss of the aesthetic value of the old-growth forest, that the explanatory variables in the model are not capturing. The major difference between Zone A and Zone B is [illegible]e presence of forestry operations in Zone B. It appears that people like the results of forestry operations (such as more ga[illegible]) but not the forestry operations themselves. The negative coefficient of the constant term in the m[illegible]del suggests that people would rather avoid areas with forestry operations unless the area offers increased hunting attributes (e.g. game). Therefore, the models are predicting the Zone A choice which has no forestry operations, more accurately than the Zone B choice which has forestry operations.

Table 4.8 Frequencies of Correct Predictions of the Whitetail Deer and Moose Hunter Models

	Whitetail Deer			Moose		
	Model 1	Model 2	Model 3	Model 1	Model 2	Model 3
% Correct Zone A Predictions	82.78	82.28	82.28	74.31	74.55	74.19
% Correct Zone B Predictions	42.73	45.28	43.78	58.58	57.98	58.73
% Correct Total Predictions	66.90	67.62	67.02	67.31	67.18	67.31

C. Application of Results

1. Welfare Measures

The purpose of this section is to use the model estimation results of the previous section to determine the welfare effects of the changes in forest structure in several post-harvesting scenarios. The tradeoffs between changes in access, game populations, congestion and travel cost can then be examined.

Recall that wildlife-logging interactions were discussed in Chapter II. Stelfox's (1988) study combined with the habitat definitions given by Besko suggest that it is reasonable to assume increased game populations in hunting zones where some clear-cut logging has taken place and that hunters can be expected to see increased benefits from timber harvesting within the area. If access to the area is improved, hunters may be facing a hunting environment such as given by scenarios 4 and 6: improved access, from forestry operations; increased game populations; and increased congestion (scenario 4) or low congestion (scenario 6), depending on the area. If access is not improved, hunters may be facing a hunting environment such as given by scenarios 1 and 5: limited access; increased game populations; and increased congestion (scenario 1) or low congestion (scenario 5), depending on the area.

The mean (P^{-}) and median (P^{+}) welfare measures, for each of the six scenarios, were calculated using equations (24) and (25) from Chapter II and are presented in Tables 4.9 and 4.10. These welfare measures represent WTP per hunter per trip. Hanemann (1984) discusses whether the mean (P^{-}) or the median (P^{+}) of the welfare measure is most appropriate. Hanemann states that the mean of the distribution "is very sensitive to slight changes in the shape of the distribution resulting from different estimation methods or outliers in the data, while the latter is relatively robust" (Hanemann, 1984 p. 339). Johansson et al. (1989) state that the mean value is the "relevant concept" (Johansson et al., 1989 p. 1055) to use in benefit-cost analysis. If one wants to interpret the results as a referendum, then the median should be used because the median gives the WTP amount where 50% of the respondents would choose Zone A and 50% would choose Zone B. Johansson et al. (1989) further states that the median value does not yield a Pareto-efficient outcome. Both the mean and median welfare measures are given in Tables 4.9 and 4.10; the mean WTP value would be the more appropriate value to use in determining the welfare impacts of changes in environmental quality on recreational hunting.

Using a Monte Carlo simulation (Kennedy, 1985) on both the whitetail deer and moose data, a sampling distribution was derived for P^{-}, where the mean and the standard deviation were calculated. The results of the Monte Carlo simulation are also included in Tables 4.9 and 4.10.

Examining Tables 4.9 and 4.10 one can see how the welfare measures change with each scenario. The environmental improvements to scenario 1 are limited to increased game populations; access is limited and congestion is increased. The mean WTP for these changes is \$31.96 for whitetail deer hunters and \$69.84 for moose hunters.

Scenario 2 has the most limited benefits of the six different scenarios: access is improved, but game populations are low and congestion is increased. The mean WTP for this scenario is $17.79 for whitetail deer hunters and $29.91 for moose hunters.

Scenario 3 has improved access, low game populations and low congestion. Comparing scenario 3 with scenario 2, one can see how decreasing congestion affects the WTP: the mean WTP for scenario 3 is $32.03 for whitetail deer hunters and $55.02 for moose hunters. The marginal value of decreasing congestion is $14.24 for whitetail deer hunters and $25.11 for moose hunters.

Scenario 4 has improved access, increased game populations and increased congestion. The mean WTP for this scenario is $35.75 for whitetail deer hunters and $85.68 for moose hunters.

Scenario 5 is similar to scenario 1 except that congestion in scenario 5 is decreased. Comparing the welfare measures of scenario 5 and scenario 1, one can see the effects of decreasing congestion when access is limited and game populations are increased. The mean WTP for scenario 5 increases by $21.05 to $53.01 for whitetail deer hunters and it increases by $45.40 to $115.24 for moose hunters.

Scenario 6 has the most extensive environmental improvements of the six different scenarios: improved access, increased game populations and low congestion. Once more, the effects of decreasing congestion can be examined by comparing the welfare measures of scenario 6 and scenario 4. The mean WTP for scenario 6 increases by $22.47 to $58.22 for whitetail deer hunters and it increases by $51.01 to $136.69 for moose hunters.

The overall WTP values are lower for whitetail deer hunters than for moose hunters. One reason for this may be that whitetail deer hunting is a local experience: hunters generally do not travel very far to hunt whitetail deer. Therefore, the environmental changes offered in the various scenarios may not be significant enough to induce whitetail deer hunters to travel the extra distance to hunt.

The standard deviation of the WTP measures for the whitetail deer hunters are much smaller than the standard deviation of the mean WTP measures for the moose hunters. This indicates that there may be greater consensus among the whitetail deer hunters than the moose hunters regarding the desirability of the environmental changes presented in the various scenarios.

The median WTP values in Tables 4.9 and 4.10 are negative in most cases. Negative medians imply that the changes outlined in those scenarios are not good enough to induce the majority of survey respondents to travel (hypothetically) the extra distance to Zone B (see Table B-2 in Appendix B for a summary of the Contingent Behaviour question results). However, since the mean WTP values are positive, some respondents are willing to travel large distances (pay large amounts) to visit Zone B which increases the mean WTP value. The median WTP for the changes in scenarios 5 and 6 are positive for both whitetail deer and moose hunters, meaning that the majority of survey participants would be willing to visit Zone B, the post-harvesting scenario if game populations are increased and congestion is decreased.

Table 4.9 Per Trip Welfare Impacts on Whitetail Deer Hunters

Attribute	Scenario					
	1	2	3	4	5	6
Access	Limited	Improved	Improved	Improved	Limited	Improved
Game Populations	Increased	Low	Low	Increased	Increased	Increased
Congestion	Increased	Increased	Low	Increased	Low	Low
Mean WTP	$ 31.96	$ 17.79	$ 32.03	$ 35.75	$ 53.01	$ 58.22
Median WTP	$ -8.53	$ -46.63	$ -8.38	$ -0.60	$ 29.73	$ 37.66
Standard Deviation[12]	$ 5.51	$ 3.21	$ 5.71	$ 6.42	$ 9.35	$ 10.60

[12] Calculated from a Monte Carlo simulation.

