RURAL ECONOMY

An Economic Evaluation of Woodland Caribou Conservation Programs in Northwestern Saskatchewan

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Project Report 95-01

PROJECT REPORT

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Abstract

The purpose of this study was to identify the values Saskatchewan residents place on their Woodland Caribou conservation programs. Using contingent valuation methods, individual values for maintaining caribou numbers within Millar Western-NorSask Forest Management Licence agreement area were estimated. Using these value estimates, societal benefits were estimated for the implementation of a woodland caribou maintenance program within the forest licence agreement area.

The data used in this study were collected using a mailout survey to Saskatchewan residents. Two contingent valuation formats were used, the opened ended willingness to pay and the dichotomous choice. A number of question structures were employed in order to judge the sensitivity of the valuation to the design. In all, 9 different versions of the contingent valuation question were used in a randomized design strategy.

The resulting welfare measures for the implementation of the caribou maintenance program were somewhat variable. The open ended format produced the lowest estimates, while the dichotomous choice estimates were higher and showed a higher degree of variability. This variability may be due to the presence of the ordering or whole-part effects.

The values elicited for the conservation program using the open ended approach average approximately $15.00 per person per year. These values, when aggregated over the provincial population, result in an annual benefit of the woodland caribou conservation program of about $10M. These are the most conservative of the estimates, suggesting that woodland caribou conservation is very important to Saskatchewan residents.

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Section 1: Introduction

1.1 Valuation

Value is a term used to describe the worth of a good or service that is desired by individuals or society. The elements of value have perplexed scholars for generations. In economics, value is central to the concept of rational choice. Under the rigors of economic analysis, values are generally measured in dollar terms. These dollar values may be defined for a given good through the actions of competitive market systems, which result in a market price.

In a natural resource setting, many goods and services are not traded in markets and their associated value cannot be measured by using market prices. Because of the lack of market pricing, information to reflect the value, in monetary terms, of these goods or services is consequently more difficult to obtain. In Canada, most of the natural resources are owned by the public. Because of the nature of non-market goods, the price demand signals from private consumers are often not communicated to the public supply side (Asafu-Adjaye *et al*., 1989).

Historically, economists had few methods to determine values for these goods and services. Many economists acknowledged the existence of these goods and services and that they were valuable. The general rule was to lump these goods into a group of "intangibles" or "unmeasurables", and exclude them from the analysis (Gittinger, 1972).

This lack of pricing information makes typical policy tools ineffective in the policy decision process. An example would be the use of Benefit Cost (BC) analysis[1]. This policy tool is used to measure what the social benefits and costs are for a given program or policy. If the final result of the analysis is a net gain to society, then the policy is deemed "good" under a potential Pareto efficient criteria (Mitchell and Carson, 1989).

One problem in BC analysis is that the process assumes complete information on the value of the resources involved. Because of the frequent exclusion of non-market goods in a natural resource setting, this assumption may be incorrect. Consequently, the potential for the misallocation of resources and an inequitable distribution of benefits increases (Adamowicz, 1991).

[1] See Sugden and Williams (1990) for a more detailed description of benefit-cost analysis.

1.2 The Situation

In Saskatchewan, most natural resources are publicly owned and managed by the provincial government. Many of the goods and services provided by these natural resources are non-market[2] in nature, such as recreational hunting and fishing, non-consumptive outdoor activities like birdwatching, and the existence of wildlife and wildlands. Due to increased extraction of some marketable resources in Saskatchewan (eg. timber), the supply of many of these non-market goods and services which depend on old growth or mature forest is decreasing. If these goods and services are valued by society then this decrease would be considered a loss to society which should be weighed against the benefits of timber harvesting[3]. In the 1991 Statistics Canada survey "Importance of Wildlife to Canadians" over 80% of Saskatchewan respondents stated that maintaining the abundance of wildlife and the preservation of endangered species are important. This same survey found that over 40 000 Saskatchewan residents were involved in maintaining natural areas. Clearly, wildlife and natural area preservation is valued by the citizens of this province.

Recently, a Forest Management Licence Agreement (FMLA) was issued in Northwestern Saskatchewan, to Norsask Forest Products Inc. (Figure 1.1), allowing this company to harvest timber on public lands. Part of the requirements of this agreement was that the company was to utilize the aspen or find another company to join them in the FMLA that would. In accordance with this provision the company formed a partnership with Millar Western Pulp (Meadow Lake) Ltd, who would utilize the aspen. The Saskatchewan Government placed several additional requirements into the terms of the agreement in the granting of the FMLA. The firms must provide a Twenty Year Forest Management Plan and an Environmental Impact Assessment of their forest operations. Within the Twenty Year Management Plan, as stipulated by Saskatchewan Environment and Public Safety, the firms must consider both fibre and non-fibre values within the FMLA. These non-fibre values

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[2] In a forest environment non-market goods are frequently referred to as non-timber benefits.

[3] This study is concerned with the measurement of gross societal benefits of one type of non-timber value and some associated problems with using contingent valuation methods. To determine the net gains or losses to society maintaining a non-timber resource the cost in relation to the estimated benefits must be examined. The trade-offs between benefits and costs determine the net gains or losses that will be incurred by society.

include non-timber resource supply benefits such as wildlife habitat, forest biodiversity, recreational/tourism opportunities and vegetation non-wood products (Mistik Management Ltd. 1992). To meet the requirements of this holistic or integrated resource management approach, the partnership created Mistik Management to manage and develop the Twenty Year Management Plan for the FMLA. To include non-timber goods into the management plan their values must be estimated.

1.3 Problem Statement

Woodland caribou (*Rangifer tarandus caribou*) are considered to be vulnerable to the effects of timber harvesting (Cumming, 1992). In the Northwestern region of Saskatchewan, increased forest industry activity could place local populations of this species in jeopardy. Given the degree of public interest in maintaining wildlife populations, and the requirements of the Twenty Year Management Plan, a study was initiated in 1992 to examine the socioeconomic significance of this species.

A survey was developed to collect information on the social and economic elements that would influence the valuation of wildlife. Contingent valuation methods (CVM) were incorporated, into the survey, to estimate the value of a woodland caribou maintenance program. These benefit estimates will be examined to determine the benefits to society that would be derived from the implementation of a caribou maintenance program within the FMLA.

1.4 Report Outline

This report is structured as follows. The following section contains an overview of non-market valuation theory including a discussion of the contingent valuation method which is used in this study. Next, the data collection process is discussed. The 4th section presents a summary of the results including the aggregate welfare measures. (In appendix A, a more detailed discussion of the results is presented, including tests of the robustness of the various methods.) Finally, section 5 contains a summary and conclusions.

Provided by Mistik Management (1993). No copyright.