Table 4.10 Per Trip Welfare Impacts on Moose Hunters						
Attribute	Scenario					
	1	2	3	4	5	6
Access	Limited	Improved	Improved	Improved	Limited	Improved
Game Populations	Increased	Low	Low	Increased	Increased	Increased
Congestion	Increased	Increased	Low	Increased	Low	Low
Mean WTP	$ 69.84	$ 29.91	$ 55.02	$ 85.68	$ 115.24	$ 136.69
Median WTP	$ -19.32	$ -137.47	$ -54.60	$ 12.82	$ 63.56	$ 95.69
Standard Deviation[13]	$ 81.19	$ 53.21	$ 71.70	$ 93.17	$ 109.53	$ 121.86

2. Post-Harvesting Simulation

a. Introduction

The purpose of this section is to put the welfare measures obtained in the previous section into a meaningful context: to use the welfare measures to determine the welfare effects of changes in the hunting environment in the Millar Western-NorSask FMLA. Using information on logging-wildlife interactions, given in Chapter II, a simulation of post-harvesting conditions can be created for a given zone in the Millar Western-NorSask FMLA area and the welfare impact on hunters can be calculated.

The welfare results given in Tables 4.9 and 4.10 represent a dollar value change in welfare per hunter per trip. Morton et al. (1993) report that the median number of trips taken by both whitetail deer and moose hunters in the 1992/1993 season was 3[14]; however, this number includes trips to all zones in Saskatchewan. In order to apply the welfare measures calculated in the previous section to the FMLA area in northwestern Saskatchewan the number of trips taken to the northwestern Saskatchewan hunting zones must be determined. Using the trip log information

[13] Calculated from a Monte Carlo simulation.

[14] The number of hunting trips taken in the 1992/1993 season includes trips taken for species other than Whitetail Deer and Moose by Saskatchewan resident hunters.

(question 7 in the survey) from the Saskatchewan hunting surveys the number of trips by survey participants to a given zone can be determined and extrapolated to estimate the total number of trips taken to that zone by Saskatchewan resident whitetail deer or moose hunters[15].

Zone 69 was the zone selected for the simulation study. Zone 69 lies east and south of the Primrose Air Weapons Range (Figure 4.1). The trip log information from the provincial whitetail deer and moose samples were used. There were a total of 45 trips by whitetail deer hunting survey participants to zone 69; the total number hunting trips taken by whitetail deer hunting survey participants was 3 154. There were a total of 95 trips by moose hunting survey participants to zone 69; the total number hunting trips taken by moose hunting survey participants was 2 175. Again, these numbers include trips for other species (question 7 asked what was harvested, not for which species the hunters were hunting). Saskatchewan Environment and Resource Management projected 53 370 whitetail deer hunters and 9 660 moose hunters in the 1992/1993 season[16]. The number of completed surveys received by the provincial sample of whitetail deer and moose hunters, respectively, were 327 and 273. Using the ratio of trips to zone 69 to total hunting trips from the survey samples, one can estimate that a total of 326 trips were taken to zone 69 by Saskatchewan resident whitetail deer hunters and a total of 142 trips were taken to zone 69 by Saskatchewan resident moose hunters.

The simulation results for whitetail deer hunters will be analyzed and discussed separately from the simulation results for moose hunters. It is important to be aware that aggregating the welfare impacts of the whitetail deer and moose hunters will result in an overstatement of the total benefits of forestry operations on recreational hunters. Morton et al. (1993) showed that most hunters carry several hunting licences; most moose hunters carry whitetail deer licences, however, the

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[15] The trips, again, will include trips in which species other than Whitetail Deer and Moose are hunted. Unfortunately, this represents a limitation of the data collected from the Saskatchewan Hunting surveys; hunters were asked what they harvested, not the primary species they were hunting.

[16] Personal communication with R.B. Crouter of Saskatchewan Environment and Resource Management, 24 March, 1993.

reverse is not necessarily true. Therefore, aggregation of the welfare measures may result in double-accounting of benefits.

A necessary assumption that was made to simplify the analysis was that the post-timber harvesting environmental quality changes do not influence the number of hunting trips to zone 69; the assumption is that the environmental quality changes being suggested in this study are small enough not to induce hunters to hunt more nor to induce non-hunters to take up hunting. Without this assumption, a more complex model, involving the substitution of hunters over zones, would be needed to estimate the changes in the number of trips to zone 69. Another simplifying assumption made was that the hunting quality of adjoining sites would remain constant. Recall that the welfare measures are calculated on a per-trip basis. The welfare impact on Saskatchewan resident hunters can be calculated using the welfare measures derived in section 4.C. and the number of trips to zone 69 estimated above. Multiplying the number of trips taken to zone 69 by the per trip welfare measure provides the change in welfare for the hunters.