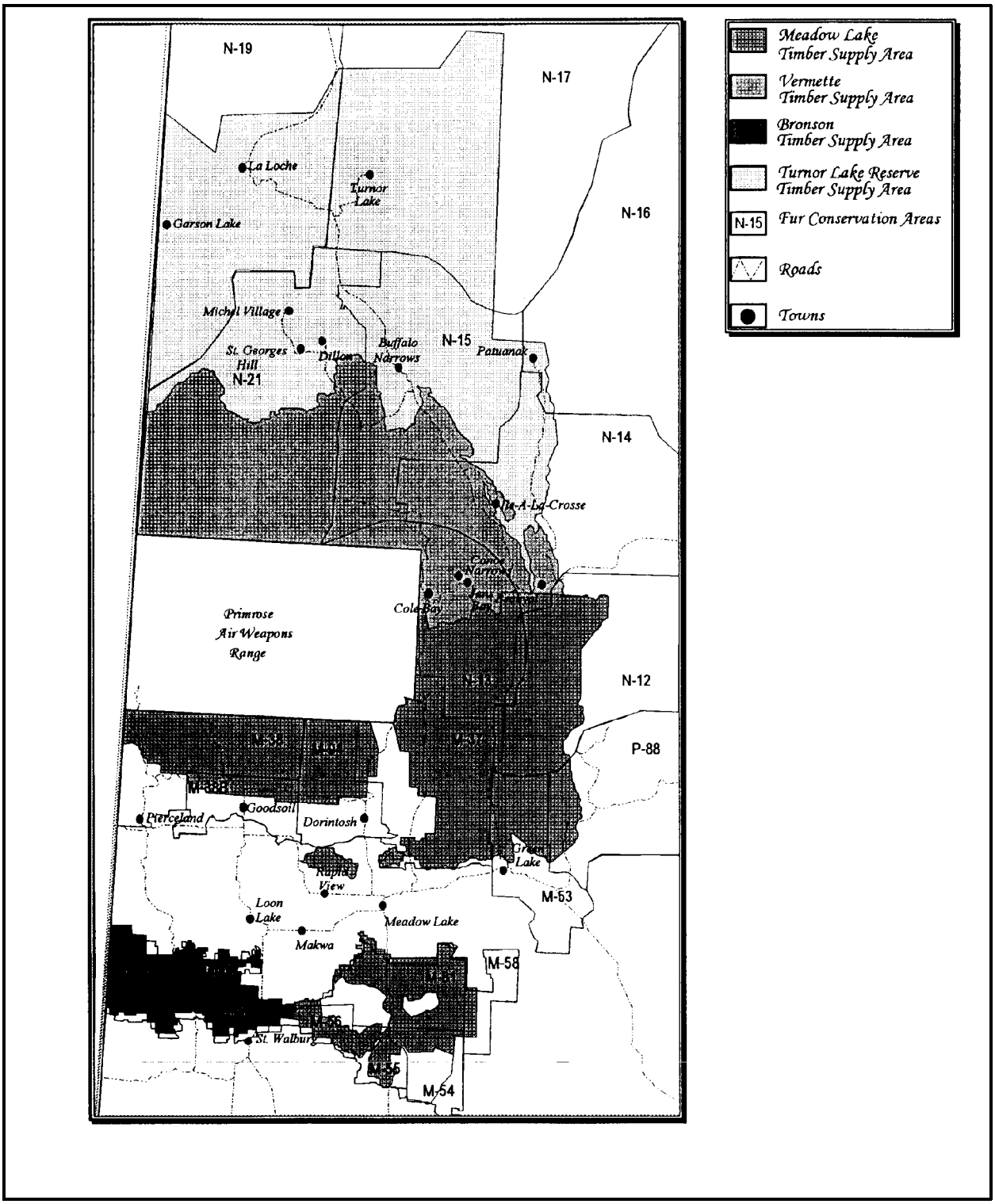

Figure 1.1 Forest Management Agreement License

Section 2: Non-Market Benefit Estimation

2.1 Identification and Definition of Non-market Goods

Many goods and services derived from natural resource settings are classified as public goods. These goods are characterized as being non-rival and non-excludable. Non-rivalry is the condition where one individual's use of a good does not take away from the satisfaction of another individual's use of the good. Nonexcludability is the condition where the right of exclusive use does not exist. In economics, an evaluation of public goods is difficult due to the lack of a competitive market pricing mechanism[4]. Without the explicit values derived from competitive markets, inclusion of these goods and services into an economic analysis is difficult (Mitchell and Carson, 1989). Within the last 25 years, methods have been developed so that many values of public goods can be measured. By being able to place a monetary value on these non-market goods and services, economists can now include these values in economic analyses. This may result in a more efficient allocation of resources (Phillips and Adamowicz, 1983).

Using a taxonomy of value measures developed by Asafu-Adjaye *et al*. (1989) the hierarchy and description of these non-market goods' values can be presented. Values can be divided into two groups, use and non-use values. Use values can be sub-divided into indirect and direct uses. With indirect use there is no first person interaction with the resource. Indirect uses can be placed into two categories: Type 1, is viewing on television or reading about a resource, while Type 2, is research dissemination.

With direct use there exists interaction with the resource by the individual. Direct Use can be broken down into consumptive and non-consumptive uses. Consumptive use involves a depletion of the resource being used. Non-consumptive uses, like birdwatching, are on site uses that do not cause a depletion of the resource with use.

Non-use values are composed of two elements, preservation and bequest values. Preservation values can be divided into pure existence values and vicarious consumption values. Existence values or "passive use values" (Arrow *et al.*, 1993), relate to the degree of uniqueness and attributes of the resource, but the resource does not have to be irreplaceable (Walsh, *et al*., 1984). Existence value,

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[4] Property rights must be complete for a given good for a competitive market to function. The lack of property rights for public goods can lead to market failures.

simply stated, is the value associated having wildlife or wildlands preserved, regardless of other uses or values (Asafu-Adjaye *et al*., 1989). Vicarious consumption values can be described as the value one derives from the satisfaction that others will use the resource. The second element of non-use values is bequest value. Bequest value is the value of endowing future generations with wilderness resources.

2.2 Measurement of Non-Market Goods: Direct and Indirect Approaches

The methods for evaluation of these non-market goods can be divided into two approaches, direct and indirect. The indirect approach relies on the assumption of weak complementarity (WC) and the most frequently used models are the travel cost (TC) model and a variant of the implicit price (IP) approach (Hoehn and Randall, 1987). Travel cost models use the difference in travel, and possibly other, costs recreationists incur to infer how a recreationist would behave if a price higher than the actual admission fee was charged[5] (Bishop and Heberlein, 1979). Implicit price or hedonic techniques are similar to the TC model but use total activity expenditures. These techniques assume that goods can be broken down into characteristics which can be valued (Phillips and Adamowicz, 1983). For example, water quality would be a characteristic of a fishing experience. These methods allow the economist to determine the increase in benefits an angler would gain with a positive change in water quality.

An indirect approach, may be suitable for measuring the value of many natural resource consumptive uses (eg. hunting or camping). However, this study is concerned with the measurement of non-use values and therefore relies on the direct approach, described in the next section.

The most common direct approach is called the Contingent Valuation Method (CVM) which is a procedure using questions to directly elicit values from the recreationist (Randall *et al.*, 1983; Adamowicz, 1991). The main objective of CVM is to determine an "ex ante" valuation of policy impacts (Hoehn and Randall, 1987). The basic premise is that the value given is contingent on there being a market created by interviews or questionnaires (Adamowicz, 1991). The procedure can cover

[5] This procedure relies on the assumption of weak complementarity. The weak complementarity assumption relies on the premise that associated expenditures relate to the receiving of benefits from some non-market good and that these expenditures can be used to estimate a value for the non-market good.

broad approaches and very specific behavioral preferences (Hoehn and Randall, 1987). CVM compared to TC, is free of many of the behavioural assumptions associated with TC (Phillips and Adamowicz, 1983). However, there are many theoretical and practical issues that must be dealt with in administering a contingent valuation survey.

2.3 Contingent Valuation Technique

CVM studies use surveys or questionnaires to elicit values from respondents. These values are obtained by asking the respondent, "how much would you be willing to pay? (WTP)" for some environmental good. An alternative form is to ask "what is the minimum amount you would be willing to accept in compensation? (WTA)" for a decrease in the supply of an environmental good (Phillips and Adamowicz, 1983). CVM is more adaptable for measuring the value of non-market goods than indirect methods because of the lack of restrictive assumptions on an individual's preferences. CVM relies on two basic assumptions. First, the respondent can accurately evaluate the non-market good or service of concern. Second, the elicited value is the maximum an individual is willing to pay or the minimum amount an individual is willing to accept for compensation (i.e. it is not just a "fair" price).

In situations where market transactions data are available over a full range of policy issues, both indirect and direct methods can be used (Hoehn and Randall, 1987). If both types of approaches are available, results from the indirect approach can be used to validate CVM results.

The validation of CVM is important because in many cases CVM is the only method available for natural resource change valuation. The cases in which CVM is the only approach for valuation are:

1) Policy considerations that lie outside the range of available data;

2) Past market transactions fail to reflect recent information regarding environmental quality, substitutes or hazards (Hoehn and Randall, 1987; Arrow *et al.*, 1993).

Since the inception of CVM, several empirical studies have been done to help establish confidence in this valuation procedure (Phillips and Adamowicz, 1983). The justification in using CVM is given by the following 4 reasons. First, results have been shown to be consistent with revealed preferences (Hoehn and Randall, 1987). Second, CVM value estimates are consistent in relation to other applied valuation methods. Third, where economic theory is sufficiently developed

to imply a qualitative relationship between CVM and other approaches, empirical results have shown the expected outcome. Fourth, CVM results are systematically related to individual demographic characteristics and to the availability of substitutes and complements (Hoehn and Randall, 1987). Despite this justification, empirical work done by Kahneman and Knetsch (1992) seems to provide some evidence questioning the validity of CVM. This evidence will be presented later in the text.

Because CVM elicits a value, respondents must go through a valuation process to determine a value response. This valuation process can be broken down into two parts, a valuation stage and a value statement stage. The valuation stage is the period where the respondent decides on the true value for a change in supply of an environmental good (Hanley and Munro, 1991; Hoehn and Randall, 1987). If the good is increasing in supply then the value given is a Hicksian compensating measure of money for the welfare change. For a decreasing supply of a good, Willingness to Pay (WTP) can be viewed as an equivalent surplus measure (Randall *et al*, 1983).

The second stage is the value statement stage where the respondent reveals a figure to the researcher. Because of some actual or perceived gain to the respondent, the revealed value may not be the same value as determined in the valuation stage. This behaviour of false value presentation is known as "strategic behaviour".

CVM is dependent on surveys, most of which are similar in design, for the gathering of data. A particular situation is described to the respondent in which a commodity is changed or a service is offered. The main difference between the techniques is in how the valuation question is structured. With the iterative bidding process, values are presented to the respondent and are either accepted or rejected. Once the upper and lower bounds of bids are defined, the incremental changes in bids are narrowed until a final bid is determined. Open ended willingness to pay (OE WTP) questions elicit a single amount from the respondent by asking "what is the maximum amount you would be willing to pay" for the described situation. Dichotomous choice willingness to pay (DC WTP) questions are designed to mimic a real market situation. A hypothetical situation is described and a bid is offered. The respondent can either accept or refuse the bid amount. The bid offered is randomized for each respondent questioned. The hypothetical situation is couched in a referendum style proposal, where the respondents may be told "the majority must accept the bid amount for the prescribed action to occur." The theoretical models for the OE WTP and the DC WTP methods are presented below.

2.4 Theory of Open Ended Willingness to Pay Model

The OE WTP for an environmental quality change can be described by using an indirect utility function[6] which includes environmental quality as a variable. The indirect utility function of a utility maximizer who is constrained by a budget, could be shown as:

$$V = v\ (\ P, q^{i}, m\ ) \qquad \textbf{(1)}$$

Where: **P** = vector of prices for all goods
q^{i} = environmental quality with level **i**
m = income

In this study, the value of an environmental change is being estimated. The value elicited is for a positive change in environmental quality. The decrease in income that maintains the individual at the same level of utility as before the change in environmental quality is a measure of welfare impact. This point of indifference can be shown as:

$$v\ (\ P, q^{0}, m\ ) = v\ (\ P, q^{1}, m - w\ ) \qquad \textbf{(2)}$$

Where: **i** = **0,1** for original and new level of environmental quality, respectively.
w = maximum willingness to pay value

The OE WTP question involves eliciting the value of **w** from the respondent.

2.5 Theory of Discrete Choice Model (Random Utility Model)

As above, an assumption of the Random Utility Model (RUM) is that the individual derives utility from environmental quality and income. In addition, observable sociological and demographic attributes are depicted as **s**, and **w** represents the bid amount **presented** to the individual to pay for the change in environmental quality. The utility function, $\mathbf{V_i}$, for a bid acceptance can be shown as:

$$V_1 = v\ (\ q^{1},\ m\ -\ w;\ s\ ) \qquad \textbf{(3)}$$

If the individual rejects the offered bid amount for the environmental change then the utility function is:

[6] The indirect utility function is derived by solving a utility maximizing, budget constrained individual optimal solution. For a detailed description and derivation of an indirect utility function see Binger and Hoffman (1988).

$$V_0 = v\ (\ q^0,\ m;\ s\ ) \qquad \textbf{(4)}$$

An important assumption is that the individual knows his/her preferences. This utility function contains attributes that are not observable to the researcher. Therefore, to the observer, there would appear to be a certain amount of randomness to the individual's actions. If we treat these unobservable characteristics as stochastic, then it is possible to develop the stochastic structure required for a statistical binary response model. The underlying sources of the randomness of the individual's utility function are the basis for the distributional assumption to be used in the statistical models. Ben-Akiva and Lerman (1985) cite 4 sources of randomness as identified by Manski (1973):

1. unobserved attributes of the good
2. unobserved taste variation
3. measurement errors and imperfect information
4. instrumental (or proxy) variables.