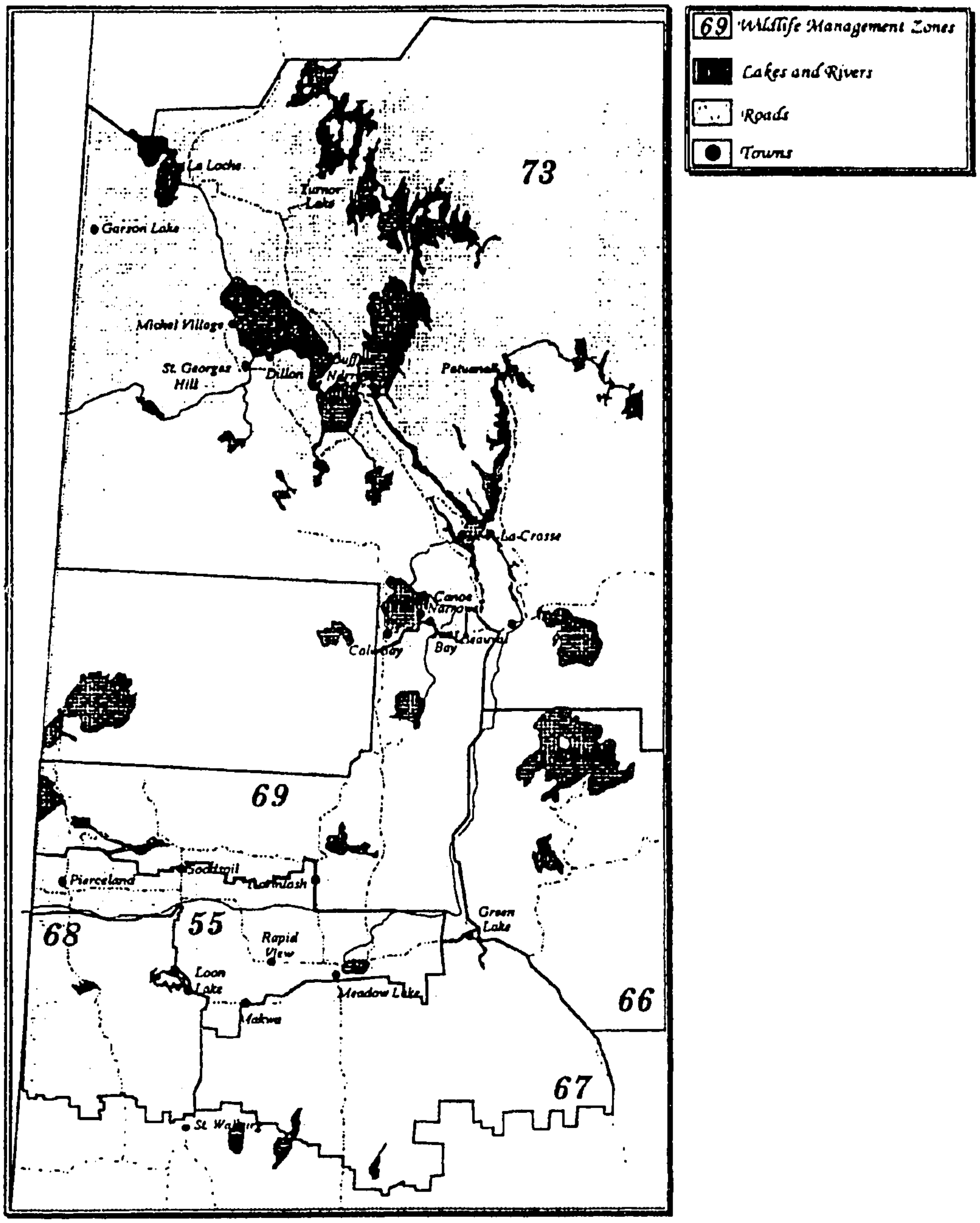

Figure 4.1 Hunting Zones in the Millar Western-Norsask Forest Management Licence Agreement Area
Source: Mistik Management (1993)

No copyright involved

b. Simulation Results - Whitetail Deer Hunters

The annual welfare impact on whitetail deer hunters is summarized in Table 4.11 below and the corresponding capitalized welfare impact is summarized in Table 4.12. With improved access, increased game populations and no increase in congestion, the estimated increase in welfare for all Saskatchewan resident whitetail deer hunters will be $18 979.72 per year. This benefit decreases if congestion in the region increases: the estimated benefit to whitetail deer hunters will decrease by $7 243.42 to $11 654.50. This decrease [illegible] from an increase in congestion shows the importance of privacy (low congestion) t[illegible] with unimproved access, increased game populations and no increase in conges[illegible], [illegible]ated increase in welfare for all Saskatchewan resident whitetail deer hunters will be $17 281.26 per year. Not surprisingly, the benefits to hunters from timber harvesting without improving access are lower than the scenarios that improve access. Again, these benefits decrease if congestion in the region increases: the estimated benefits to whitetail deer hunters will decrease by $6 862.30 to $10 418.96.

The capitalized annual welfare impacts were calculated using two discount rates: 3% and 5%. The capitalized welfare measures presented in Table 4.12 are based on the assumptions that these values accrue in perpetuity[17] and that there are no additional costs or benefits in future years. The capitalized values were calculated using the following formula:

$$\textit{Net Present Value} = \frac{\textit{Annual Welfare Value}}{\textit{Discount Rate}} \qquad (29)$$

The capitalized values may be used in benefit-cost analysis. The capitalized values calculated in this study would represent the benefits of maintaining a forest structure given in the six different scenarios; these benefits would be compared to the capitalized costs of creating or maintaining such an

[17] The discussion of wildlife-logging interactions in Chapter II explained that the post-logging forest environment will change over time. To simplify the analysis in this study, I assumed that the post-logging environmental qualities would be constant over time. In the absence of this assumption, the annual welfare values would change and, therefore it would alter the capitalized welfare values.

environment. The values calculated would be useful to a forest products company, such as Millar Western or NorSask, if they were comparing various forest management plans which provided, for example, different qualities of moose habitat or road access. The company could compare the costs of the different management plans with these benefits, which would accrue to the resident whitetail deer and moose hunters of Saskatchewan.

Table 4.11 Annual Welfare Impact From Environmental Changes on Whitetail Deer Hunters

Attribute	Scenario					
	1	2	3	4	5	6
Access	Limited	Improved	Improved	Improved	Limited	Improved
Game Populations	Increased	Low	Low	Increased	Increased	Increased
Congestion	Increased	Increased	Low	Increased	Low	Low
Mean WTP	$10 418.96	$5 799.54	$10 441.78	$11 654.50	$17 281.26	$18 979.72

Table 4.12 Capitalized Welfare Impact From Environmental Changes on Whitetail Deer Hunters

Discount Rate	Scenario					
	1	2	3	4	5	6
Discount Rate 3% Mean WTP	$347 298.67	$193 318.00	$348 059.33	$388 483.33	$576 042.00	$632 657.33
Discount Rate 5% Mean WTP	$208 379.20	$115 990.80	$208 835.60	$233 090.00	$345 625.20	$379 594.40

c. Simulation Results - Moose Hunters

The annual welfare impact on moose hunters is summarized in Table 4.13 below and the corresponding capitalized welfare impact is summarized in Table 4.14. With improved access, increased game populations and no increase in congestion, the estimated increase in welfare for Saskatchewan resident moose hunters will be $19 409.98 per year. The benefits decrease if congestion in the region increases: the estimated benefit to moose hunters will decrease by $7 243.42 to $12 166.56 per year. With unimproved access, increased game populations and no increase in congestion, the estimated increase in welfare for Saskatchewan resident moose hunters will be $16 364.26 per year. The benefits to hunters from timber harvesting without improving access are lower than the scenarios that improve access. Again, these benefits decrease if congestion in the region increases: the estimated benefit to moose hunters will decrease by $6 446.80 to $9 917.28 per year.

Table 4.13 Annual Welfare Impact From Environmental Changes on Moose Hunters

Attribute	Scenario					
	1	2	3	4	5	6
Access	Limited	Improved	Improved	Improved	Limited	Improved
Game Populations	Increased	Low	Low	Increased	Increased	Increased
Congestion	Increased	Increased	Low	Increased	Low	Low
Mean WTP	$9 917.28	$4 247.22	$7 812.84	$12 166.56	$16 364.08	$19 409.98

Table 4.14 Capitalized Welfare Impact From Environmental Changes on Moose Hunters

Discount Rate	Scenario					
	1	2	3	4	5	6
Discount Rate 3% Mean WTP	$330 576.00	$141 574.00	$260 428.00	$405 552.00	$545 469.33	$646 999.33
Discount Rate 5% Mean WTP	$198 345.60	$84 944.40	$156 256.80	$243 331.20	$327 281.60	$388 199.60

d. Discussion of Simulation Results

The welfare measures developed earlier in this chapter are used in this section to determine the welfare effects of changes in the hunting environment in the Millar Western-NorSask FMLA. Zone 69, within the FMLA, was selected for a simulation study. The annual welfare impacts on whitetail deer and moose hunters are summarized in Tables 4.11 and 4.13 and the corresponding capitalized welfare impacts are summarized in Tables 4.12 and 4.14.

Examining Tables 4.11 to 4.14 one can see that the annual and capitalized welfare impacts from environmental changes on whitetail deer hunters are similar to the annual and capitalized welfare impacts on moose hunters. Although the per trip welfare measures (Tables 4.9 and 4.10) moose hunters exceed the per trip welfare measures for whitetail deer hunters, the number of estimated whitetail deer hunting trips to Zone 69 was more than double the number of estimated moose hunting trips to the same zone.