If the above assumption on stochastic structure holds then the utility functions of the individual can be viewed as random variables. We can let the individual's random utility functions for bid acceptance and bid refusal be represented as $\mathbf{u}_1$ and $\mathbf{u}_0$, respectively. The utility function can then be shown as:

$$u_i = V_i + \epsilon_i \qquad \textbf{(5)}$$

where: ϵ_0 and ϵ_1 are independently identically distributed (i.i.d.) random variables with zero means. These random utility functions have some given parametric probability distribution with means, $\mathbf{v(q^1,m-w;s)}$ and $\mathbf{v(q^0,m;s)}$, respectively. It is assumed that the means are dependent on the observable characteristics of the individual given.

If an individual is asked a WTP question for some environmental quality change and the individual responds positively then:

$$v\ (q^1,\ m-w;\ s) + \epsilon_1 \geq v\ (q^0,\ m;\ s) + \epsilon_0 \qquad \textbf{(6)}$$

If this condition does not hold, then the respondent will refuse the bid. We assume that the individual knows the proper allocation of resources to maximize his/her utility.

2.6 Logit Model

Under the assumption that ϵ_0 and ϵ_1 are i.i.d., the random variables $\eta \equiv (\epsilon_0 - \epsilon_1)$ and $\eta' \equiv$

$(\epsilon_1 - \epsilon_0)$ have the same distribution. If we assume the distribution of ϵ_i is a Weibull density function the probability that an individual will respond "yes" to the bid amount takes the form of a general logit[7] model (Sellar *et al*., 1986).

The probabilities can be written with the standard logistic variate as:

(7)

where:

$$\triangle u \equiv u_1 - u_0 \qquad \textbf{(8)}$$

Two forms of $\mathbf{u_i}$ are used in this study, a linear utility function and a logarithmic utility function. The utility difference functions (equation 9) generated from these forms contain the bid as an independent variable in the linear case and bid divided by income as an independent variable in the logarithmic case (see Hanneman, 1984 for details).

2.7 Welfare Measures

To determine the welfare impacts, one can examine either median or mean welfare measures. The median WTP value can be estimated as the bid value (w) that sets the probability of accepting the bid equal to 0.5:

$$0.5 = (1 + e^{-\triangle u})^{-1} \qquad \textbf{(9)}$$

To determine the mean values, where WTP is a non-negative random variable, the area under the logit distribution is measured by:

$$w^{**} = \int_0^{\infty} [1 - F(w)] \, dw \qquad \textbf{(10)}$$

This can be simplified to:

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[7] Because of the referendum styling of the DC WTP technique, a logit or probit distribution is used within the model. The results obtained from these two distribution functions are similar and since logit models are easier to work with, they are the models of choice (Sellar et al., 1986).

$$w^{**} = (1/-B) * \ln(1 + \exp^{\alpha}) \quad \textbf{(11)}$$

for the linear model and for the logarithmic model this expression simplifies to:

$$WTP^{//} = (1/ (-B / m)) * \ln(1 + \exp^{\alpha}) \quad \textbf{(12)}$$

This completes the description of the open ended and closed ended contingent valuation approaches. Additional detail on problems in eliciting CVM responses and issues in construction and testing of a CVM survey can be found in Appendix A.

Section 3: Data Collection and Survey Results

3.1 Data Collection

The data collection for welfare estimates were obtained from a mail survey conducted by the University of Alberta and The Canadian Forest Service in the winter of 1992-93. The questionnaire was composed of 3 sections. The first section contained questions concerning attitudes and opinions towards wildlife and more specifically, woodland caribou. Also included in this section were questions eliciting information about participation in wildlife and outdoor related activities. These questions were asked so that the importance of wildlife to the respondents could be determined. The second section was composed of several CV questions, which are described in the following section. The final section elicited demographic information from the respondents. The size of household, income, age, and other attributes could be important in predicting the value respondents have for woodland caribou. A final version of the questionnaire can be found in Appendix C.

3.2 The Contingent Valuation Questions

There were 9 versions of the questionnaire. These versions can be divided into two groups: Discrete Choice Willingness to Pay questions (DC WTP) questions (versions 1 through 4 and 9) and Open Ended Willingness to Pay questions (OE WTP) questions (versions 5 through 8). These two types of questions were used so that a comparative validity analysis could be done. Research by Loomis (1990) found that OE WTP and DC WTP estimates were not significantly different. However, in an earlier paper, Seller *et al*. (1985) found that OE WTP measures were significantly

lower than DC WTP measures. Research by Kristrom (1993) found results similar to Seller *et al*. (1985). The zero bids and non-responses were also found to be higher for the OE WTP format. In this CVM study an analysis was conducted to determine how OE WTP and DC WTP measures compare.

Further questionnaire versions (within the DC and OE WTP format) were designed in order to measure the impacts and the influences of the whole-part and ordering effects. Two WTP questions dealing with a woodland caribou maintenance program were designed. One question dealt with a Canadian program and a second question pertained to a Saskatchewan program. Table 3.1 shows how the presentation of the WTP questions varied in the 9 versions of the questionnaire. Versions 1, 2, 5 and 6 were composed of two-tiered questions. In versions 1 and 5 a question about the Canadian population of caribou was asked first, followed by a Saskatchewan caribou WTP question. In versions 2 and 6 the question order was reversed. A Canadian WTP question was the single question presented in versions 3 and 7 and the Saskatchewan question was presented alone in versions 4, 8 and 9. Within the versions containing two-tiered questions the respondent was informed on the final question that s/he may change their initial values if desired.

Table 3.1: Question Position

	DC WTP					OE WTP			
Version	1	2	3	4	9	5	6	7	8
Canada	2	1	*			2	1	*	
Saskatchewan	1	2		*	*	1	2		*

Note: 1 indicates question appeared first; 2, question was second; *, question presented alone.

Using guidelines set out by Smith (1992), Harrison (1992) and Boyle (1989) the following attributes were incorporated into the WTP question. First a brief description of the good and associated tradeoffs were provided prior to the WTP question. Within the question, a base population number was given as was the expected gain contingent on the maintenance program's implementation. A map of the Canadian distribution of woodland caribou was provided with the Saskatchewan program so that respondents were aware of the inclusiveness of the provincial question and that substitute populations of caribou existed elsewhere in Canada. The duration of

payments and the payment vehicle were also provided. All WTP questions used similar wording. Below is an example of the DC WTP question.

Suppose you have a choice between two options, given below. The action described will be carried out for the option that receives the majority of votes

Option A, Have No Maintenance Program to preserve Woodland Caribou. Local populations will disappear within 10 years of logging activities due to increased hunting from people and wolves, habitat loss and animals leaving the area. The end result is that Woodland Caribou populations will decrease to 1,800 in Northwestern Saskatchewan by the year 2002.

Option B, Have every household in Saskatchewan pay $_____ per year for the next ten years into a trust fund to be spent on a Caribou Maintenance Program. This maintenance program will be run by an independent foundation and will maintain the current range and numbers of approximately 3,600 Woodland Caribou within Northwestern Saskatchewan.

Given the opportunity to vote for Option A or B which one would you choose?

___ Option A ____ Option B

In version 9 the vehicle payment mechanism was changed from payment to an independently run private foundation to increased wood product expenditures[8]. This was done so that the influences of vehicle payment could be analyzed. The conciseness of the question format was expected to mitigate many of the problems, discussed earlier, associated with CVM (eg. hypothetical and information biases). For additional information on the survey and a discussion of descriptive statistics, see Tanguay *et al.* (1993).

To determine the bid range for the DC WTP questions, empirical results from several other studies which estimated the existence value of other species were used. In a study by Samples *et al*. (1986) the mean values for humpback whales was between 40 and 60 dollars. In another study the mean value for bald eagles was estimated at $28.25 (Stevens *et al*., 1991). From this information it was decided that the DC WTP bids would range from $1 to $100. Values used in the questionnaire were selected at random from a uniform distribution within this range.

For the purpose of the survey, two samples, one provincial and one from the northwestern

[8] The respondent was informed of average annual expenditures a Saskatchewan resident spends on paper products. The respondent was then told that paper product expenditures would increase by a given amount of dollars per year if a caribou maintenance program was implemented. The respondents could accept or refuse the increase in expenditures.

region of Saskatchewan were required. The regional sample was considered a critical area since any change due to the forestry development would directly effect the economy of this region. The two samples were tested to examine if regional verse provincial perspectives influenced respondents valuation of the caribou maintenance program. To obtain a representative cross section of the sample regions two sample intensities were used. A 0.75% provincial sample and a 7.5% regional sample was determined to meet the needs of the analysis.

Names and mailing addresses were purchased from Targetwest Marketing of Saskatoon, Saskatchewan. These addresses were randomly generated from telephone listings provided by Saskatchewan Telephones.

3.3 Response Rates

Table 3.2 summarizes the response rates for the completed returns for the Saskatchewan and Northwestern samples. The total mail out for the Saskatchewan sample was 2 774 (309 per questionnaire version) and the Northwestern was 1 472 (164 per questionnaire version). The questionnaire's covering letters, and reminder card were designed using guidelines set out by Dillman (1978) to maximize response rates. The total completed returns for the Saskatchewan sample were 1 374, another 113 surveys were returned unopened (eg. respondent may have died or moved). The completed returns represent a response rate of 51.6%. For the Northwestern region, 680 completed (50.4% response rate) and 123 unopened questionnaires were returned. These response rates are considered good for a general household survey. Both unopened return rates were below 10%.

The first and third mailings were examined for any response bias using the demographic variables and none was found.

Table 3.2: Sample Size, Response and Response Rates

Mailed	Number Sent	Number Returned Unopened	Percent Returned Unopened	Effective Sample Size	Number Completed	Percent of Effective Completed
Sask. Region	2 774	113	4.0	2 661	1 374	51.6
N.W. Region	1 472	123	8.4	1 349	680	50.4
Total	4 246	236	5.6	4 010	2 054	51.22

3.4 Data Entry

All responses entered were verified. The final data set was segregated into OE WTP and DC WTP subsets, which had 908 and 1 074 observations, respectively. Because of the large number of versions within the questionnaire design, cleaning of the data for missing values was done on a per variable basis during the analysis so that the largest possible number of observations could be maintained.

3.5 Data Segmentation

The raw data set contained 48 potential variables for model formulation. From these 48 variables only variables that were considered relevant[9] to the analysis were used. Since two types of models were to be developed, the data set was divided into two groups. For the DC WTP models a total of 38 variables were identified for inclusion into the analysis. The OE WTP models used 36 of the 48 variables. As recommended by Train (1979) to avoid the process of "data mining" only variables that were thought to be relevant in revealing individual preferences were considered.

The data described in this section were used in this study to conduct analyses which are discussed section 4 and in Appendix B. Section 4 contains a discussion of the mean values from the DC and OE surveys and a discussion of the aggregation of the welfare measures. Appendix B examines the issues of whole-part and sequencing effects across the various CVM questions.

Section 4: Results and Discussion

4.1 Results

The results of the contingent valuation experiments are discussed below. The discussion in this section is limited to the presentation of the aggregate WTP values for the open-ended and discrete choice approaches to valuation. Issues of whole-part effects and the estimation of bid functions (functions explaining variation in bid values) are discussed in Appendix B.

4.2 Welfare Measures from Aggregated Open Ended and Dichotomous Choice Willingness to Pay Models

Welfare measures from the aggregated OE WTP were calculated and are presented in Table

[9] Since the questionnaire was designed to collected data for both the different CVM formats some of the variables were only relevant for one of the models and not the other.

4.1. The mean WTP for the Saskatchewan program (Caribou conservation program in Saskatchewan only) is higher than the value for the Canada program (conservation at a national level). The total welfare measures (accruing to the people of Saskatchewan) for the Canadian and Saskatchewan caribou program are calculated by multiplying the mean values by the population of Saskatchewan

Table 4.1: Aggregated means and Total Welfare Measures for OE WTP

	Canada	Saskatchewan
Average Mean	12.90	14.66
Saskatchewan Total Welfare Measure	9 127 653	10 372 976

which is 18 years or older[10]. The 1991 Canada census estimated the population of citizens 18 years and older for Saskatchewan, at 707 570. The benefits identified for the Canada and Saskatchewan programs for the OE WTP CV questions were approximately 9.1 and 10.4 million, respectively.

The DC WTP welfare measures were calculated using the median and mean values given in Table 4.2. Since these values represent **household** values they were divided by 3.2[11] so that values represent individual measures (Table 4.3). Total number of Saskatchewan residents were used in this calculation since the question valuation represented households. Households would included all individuals residing within the household regardless of age, consequently total population values can be used.

[10] This portion of the population was used since the questionnaire was limited to respondents who were 18 years and over. Inclusion of individuals less than this threshold age would lead to an over estimation of the total benefits.

[11] This value represents the average number of individuals per household in Saskatchewan as identified by Statistics Canada (1991).

Table 4.2: Household Mean and Median values for the DC WTP Models

	Canada	Saskatchewan
Median	73.97	80.84
Mean	90.98	97.99
Mean (Monte Carlo)	91.62	101.54
Variance	190.99	284.77

Table 4.3: Individual Mean and Median values for the DC WTP Models

	Canada	Saskatchewan
Median	23.11	25.26
Mean	28.43	30.62
Mean (Monte Carlo)	28.63	31.73

Table 4.4 contains the total welfare measure estimates for the people of Saskatchewan gained from the implementation of a caribou maintenance program.

Table 4.4: Total Welfare Measures For The DC WTP Models

Value Used	Canada	Saskatchewan
Median	22 854 126	24 980 321
Mean	28 313 009	30 280 975

Although value estimates for the OE and DC were positive indicating that there is a positive value for the described caribou program, the DC WTP estimates are approximately 2.0 to 3.0 times greater than the OE WTP welfare measures. This disparity is similar in magnitude and direction to the results found by Kealy and Turner (1993) of 2.5 times between the two measures. Kealy and Turner suggest the disparity could be caused by several factors including the potential for strategic

behaviour in the open ended format, the ability and willingness of respondents to formulate their preferences and the differences in question formats.