This study examined the welfare impacts of changes in more than one single environmental attribute on hunting; respondents were required to make tradeoffs between different levels of attributes. The results presented in this section are comparable to those presented by Wilman (1984) and Johansson et al. (1988). The design of the contingent behaviour question in this study gives some insight into the relationships between the effects of forestry operations, including increasing game populations, and recreational hunting benefits.

CHAPTER V SUMMARY AND CONCLUSIONS

A. Summary

This study is unique in several ways. First, it extends traditional contingent valuation analysis by evaluating multiple quality changes at once and it utilizes the contingent behaviour framework. In the past, contingent valuation questions evaluated one change at a time; evaluating multiple changes would require multiple contingent valuation studies. Using such a method would be very expensive for companies such as Millar Western or NorSask to conduct if they were unsure of the exact expected changes to the environment from harvesting operations. Therefore, the flexibility of the methodology used in this study is a great advantage. The survey question design was very efficient for a mail questionnaire. There were three versions of each survey, each with two different contingent behaviour questions, for a total of six different scenarios to be evaluated. Each respondent was given only two contingent behaviour questions to answer, and thus, the response rate for the survey was quite high.

This study was designed to examine the economic benefits of recreational whitetail deer and moose hunting in the Millar Western-NorSask Forest Management Licence Agreement under changing forest structure due to timber harvesting operations. The environmental quality attributes examined in this study were access, game populations, hunter congestion and travel cost. A binary choice random utility model was used to examine the discrete choice problem of choosing between two hypothetical hunting zones in Northwestern Saskatchewan: Zone A represented a pre-harvesting environment and Zone B represented a post-harvesting environment.

Using the data from the Saskatchewan hunting surveys, several models were developed and one model was selected for calculating the welfare changes. Under the assumptions made in Chapters III and IV, the model revealed that an increase in the welfare of resident Saskatchewan whitetail deer and moose hunters can be expected from the harvesting of timber in the Forest Management Licence Agreement.

The sensitivity of the model to model complexity was examined as well as its predictive ability. There was a large difference in the frequency with which the model correctly predicted Zone A and Zone B choices, particularly with the whitetail deer hunter data. The reason suggested for this large difference was that there was some factor, such as the loss of the aesthetic value of the old growth forests, that respondents were perceiving in Zone B that was not included in the model. The selection of variables used in the models was based upon a review of previous hunting studies, hunter focus-group discussions and communication with a Saskatchewan outfitter and forest managers, but the predictive ability of the model might have been improved if additional variables could be identified and employed in the model.

Wildlife-logging interactions were discussed and a simulation of post-logging operations in Zone 69 were performed in order to place the welfare measures obtained into a meaningful context. A limitation of the trip log data used in the estimation of the total number of trips to Zone 69, was that the trips may include hunting trips for species other than whitetail deer or moose, resulting in the possibility of an overstatement of the trips to Zone 69 and therefore, an overstatement of the benefits of environmental changes.

The willingness to pay was lower for whitetail deer hunters than for moose hunters. It appeared that the environmental changes offered in the various scenarios were not significant enough to induce whitetail deer hunters to travel the extra distance to hunt. The median willingness to pay values were negative in most cases, implying that the changes outlined in those scenarios were not good enough to induce the majority of survey respondents to travel (hypothetically) the extra distance to Zone B. However, since the mean willingness to pay values were positive, some respondents would be willing to travel large distances (pay large amounts) to visit Zone B which increased the mean willingness to pay value. The highest welfare impacts were obtained from scenarios 5 and 6 where game populations were increased and congestion was decreased, suggesting that people may prefer to avoid areas with forestry operations unless the area offers increased hunting attributes (e.g. game). The capitalized welfare measures obtained were also sensitive to the interest rate chosen for discounting the benefits.

B. Limitatioı

The benefits calculated in this study represent only a small portion of recreational activities that occur in the Forest Management Licence Agreement. In addition to whitetail deer and moose hunting, other use values include fishing, camping, hiking, and boating. If a benefit-cost analysis of forestry operations in the Forest Management Licence Agreement is to be performed, one should determine the its impacts on other recreation in the area. It is unclear whether the welfare impacts of forest operations on these other recreational activities would be positive or negative. Furthermore, non-use values of the forest should also be considered.

Another limitation of this study concerns the role of native hunters and non-resident hunters in Saskatchewan; this study only considered Saskatchewan resident hunters in its analysis. Due to lack of expertise in the area of Native issues, Native hunting was not addressed in this study. The *Saskatchewan Game Management 1988-1989* report disclosed that Canadian resident (non-Saskatchewan resident) and non-resident (non-Canadian) hunters represent a small proportion of total hunters in Saskatchewan (1.3 to 2.5 percent of whitetail deer first licence sales and 2.0 to 2.8 percent of second licence (forest hunting) sales and approximately 10 percent of moose licence sales), however they do appear to represent a significant proportion of hunting activity in northwestern Saskatchewan. Topolniski et al. (1984) report that 30 percent of northern outfitters' guests are non-Saskatchewan residents. Their expenditures on services such as outfitters may be quite substantial.

The results of this study are further limited by the concerns regarding the reliability of contingent valuation, or contingent behaviour, methodology for eliciting true willingness to pay measures for the environmental changes. Many sources of "bias" were discussed in Chapter II. The contingent behaviour questions developed for the Saskatchewan hunting surveys were developed to attempt to avoid payment vehicle bias in the willingness to pay values and to examine how hunters make tradeoffs between varying levels of environmental qualities. One must still be concerned that respondents may not have fully understood the subtle environmental changes between Zone A and Zone B and that Zone B represented a plausible alternative. Using pictures to help the respondent visualize and understand the choices may aid in reducing question ambiguity and in improving communication, which is critical for the success of a contingent valuation or contingent behaviour experiment.

C. Future Research Needs

Research into non-resident hunting activity would be important for regional economic impact analysis. Furthermore, there are a number of sensitive issues surrounding Native hunting that should be addressed in future studies.

The contingent behaviour approach, the travel cost approach, or a combination of the two could be used in future research to predict hunting zone visitation changes resulting from, for example, environmental quality changes or zone closures.

Further research should also include analysis of questions 5 and 7 (Appendix A) and from the Saskatchewan hunting surveys. Question 5 asked respondents in which activities they would participate if they could not hunt, and where they would pursue these activities. Such information would be valuable to resource managers for determining where hunting-related expenditures would flow if a hunting zone was closed for hunting. The information included in question 7 (the trip log) would provide data for a travel cost analysis of hunting trips taken in Saskatchewan. Again, research into actual hunting activity would be important for regional economic impact analysis.

D. Conclusions

In conclusion, the results from this study provide some of the social values for the non-timber component of the Millar Western-NorSask Forest Management Licence Agreement that are needed for a successful integrated resource forest management plan. This study illustrated how hunters tradeoff environmental quality attributes and how they respond to the introduction of forestry operations in northwestern Saskatchewan. Continued improvements in contingent valuation or contingent behaviour methodologies may facilitate more incorporation of the general public into resource decision-making processes. The Saskatchewan hunting surveys used to obtain the data for this study will also provide data for further research on recreational hunting in Saskatchewan.