4.3 Capitalized Values of WTP Estimates for Aggregated Dichotomous Choice and Open Ended Models

The capitalized values of the welfare measures were examined. The capitalization formula for a fixed term annual payment (Gunter and Haney, 1984) is:

$$PV = a\left[\frac{(1+i)^n - 1}{i(1+i)^n}\right] \qquad \textbf{(13)}$$

where: PV = Present value, a = Annual Payment, I = Discount Rate, n = Periods.
Two discount rates, 3% and 5%, were used to estimate the capitalized welfare measures. The WTP questions elicited payments for a 10 year period (**n**) and **a** represents the annual median or mean values as required.

The capitalized values represent the present value of a caribou maintenance program. The calculations assume that the annual values will remain constant over the ten year period. Since these values would be used in a Benefit Cost analysis Johansson *et al*. (1989) suggest that the means are the appropriate values to include. The results of the calculation are presented in Table 4.5.

Table 4.5: Capitalized Benefits for Aggregated Individual Welfare Measures

	Canada		Saskatchewan	
	Discount Rates (%)			
	3	5	3	5
Mean (OE WTP)	77 860 731	70 481 317	88 483 589	80 097 371
Mean (DC WTP)	241 515 000	218 625 000	258 302 000	233 821 000
Median (DC WTP)	194 950 000	176 473 000	213 087 000	192 891 000

One difficulty with incorporating these values into a Benefit Cost analysis is the disparity between the OE and DC WTP mean values. A t-test was performed on the dichotomous choice and the open ended mean values to determine if they were significantly different. The null hypothesis that

the means were not significantly different was rejected at a 99% level and that the mean values are significantly different between the question formats. At present there is no economic theory which suggests which is the correct mean to incorporate into the analysis.

Despite the disparity between values generated by both approaches the values for both types of questions are positive. Consequently, non-implementation of the caribou program could cause society to forgo between 70 and 258 million dollars in benefits. From a policy perspective these values are quite large. This indicates that the citizens of Saskatchewan place a high value on the caribou maintenance program. Consequently, any provincial forest management program that did not attempt to maintain caribou numbers in Saskatchewan would result in a large loss to the people of Saskatchewan[12].

Section 5: Conclusions, Implications and Further Research

This study was conducted to determine the value of a woodland caribou maintenance program to the citizens of Saskatchewan. To meet these objectives 9 versions of a contingent valuation survey were developed. Of these 9 versions, 4 contained open ended willingness to pay CV questions and 5 were composed of dichotomous choice CV questions. The estimated values from these two CV formats were determined and compared.

5.1 Welfare Measures

Two types of contingent valuation questions, Open Ended (OE) and Dichotomous Choice (DC), were used to estimate willingness to pay values. The results from this study produced mean value estimates for the Saskatchewan caribou maintenance program of between $14 and $30[13] per individual for the OE and DC WTP methods, respectively. These figures represent what a resident of Saskatchewan would be willing to pay annually for ten years to implement a woodland caribou maintenance project. The values for the OE questions were found to be consistent and robust across

[12] These positive values represent a gross benefit measure. If the cost of the maintenance program are greater than the benefits the net value would be negative and the loss to society would be associated with the implementation of the caribou program.

[13] The estimated values for the Canadian caribou maintenance program for the OE and DC questions were $12 to $29, respectively.

the different survey formats. The values derived from the DC questions displayed a high degree of variability between the different question presentation formats. This variation in willingness to pay values was attributed to the ordering and whole-part effects and inherent weaknesses within contingent valuation methods.

The range of estimated values for both formats were similar to values estimated in other existence value studies (Samples *et al*. 1986; Stevens *et al*., 1991). The individual values for this program on an annual basis may not seem very large, but these values, aggregated for the province of Saskatchewan and discounted at a 5% interest rate equate, to a welfare gain of between 70 to 233 million dollars for the Saskatchewan caribou program. Clearly, the people of Saskatchewan have indicated a substantial value on the existence and maintenance of caribou within the province. This value can be attributed to the guarantee of maintaining the present caribou population within the Northwest region of Saskatchewan. If the residents of Saskatchewan were told that there was a probability that the caribou could disappear even with the incorporation of the maintenance program the WTP values would be lower.

5.2 Implications

In many analyses of this type, benefits are readily estimated with little consideration given for the involved costs in achieving these benefits. One type of cost for such a program is the opportunity cost related to the impact this program would have on the forest industry. Woodland caribou require large tracts of old growth forest to ensure their survival. If these tracts of land are removed from a timber firm's harvestable landbase the firm could expect a decrease in its allowable cut. If we assume that the timber resources are fully committed then the foregone timber volumes would be the opportunity cost of the program which would be carried by the firm. Associated with the loss of volume to the firm there is the cost to governments. These costs would include foregone stumpage revenues and possibly increase protection charges. For example, if the area surrounding the reserve is being harvested, increased fire protection may be required within the reserve area to maintain the age structure required by the caribou. This would be an additional cost to society. During extremely dry years, which has been the case recently in Northwestern Saskatchewan, the cost of fire control could be very high.

In addition to opportunity costs to the firms and governments, there are also other foregone

values which must be estimated. A study on the value of moose and deer hunting in the Northwest region was conducted at the same time as this study (Morton, 1993). The hunting study's results have found large benefits are derived from harvesting due to the increase populations of early forest successional game species like moose and deer from improved habitat. If large tracts of land are excluded from harvesting then the opportunity costs borne by the hunters of Saskatchewan must be estimated and included in the analysis. Other regional opportunity costs must also be analyzed if an optimal solution is to be determined. For example, the indigenous people of the Northwest region rely on plentiful game for subsistence, do they prefer moose or caribou as a food source?

All of the opportunity costs discussed thus far have concentrated on the impacts of a regional program, if the Canadian program was implemented the impacts could possibly be felt globally. Canada is a major exporter of wood products to the world. If this supply is reduced due to landbase withdrawals new sources of supply may be sought from other countries. In a recent paper by Sedjo (1993) the opportunity cost of maintaining bio-diversity are discussed within a global context. If the North American timber supply is decreased due to landbase removals for maintaining bio-diversity and timber demand is inelastic, prices will rise and attract supply from new areas. If the new supply is of timber is derived from a rainforest region it is possible that the gains from maintaining national bio-diversity will be affected by the loss of bio-diversity in another country.

The challenge to the resource economist is to be able to identify and accurately measure the gains and losses that are applicable for the task at hand. This challenge cannot be met alone, it will require the assistance of other professionals and experts to aid the economist as to what is or is not relevant to the analysis. Only once the objectives and elements of the analysis are identified can the economist realistically meet his/her goal of determining an optimal solution.

5.3 Future Research

This study has identified several areas where future research should be pursued. In the DC WTP format the use of increased expenditures as a payment vehicle was used in one version of the questionnaire. Increased expenditures was considered a realistic consequence of restricted forest harvest due to the implementation of a caribou maintenance program. It was believed that the respondent's evaluation of a caribou maintenance program would be more concise using increased expenditures. This may have been the case, however it was found that bid values remained

insignificant in determining the probability of a respondent accepting or refusing the bid offered. Additional research should be undertaken to determine how applicable increased expenditures are in a DC WTP format and how respondents are motivated in their decision process when faced with this type of payment vehicle.