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APPENDIX A : The Data Collection Surveys

Whitetail Deer Hunting
In Saskatchewan

University of Alberta
Edmonton

HUNTING IN SASKATCHEWAN

We would like to know what you think about Saskatchewan's hunting resources. What do you look for when choosing a hunting site in Saskatchewan? Where do you hunt? How often? How is your hunting enjoyment affected by changes in wildlife habitat? Your answers are important as they will help contribute to more effective management of Saskatchewan's wildlife resources.

1. *Factors You Consider In Selecting A Hunting Area*

When you decide to go hunting, how important are the following factors in deciding where you want to hunt? (Please circle the number on the 5 point scale below that best reflects the importance of each item where 1 means the factor is not important in your decision and 5 means it is very important.)

		Not Important		Somewhat Important		Very Important
a.	Familiarity with the area	1	2	3	4	5
b.	Good access to region (paved roads, 2-Wheel Drive access)	1	2	3	4	5
c.	Good chance of harvesting an animal	1	2	3	4	5
d.	Naturalness of the area or lack of development	1	2	3	4	5
e.	Seeing wildlife other than Whitetail deer (e.g. hawks, squirrels)	1	2	3	4	5
f.	Nice area for a hunting camp	1	2	3	4	5
g.	Own or know someone who owns land or a cabin in the region	1	2	3	4	5
h.	Privacy from other hunters	1	2	3	4	5
i.	Distance from home	1	2	3	4	5
j.	Opportunities to hunt with family or friends	1	2	3	4	5

2. While hunting on your **typical hunting trip** did you?: (P'aase ☑ all that apply)

- ☐ Use a 2-wheel drive vehicle
- ☐ Use a 4-wheel drive vehicle
- ☐ Use a trail bike or ATV
- ☐ Use a snowmobile
- ☐ Use horses
- ☐ Use a boat
- ☐ Hike or backpack

3. What is your favourite hunting zone?

Zone ______

4. How many years in the last 10 years have you or your party hunted in your favourite zone (from question 3)?

_______ years

5. If for some reason you could **not** go hunting next year in your **favourite** hunting zone, or if the season closed, what sorts of activities would you do instead? (Please ☑ all that apply)

		Where? (Zone or Landmark)
☐	Fishing	____________________
☐	Camping	____________________
☐	Wildlife viewing, Hiking, Photography	____________________
☐	Indoor sports, Attend professional sporting events	____________________
☐	Other (please specify) ____________________	____________________
☐	Hunt elsewhere (please specify zone or landmark)	____________________

6. How many hunting trips (for any species) did you take in Saskatchewan in **the 1992 season?**

_____ trips.

7. For each hunting trip in the 1992 hunting season, please complete the following information if you took more than 10 trips, only list the first 10.

Trip No.	Date you left Home for your Trip	Length of Trip (Days)	No. of Individuals in Hunting Party	Distance from Home to Site (km one way and travel time in hours)	Game Harvested by Yourself / Game Harvested by Your Total Party	Management Area Number or Nearest Landmark, Town	Type of Accommodation eg. camping, motel, etc.
Eg.	*Nov. 14, 1992*	*5 days*	*4*	*50 km, 3/4 hrs*	*1 Moose / 3 Moose*	*66*	*camped*
1							
2							
3							
4							
5							
6							
7							
8							
9							
10							

Expenditures on hunting are one measure of the economic importance of wildlife resources. We would like to know what your expenses are while hunting in Saskatchewan. This information may be used in land management planning decisions affecting wildlife habitat.

8. Please indicate the amount of money spent on all hunting trips during 1992, **excluding licence fees.** (Where no expenditure was incurred, please write 0)

Transportation (incl. oil, gas, airfare, bus, etc.)	________
Accommodation (hotels, campsite fees, etc.)	________
Restaurant meals	________
Other food (including alcohol)	________
Rentals and Repairs (including towing)	________
Equipment purchased specifically for the trip (i.e. boots, weapons, ammunition, etc.)	________
Other (please specify) ________________	________

9. If you made any major purchases (trucks, ATVs, cabins) for hunting in Saskatchewan (in 1992), that are used in whole or in part for hunting in Saskatchewan, please list the item, the purchase price and the extent to which this item is used for hunting in Saskatchewan.

Item	Purchase Price	Percentage of time item is used for hunting in Saskatchewan
____________	$ ______	______ %
____________	$ ______	______ %
____________	$ ______	______ %

10. Which Saskatchewan licences did you hold, or are you planning on buying for 1992? (Please ☑ all that apply)

- ☐ Upland Game Bird
- ☐ Waterfowl
- ☐ Angling Licence
- ☐ Antelope
- ☐ Mule Deer
- ☐ Whitetail Deer
- ☐ Bear
- ☐ Elk
- ☐ Draw Elk
- ☐ Moose
- ☐ Draw Moose
- ☐ Other (please specify)

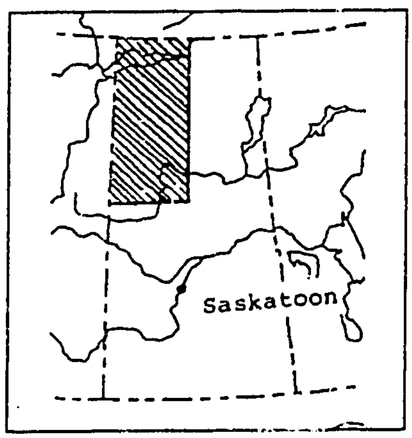
____

HUNTING IN NORTHWESTERN SASKATCHEWAN

Northwestern Saskatchewan is an important are for hunting and there has been increased economic activity in this region. We are interested in your opinions about hunting quality in this region. Even if you did not hunt in Northwestern Saskatchewan please answer the following questions.

11. Looking at the map provided below, did you hunt in any part of Northwestern Saskatchewan (the shaded area) the map this season? (Please ☑)

- ☐ YES
- ☐ NO



If you answered *NO* to question 11, please answer question 12.

12. Why did you not go hunting in this area this season? (Please ☑ all that apply)

- ☐ It was too far or too expensive to travel that far
- ☐ I did not harvest any deer there last year
- ☐ I am unfamiliar with the area
- ☐ I have other favourite hunting areas
- ☐ I was unsuccessful in the draw for Moose for that region
- ☐ Other (please specify) ________________________________

Please go to question 18.

If you answered YES to question 11, please answer the following questions.

13. How many hunting trips to Northwestern Saskatchewan (the shaded area on the map) did you make in 1992?

    ________ trips.

14. How many trips did you make to **Meadow Lake Provincial Park** in 1992?

    ________ trips.

15. Why do you hunt in **Northwestern Saskatchewan**? (Please ☑ all that apply)

    - ☐ Familiar with the area
    - ☐ Access within region (highway network, logging roads)
    - ☐ Good chance of harvesting an animal
    - ☐ Good chance of harvesting a trophy animal
    - ☐ Moose draw or other big game animals
    - ☐ Lack of commercial development
    - ☐ Nice area to set up a hunting camp
    - ☐ Close to Meadow Lake Provincial Park
    - ☐ Own land or a cabin in the region
    - ☐ Know someone who owns land or has a cabin in the region
    - ☐ Privacy from other hunters
    - ☐ It's close to my home
    - ☐ Other (please specify) ________________________________

    ____

16. Approximately what percentage of your total hunting expenditures (from question 7, on page 4) occurred on hunting trips to the shaded area on the map?

    ________ percent

17. During your hunting trips to the shaded area of the map what **other activities** did you participate in? (Please ☑ all that apply)

    - ☐ Fished
    - ☐ Stayed in a motel / hotel
    - ☐ Visited friends or relatives
    - ☐ Other (please specify)
    - ☐ Camped
    - ☐ Birdwatching
    - ☐ Visited Meadow Lake Provincial Park

    ____

EFFECTS OF CHANGING HUNTING CONDITIONS

18. Listed below are several statements about the management and development of Whitetail deer habitat (forested areas). Please rate to what extent each would add to or lessen your Whitetail deer hunting enjoyment by circling the appropriate number.

		Lessens Enjoyment				Increases Enjoyment
a.	Encountering another hunting party	1	2	3	4	5
b.	Road access to new sites	1	2	3	4	5
c.	Gates on roads	1	2	3	4	5
d.	Roads closed to vehicular traffic	1	2	3	4	5
e.	Slash (large logs) on cut lines	1	2	3	4	5
f.	Seeing twice as many Whitetail deer	1	2	3	4	5
g.	Seeing other kinds of wildlife (birds, moose, squirrels, etc.)	1	2	3	4	5
h.	Seeing or hearing logging equipment (trucks etc.)	1	2	3	4	5
i.	Deterioration of roads	1	2	3	4	5
j.	Road corridors	1	2	3	4	5
k.	Seeing a previously logged area replanted with seedlings or saplings	1	2	3	4	5

19. Which *one* of the items above increases enjoyment more than others? ________

20. Which *one* of the items above decreases enjoyment more than others? ________

21.

On the following page are some hypothetical hunting options you are asked to consider. We emphasize that these are hypothetical and are not being considered as part of any government policy.

Consider the choice of hunting in sites A or B:

These descriptions are not meant to represent any site at which you currently hunt.

A. The following description is a representation of a typical forest stand in the mixed forests of Northwestern Saskatchewan.

- the forest trails in this area are easily passable in dry weather in a 2-wheel drive vehicle, but in foul or wet weather, access is difficult even with a 4-wheel drive vehicle
- on a typical day you will see, or find evidence (tracks, scrapes, rubs or droppings) of **6 to 10 Whitetail deer**
- your hunting party will not encounter another hunting party on your trip

B. The following description represents a similar forest stand in the mixed forest of Northwestern Saskatchewan.

- the roads into this forest are maintained by the forest products company during harvesting and are a mixture of sand and clay (no gravel) that are easily passable in dry weather in a 2-wheel drive vehicle. In foul or wet weather, access is difficult even with a 4-wheel drive vehicle. There are **also some old forest trails** which are also passable with a 2-wheel drive vehicle.
- due to harvesting and replanting, there is increased vegetation for species like Whitetail deer to eat
- on a typical day you may see, or find evidence (tracks, scrapes, rubs or droppings) of **8 to 12 Whitetail deer**
- your hunting party will not encounter another hunting party on your trip
- **In order to hunt in this area, you will have to travel further and it will cost YOU an extra $ ____ to get there**

In which zone would you prefer to hunt? (Please ☑)

☐ A
☐ B

Consider the choice of hunting in sites A or B:

These descriptions are not meant to represent any site at which you currently hunt.

A. The following description is a representation of a typical forest stand in the mixed forests of Northwestern Saskatchewan.

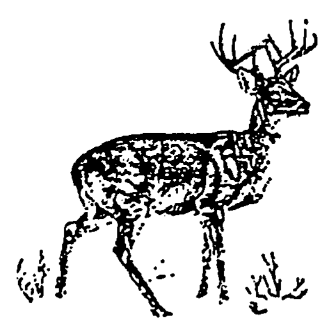
- the forest trails in this area are easily passable in dry weather in a 2-wheel drive vehicle, but in foul or wet weather, access is difficult even with a 4-wheel drive vehicle
- on a typical day you will see, or find evidence (tracks, scrapes, rubs or droppings) of **6 to 10 Whitetail deer**
- your hunting party will not encounter another hunting party on your trip

B. The following description represents a similar forest stand in the mixed forest of Northwestern Saskatchewan

- the roads into this forest are maintained by the forest products company during harvesting and are a mixture of sand and clay (no gravel) that are easily passable in dry weather in a 2-wheel drive vehicle. In foul or wet weather, access is difficult even with a 4-wheel drive vehicle
- due to harvesting and replanting, there is increased vegetation for species like Whitetail deer to eat
- on a typical day you may see, or find evidence (tracks, scrapes, rubs or droppings) of **8 to 12 Whitetail deer**
- your hunting party will not encounter another hunting party on your trip
- **in order to hunt in this area, you will have to travel further and it will cost YOU an extra $ ____ to get there**

In which zone would you prefer to hunt? (Please ☑)

☐ A
☐ B



We would like to ask a few questions about your household. These questions are necessary because they help us understand how different kinds of people feel about these issues. Your answers to these questions will be kept in absolute confidence and will never be related to your name.

22. Are you: ☐ Male
☐ Female

23. What is your age? ______ years.

24. What is the size of your town or city? (Please ☑)

- ☐ Rural, farm
- ☐ Small town (less than 1000 people)
- ☐ Urban (1000 people or more)

25. What is the name of the town or city in which you live? ______________________

26. Please indicate the highest level of education you have completed. (Please ☑)

- ☐ primary school (kindergarten to grade 3)
- ☐ elementary school (grades 4 to 6)
- ☐ high school (grades 7 to 11/12)
- ☐ trade school or technical college
- ☐ university
- ☐ graduate degree

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

28. Which of the following categories best represents your annual household income before taxes?

☐ $0 - $10,000	☐ $10,001 - $20,000	☐ $20,001 - $30,000
☐ $30,001 - $40,000	☐ $40,001 - $50,000	☐ $50,001 - $60,000
☐ $60,001 - $70,000	☐ $70,001 - $80,000	☐ $80,001 - $90,000
☐ $90,001 - $100,000	☐ Over $100,000	

29. How many persons in your household contribute to this income?

_______ persons.

If you have any other comments or concerns about this survey, please feel free to write them in the space below.