The whole-part effect and the ordering effect were both determined to be present in this research project within the dichotomous choice format. Many of the guidelines set out by Smith (1992) and Harrison (1992) to mitigate the impact of these two effects were incorporated into the questionnaire design. Even with the addition of these mitigating features the two effects were persistent in the dichotomous format. Additional research is therefore required in the area of questionnaire design and Contingent Valuation question presentation to develop methods which remove these two effects in the dichotomous format.

In closing, this study estimated the value of woodland caribou to the citizens of Saskatchewan using a contingent valuation method. Non-market value estimation techniques, like the one used in this study, are increasing in importance because of society's insistence that non-market goods' values be included in natural resource project evaluations and damage assessments. In conjunction with the value estimates for woodland caribou this study investigated the ordering and whole-part effects; these effects can influence the magnitude of the value estimates. Evidence for the presence of these effects was found in the dichotomous choice experiments. Although this means that values may have been influenced by these effects it does not mean the values are unusable. It is important to remember that contingent valuation methods are a tool to be used by resource managers and values identified are not absolutes. The information provides the decision maker with a better understanding of the potential trade-offs which may occur under different scenarios. The trade-off between environmental quality and economic development has grown in importance as society re-adjusts its value system. Consequently methods that can provide additional information in the decision making process deserve due consideration.

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Appendix A - An Overview of the Contingent Valuation Method

Open Ended Versus Dichotomous Choice Methods

There are two formats for asking contingent valuation questions. The first is called the open ended method. This involves simply asking an individual what they would be willing to pay for a level of provision of some public good. The closed ended or dichotomous choices approach involves providing a specific value for an individual and simply asking them if they would be willing to pay this much. The respondent provides one of two possible responses, a "yes" or a "no"; hence the term dichotomous choice. The challenge in the design of the closed ended method is to provide a valid distribution of values or "bid amounts" to the entire sample of respondents.

Each of the two methods have advantages and disadvantages for estimating willingness to pay. The main advantage in using the open ended method is that values are directly elicited from the respondent. Since no values are presented to the respondent no value inference is provided for the good being valued. Open ended methods are free of the restrictive assumptions concerning distribution of the error terms and the specified utility function (Sellar *et al*., 1986).

The advantages of the dichotomous choice or closed ended methods are: 1) it is less demanding mentally for the respondent to use and consequently the number of non-responses are fewer (Seller *et al*., 1985); 2) the structure of dichotomous choice surveys can be designed so that the impact of strategic behaviour is minimized and the respondent's true preference is revealed; 3) closed ended methods tend to have smaller variances of the estimated values (Boyle, 1989); and 4) closed ended models are structured so as to mimic a true market situation and the respondent behaves as a price taker. It is for the above reasons that DC WTP models are generally preferred by CVM researchers.

A major issue, however, is the comparability of values derived from the two CV methodological frameworks. Most studies which compare the two methods find that the dichotomous choice method yields larger estimates of willingness to pay than the open ended method. The reasons for this difference are still topics for debate. Some suggest that the open ended format actually underestimates values while the other method overestimates them. Brown *et al*. (1994) provide an overview of the comparative studies and conduct their own empirical analysis of the issue.

We use both methods in this study and provide a brief comparison of the resulting values in this report.

Mean versus Median Willingness to Pay Measures

There has been some debate over which welfare measure is appropriate. Hanemann (1989) believes that the median value is the correct one for the following reasons: 1) the mean is sensitive to parameter changes; and 2) the median is more robust, and for a probability function better reflects the value of the majority.

On the second point, Hanemann (1989) gives the following example. If 1000 respondents were questioned and 999 gave $1 and one individual gave $1000, the mean would be $1.98. If this value was used there would be 999 disenfranchised individuals. However, Johansson *et al*. (1989) believe that the mean value should be used to determine the appropriate welfare measure. The reason cited is that the median value does not produce a Pareto-efficient outcome since the voter expects more or less public expenditure than is consistent with Pareto efficiency. In cost/benefit analysis the total costs and total benefits are required. Thus, the mean value is the appropriate measure. Since total costs are compared to total benefits, the mean WTP measure multiplied by the number of individuals would be the relevant measure of total benefits. However, in cases where the dichotomous choice values are used in a true referendum, the median value would be the correct measure. In situations where total value estimates are required (eg. cost/benefit analysis) the mean values are appropriate. To use the median value would underestimate the true value of the provision of the public good to society.

In this study, for the referendum format of the WTP choice question, both the median and mean welfare measures are presented. For the open ended format only the mean values are presented. In comparing the results between the open and closed ended methods the mean values are used as the basis for comparison.

Problems Associated with the Contingent Valuation Method

Contingent valuation (CVM) studies usually involve asking samples of individuals hypothetical and often complex questions through in-person interviews or the administration of mail or telephone surveys. Thus both the administration of CVM questions and the way the questions are asked may

cause problems. On the one hand a respondent faces considerable "response burden" if the questions are too complex and involve considerable time and effort to answer. In addition, from the perspective of the researcher high costs associated with administering CVM questions, particularly complex ones, can be a constraint. The conflicts involved in keeping costs down and considering response burden produces the potential for information errors due to the complexity of many policy issues, the large amounts of information that must be conveyed, and the levels of understanding of the provided information to the respondent. These information errors may introduce errors in the valuation of the public good. Although CVM's are gaining favour with researchers, several additional potential problems have been identified. These problems can be categorized as potential "biases"[14], strategic behaviour, and the embedding effect. The potential biases identified in the literature are: the composition of the sample, the payment vehicle, levels of information, the "hypotheticalness" of many valuation scenarios, and starting point bias. All of these biases can potentially influence a respondent's willingness to pay for provision of a public good and may thus impair the final results of the analysis. These factors are discussed in below, and one of them - the embedding effect - is described in detail and was specifically examined in this study of Saskatchewan woodland caribou.

Sample Bias

Sampling bias is a problem common to all surveys and questionnaires. It refers to the potential for the sample used in a study to not reflect the true population of concern. It is possible, however, to remove this bias with proper research design and management (Hoehn and Randall, 1987). To the best of our ability these designs and procedures were incorporated into this study.

Starting Point Bias

Starting point bias is a problem of the iterative bidding method commonly used in personal interviews. This bidding method involves providing respondents with a value which they are asked they would be willing to pay. Following their response additional values are provided until the individual's maximum willingness to pay is provided. The bias is a consequence of using a constant starting point bid and the direction of incremental changes used to arrive at a final value. For

[14] These "biases" , as described in the literature, are not all true biases because there is no "true" value. The WTP values estimated in CV questions are sensitive to these issues.

example, if the method used starts with a constant low amount and the incremental changes in the bids work upwards, the final WTP value will be biased downwards (Walsh, 1986). The bias will be reversed if bids start high and work downwards. Walsh (1986) suggests procedures for removing this bias in iterative bidding CVM studies.