. ..e questions about this survey please call Karen Parlardg at:

1 - 800 - 267 - 6413 (Toll Free)

THANK YOU FOR TAKING THE TIME TO PARTICIPATE IN THIS SURVEY

Please remember to return your completed questionnaire in the self-addressed stamped envelope to:

DEPARTMENT OF RURAL ECONOMY
MATERIALS MANAGEMENT BLDG
UNIVERSITY OF ALBERTA
EDMONTON AB T6G 9Z9

Moose Hunting in Saskatchewan

University of Alberta
Edmonton

Canada-Saskatchewan
Partnership Agreement
in Forestry

Entente d'association
Canada-Saskatchewan
en foresterie

HUNTING IN SASKATCHEWAN

We would like to know what you think about Saskatchewan's hunting resources. What do you look for when choosing a hunting site in Saskatchewan? Where do you hunt? How often? How is your hunting enjoyment affected by changes in wildlife habitat? Your answers are important as they will help contribute to more effective management of Saskatchewan's wildlife resources.

1. *Factors You Consider In Selecting A Hunting Area*

When you decide to go hunting, how important are the following factors in deciding where you want to hunt? (Please circle the number on the 5 point scale below that best reflects the importance of each item where 1 means the factor is not important in your decision and 5 means it is very important.)

		Not Important		Somewhat Important		Very Important
a.	Familiarity with the area	1	2	3	4	5
b.	Good access to region (paved roads, 2-Wheel Drive access)	1	2	3	4	5
c.	Good chance of harvesting an animal	1	2	3	4	5
d.	Naturalness of the area or lack of development	1	2	3	4	5
e.	Seeing wildlife other than Whitetail deer (e.g. hawks, squirrels)	1	2	3	4	5
f.	Nice area for a hunting camp	1	2	3	4	5
g.	Own or know someone who owns land or a cabin in the region	1	2	3	4	5
h.	Privacy from other hunters	1	2	3	4	5
i.	Distance from home	1	2	3	4	5
j.	Opportunities to hunt with family or friends	1	2	3	4	5

2. While hunting on your **typical hunting trip** did you?: (Please ☑ all that apply)

- ☐ Use a 2-wheel drive vehicle
- ☐ Use a 4-wheel drive vehicle
- ☐ Use a trail bike or ATV
- ☐ Use a snowmobile
- ☐ Use horses
- ☐ Use a boat
- ☐ Hike or backpack

3. What is your favourite hunting zone?

Zone ______

4. How many years in the last 10 years have you or your party hunted in your favourite zone (from question 3)?

______ years

5. If for some reason you could not go hunting next year in your favourite hunting zone, or if the season closed, what sorts of activities would you do instead? (Please ☑ all that apply)

	Where? (Zone or Landmark)
☐ Fishing	______________
☐ Camping	______________
☐ Wildlife viewing, Hiking, Photography	______________
☐ Indoor sports, Attend professional sporting events	______________
☐ Other (please specify) ______________	______________
☐ Hunt elsewhere (please specify zone or landmark)	______________

6. How many hunting trips (for any species) did you take in Saskatchewan in the 1992 season?

____ trips.

7. For each hunting trip in the 1992 hunting season, please complete the following information if you took more than 10 trips, only list the first 10.

Trip No.	Date you left Home for your Trip	Length of Trip (Days)	No. of Individuals in Hunting Party	Distance from Home to Site (km one way and travel time in hours)	Game Harvested by Yourself / Game Harvested by Your Total Party	Management Area Number or Nearest Landmark, Town	Type of Accommodation eg. camping, motel, etc.
Eg.	*Nov. 14, 1992*	*5 days*	*4*	*50 km, 3/4 hrs*	*1 Moose / 3 Moose*	*66*	*camped*
1							
2							
3							
4							
5							
6							
7							
8							
9							
10							

Expenditures on hunting are one measure of the economic importance of wildlife resources. We would like to know what your expenses are while hunting in Saskatchewan. This information may be used in land management planning decisions affecting wildlife habitat.

8. Please indicate the amount of money spent on all hunting trips during 1992, **excluding licence fees.** (Where no expenditure was incurred, please write 0)

Transportation (incl. oil, gas, airfare, bus, etc.)	________
Accommodation (hotels, campsite fees, etc.)	________
Restaurant meals	________
Other food (including alcohol)	________
Rentals and Repairs (including towing)	________
Equipment purchased specifically for the trip (i.e. boots, weapons, ammunition, etc.)	________
Other (please specify) ________________	________

9. If you made any major purchases (trucks, ATVs, cabins) for hunting in Saskatchewan (in 1992), that are used in whole or in part for hunting in Saskatchewan, please list the item, the purchase price and the extent to which this item is used for hunting in Saskatchewan.

Item	Purchase Price	Percentage of time item is used for hunting in Saskatchewan
________	$ ________	________ %
________	$ ________	________ %
________	$ ________	________ %

10. Which Saskatchewan licences did you hold, or are you planning on buying for 1992? (Please ☑ all that apply)

- ☐ Upland Game Bird
- ☐ Waterfowl
- ☐ Angling Licence
- ☐ Antelope
- ☐ Mule Deer
- ☐ Whitetail Deer
- ☐ Bear
- ☐ Elk
- ☐ Draw Elk
- ☐ Moose
- ☐ Draw Moose
- ☐ Other (Please Specify)

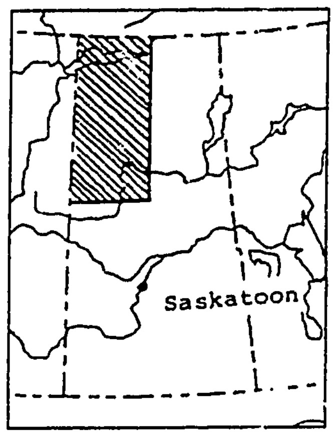
____

HUNTING IN NORTHWESTERN SASKATCHEWAN

Northwestern Saskatchewan is an important area for hunting and there has been increased economic activity in this region. We are interested in your opinions about hunting quality in this region. Even if you did not hunt in Northwestern Saskatchewan please answer the following questions.

11. Looking at the map provided below, did you hunt in any part of Northwestern Saskatchewan (the shaded area) the map this season? (Please ☑)

☐ YES
☐ NO



you answered ***NO*** to question 11, please answer question 12.

12. Why did you not go hunting in this area this season? (Please ☑ all that apply)

☐ It was too far or too expensive to travel that far
☐ I did not harvest any Moose there last year
☐ I am unfamiliar with the area
☐ I have other favourite hunting areas
☐ I was unsuccessful in the draw for Moose for that region

☐ Other (please specify) ______________________________

Please go to question 18.

If you answered *YES* to question 11, please answer the following questions.

13. How many hunting trips to **Northwestern Saskatchewan** (the shaded area on the map) did you make in 1992?

    ________ trips.

14. How many trips did you make to **Meadow Lake Provincial Park** in 1992?

    ________ trips.

15. Why do you hunt in **Northwestern Saskatchewan**? (Please ☑ all that apply)

    - ☐ Familiar with the area
    - ☐ Access within region (highway network, logging roads)
    - ☐ Good chance of harvesting an animal
    - ☐ Good chance of harvesting a trophy animal
    - ☐ Moose draw or other big game animals
    - ☐ Lack of commercial development
    - ☐ Nice area to set up a hunting camp
    - ☐ Close to Meadow Lake Provincial Park
    - ☐ Own land or a cabin in the region
    - ☐ Know someone who owns land or has a cabin in the region
    - ☐ Privacy from other hunters
    - ☐ It's close to my home
    - ☐ Other (please specify) ________________________________

      ____

16. Approximately what percentage of your total hunting expenditures (from question 7, on page 4) occurred on hunting trips to the shaded area on the map?

    ________ percent

17. During your hunting trips to the shaded area of the map what **other activities** did you participate in? (Please ☑ all that apply)

    - ☐ Fished
    - ☐ Stayed in a motel / hotel
    - ☐ Visited friends or relatives
    - ☐ Other (please specify)

      ____
    - ☐ Camped
    - ☐ Birdwatching
    - ☐ Visited Meadow Lake Provincial Park

EFFECTS OF CHANGING HUNTING CONDITIONS

18. Listed below are several statements about the management and development of Moose habitat (forested areas). Please rate to what extent each would add to or lessen your Moose hunting enjoyment by circling the appropriate number.

		Lessens Enjoyment				Increases Enjoyment
a.	Encountering another hunting party	1	2	3	4	5
b.	Road access to new sites	1	2	3	4	5
c.	Gates on roads	1	2	3	4	5
e.	Roads closed to vehicular traffic	1	2	3	4	5
f.	Slash (large logs) on cut lines	1	2	3	4	5
g.	Seeing twice as many Moose	1	2	3	4	5
h.	Seeing other kinds of wildlife (birds, deer, squirrels, etc.)	1	2	3	4	5
i.	Seeing or hearing logging equipment (trucks etc.)	1	2	3	4	5
j.	Deterioration of roads	1	2	3	4	5
k.	Road corridors	1	2	3	4	5
l.	Seeing a previously logged area replanted with seedlings or saplings	1	2	3	4	5

19. Which *one* of the items above increases enjoyment more than others? _______

20. Which *one* of the items above decreases enjoyment more than others? _______

21.

On the following page are some hypothetical hunting options you are asked to consider. We emphasize that these are hypothetical and are not being considered as part of any government policy.

Consider the choice of hunting in sites A or B:

These descriptions are not meant to represent any site at which you currently hunt.

A. The following description is a representation of a typical forest stand in the mixed forests of Northwestern Saskatchewan.

- the forest trails in this area are easily passable in dry weather in a 2-wheel drive vehicle, but in foul or wet weather, access is difficult even with a 4-wheel drive vehicle
- on a typical day you will see, or find evidence (tracks, droppings, rubs or wallows) of **2 Moose**
- your hunting party **will not** encounter another hunting party on your trip

B. The following description represents a similar forest stand in the mixed forest of Northwestern Saskatchewan.

- the roads into this forest are maintained by the forest products company during harvesting and are a mixture of sand and clay (no gravel) that are easily passable in dry weather in a 2-wheel drive vehicle. In foul or wet weather, access is difficult even with a 4-wheel drive vehicle.
- due to harvesting and replanting, there is increased vegetation for species like Moose to eat
- on a typical day you may see, or find evidence (tracks, droppings, rubs or wallows) of **3 to 4 Moose**
- your hunting party **will** encounter another hunting party unfamiliar to you on your trip
- **In order to hunt in this area, you will have to travel further and it will cost YOU an extra $ ____ to get there**

In which zone would you prefer to hunt? (Please ☑)

☐ A
☐ B

Consider the choice of hunting in sites A or B:

These descriptions are not meant to represent any site at which you currently hunt.

A. The following description is a representation of a typical forest stand in the mixed forests of Northwestern Saskatchewan.

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- on a typical day you will see, or find evidence (tracks, droppings, rubs or wallows) of 2 **Moose**
- your hunting party **will not encounter** another hunting party on your trip

B. The following description represents a similar forest stand in the mixed forest of Northwestern Saskatchewan.

- the roads into this forest are maintained by the forest products company during harvesting and are a mixture of sand and clay (no gravel) that are easily passable in dry weather in a 2-wheel drive vehicle. In foul or wet weather, access is difficult even with a 4-wheel drive vehicle. There are **also some old forest trails** which are also passable with a 2-wheel drive vehicle.
- on a typical day you may see, or find evidence (tracks, droppings, rubs or wallows) of 2 **Moose**
- your hunting party **will encounter** another hunting party unfamiliar to you on your trip
- **In order to hunt in this area, you will have to travel further and it will cost YOU an extra $ ____ to get there**

In which zone would you prefer to hunt? (Please ☑)

☐ A
☐ B

We would like to ask a few questions about your household. These questions are necessary because they help us understand how different kinds of people feel about these issues. Your answers to these questions will be kept in absolute confidence and will never be related to your name.

22. Are you: ☐ Male
☐ Female

23. What is your age? ______ years.

24. What is the size of your town or city? (Please ☑)

- ☐ Rural, farm
- ☐ Small town (less than 1000 people)
- ☐ Urban (1000 people or more)

25. What is the name of the town or city in which you live? ____________________

26. Please indicate the highest level of education you have completed. (Please ☑)

- ☐ primary school (kindergarten to grade 3)
- ☐ elementary school (grades 4 to 6)
- ☐ high school (grades 7 to 11/12)
- ☐ trade school or technical college
- ☐ university
- ☐ graduate degree

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

28. Which of the following categories best represents your annual household income before taxes?

☐ $0 - $10,000	☐ $10,001 - $20,000	☐ $20,001 - $30,000
☐ $30,001 - $40,000	☐ $40,001 - $50,000	☐ $50,001 - $60,000
☐ $60,001 - $70,000	☐ $70,001 - $80,000	☐ $80,001 - $90,000
☐ $90,001 - $100,000	☐ Over $100,000	

29. How many persons in your household contribute to this income?

_______ persons.

If you have any other comments or concerns about this survey, please feel free to write them in the space below.

If you have questions about this survey please call Karen Parlardg at:

1 - 800 - 267 - 6413 (Toll Free)

THANK YOU FOR TAKING THE TIME TO PARTICIPATE IN THIS SURVEY

Please remember to return your completed questionnaire in the self-addressed stamped envelope to:

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UNIVERSITY OF ALBERTA
EDMONTON AB T6G 9Z9

APPENDIX B: Sample Sizes and Contingent Behaviour Question Summary

Table B-1 Sample Sizes for Survey Versions

Sample Sizes for Survey Versions		
Version	Whitetail Deer Survey	Moose Survey
1	291	268
2	286	263
3	267	213
4	266	209
5	287	275
6	284	267

Table B-2 Contingent Behaviour Question Summary

Summary of Contingent Behaviour Question Responses				
Scenario	Whitetail Deer Respondents' Choice		Moose Respondents' Choice	
	Zone A	Zone B	Zone A	Zone B
Scenario 1	65.4%	32.1%	59.5%	37.7%
Scenario 2	73.0%	22.6%	75.4%	19.7%
Scenario 3	64.8%	31.5%	64.3%	31.5%
Scenario 4	60.4%	35.6%	47.9%	45.4%
Scenario 5	45.9%	49.4%	39.3%	58.4%
Scenario 6	41.5%	53.2%	35.2%	61.1%

Note: The percentages may not add to 100% due to non-response of the contingent behaviour question by some survey participants.