Vehicle Bias

The mechanism of payment (i.e. taxes, permits, donations), or the "payment vehicle" can influence a respondent's final WTP. The mean bids and/or number of protest bids have been shown to vary significantly with the type of payment vehicle used (Cummings, *et al*., 1988). One reason is that substitute possibilities may differ with the payment vehicle used. If the payment vehicle allows for substitution over a wide range of commodity purchases the WTP will be higher (Cummings, *et al*., 1988). For example, if the payment vehicle used can allocate funds to a number of causes with similar attributes as opposed to just one cause, the WTP amount will be higher.

In this study a number of payment vehicles were used in an attempt to remove or at least understand possible payment vehicle bias. Some researchers (e.g. Walsh 1986) suggest pretests with several different likely payment vehicles and then testing for statistical differences. Questioning respondents about the acceptability of the various payment vehicles is also suggested. The influence of the payment vehicle is reduced if the vehicle seems appropriate to the respondent.

Hypothetical Bias

Because CVM uses a hypothetical market situation, the method can be biased by its own design. Hypothetical bias is due to the weak penalties (no true payment) for inaccurate information (Randall and Hoehn, 1983). The respondent may not take the valuation process seriously and therefore may not convey a true value for the described good. To mitigate the effects of this lack of realism it is important that the researcher provide a realistic market situation to the respondent (Mitchell and Carson, 1989).

Information Bias

Information bias can occur during the respondent's value formulation stage. It has been found that the levels and type of information provided will influence WTP amounts. In a study by Bergstrom *et al*. (1990), it was found that as the information concerning wetland preservation increased, so did the WTP amounts. The authors did not feel this was a problem as the information

provided accuracy and completeness in defining the commodity being valued. When using CVM it is important that the respondents can make a well informed value decision. Several studies have found that small incremental changes in information have little influence on WTP amounts, while large incremental changes can have a significant effect on WTP (Hanley and Munro, 1991; Samples *et al*. 1986; Boyle, 1989). Hanley and Munro (1991) observed that information also displayed diminishing marginal returns in relation to bid values. Information may also change a respondent's marginal utility for a given commodity. In a study done by Samples *et al*. (1986) there was some evidence that the marginal utility of the respondents did change with the amount of information provided. In the same study it was suggested that respondents may refuse the market situation when inadequate information is provided. Without adequately describing the opportunity cost and pay-offs, the WTP values may be under estimated (Samples *et al*. 1986).

In addition the information provided must not be biased or inaccurate. It is therefore important that the information be checked for such biases and inaccuracies (Samples *et al*. 1986).

Strategic Behaviour

It has been suggested that optimizing individuals could pursue policies of extreme misstatement, or in other words respond to CVM questions strategically rather than responding to them as market questions. Such individuals may grossly over/under estimate WTP values depending on the strategies employed for the given situation (Hoehn and Randall, 1987). For example, if individuals are prone to "free riding" they may understate WTP if they assume others will pay for a service that they want to use (Walsh, 1986). The process of strategic behaviour occurs during the value statement stage where the respondent's revealed WTP is not equal to their true WTP value. Little evidence of strategic behaviour has been found in studies to date (e.g. Milon, 1989; Hoehn and Randall, 1987; Walsh, 1986).

The Embedding Effect

The embedding effect, coined by Kahneman and Knetsch (1992), encompasses the ordering effect, whole-part effect and the purchase of moral satisfaction. The ordering effect refers to the order in which a CV question is presented within a series of CV questions. The ordering effect suggests that the fewer the questions or the higher the position of the question within a series of questions the greater the value it will be assigned. The whole-part effect describes inappropriate

valuation of a subset of goods when compared to the associated complete set of goods.

We specifically examined the ordering and whole-part effects in this study through a series of different questionnaire designs. We asked Saskatchewan respondents to value caribou conservation efforts in their province and nationally. Different portions of the sample received these questions in different orders, and some only received questions dealing with Saskatchewan programs. A summary of these different valuation frameworks are shown below:

Question Order	Design 1	Design 2	Design 3
First Valuation Question	Saskatchewan Program	Canada Program	Saskatchewan Program
Second Valuation Question	Canada Program	Saskatchewan Program	None

If an ordering effect is present, then the value stated for the caribou program will be different depending on the position of the question within the series of questions. For example, in Design 1 the Saskatchewan program would receive a higher value than the same program in Design 2 because it appears first in the two CV questions. To examine the whole-part effect, we assumed that the Canadian caribou program represents the "complete set" of goods, while the Saskatchewan program represents the subset within the complete set. In Design 2 the Canadian program was offered first to the respondent followed by the provincial program. The questions were structured so that the respondent would value each program independently. In Design 3 just the provincial program was offered to the respondents for valuation. According to Kahneman and Knetsch (1992) the provincial programs in the two designs should be valued equally by respondents since they are the same programs. On the other hand, the Canadian program should be of equal or higher value since it is a more inclusive good. Evidence of the whole-part effect would exist in our study if the valuation for the Canadian program in Design 2 and the provincial program in Design 3 are not statistically different, and the value of the provincial program in Design 2 is statistically lower than the same program in Design 3.

Two issues are raised by the whole-part and ordering effects. First, embedding provides an opportunity to manipulate a good's value by placing deliberately structured questions into the survey

design. Second, if a number of values are estimated using different survey structures, as in this study, which value is the correct one? Economic theory cannot account for these phenomena and these effects in CVM studies have not been intensively examined. We hope to examine these issues with Canadian data in order to add to the growing body of studies identifying potential embedding effects.

The purchase of "Moral Satisfaction" is another potential problem identified by Kahneman and Knetsch (1992). This phenomenon suggests that the good being valued is not really the good described in the CV question, but rather a good embedded within it. This embedded good is described as the satisfaction in giving to a good cause. Smith (1992) and Harrison (1992) have argued that moral satisfaction is just another name for utility and that respondents are simply maximizing their utility by paying for some change in environmental quality. At present there is still considerable debate on this issue.

Willingness to Pay (WTP) Versus Willingness to Accept (WTA)

Another problem identified in the CV literature is the difference between WTP and WTA. Economic theory suggests that WTP and WTA values should be similar (Hoehn and Randall, 1987; Knetsch, 1990). However, there is a growing body of empirical evidence that suggest this assumption is incorrect (Randall and Hoehn, 1983; Knetsch, 1990). The empirical results from numerous studies have shown a difference of between 3 to 5 times for WTA over WTP values (Adamowicz *et al*., 1993; Knetsch, 1990). Several reasons for this disparity have been proposed: income effects, substitution effects, and psychological effects.

The income effect suggests WTP amounts are constrained by the respondents income, while WTA amounts are not. In the case of high valued goods this may be a relevant explanation. However, in a study by Knetsch (1990), he provided empirical evidence that when participants traded non-income constrained inexpensive private goods the disparity still existed.

The availability of substitutes for a good has been suggested as a reason for this disparity. The substitution effect theory states that the lack of available substitutes for the commodity being valued causes the disparity. If there are a large number of perfect substitutes for the good being valued then WTA should equal WTP. If no substitutes exist then WTA should be greater than WTP (Hanemann, 1989). Adamowicz *et al*. (1993) found if a suitable substitute is available the WTA measure will decrease and converge towards the WTP measure. However a disparity between WTP

and WTA persisted.

Several psychological effects have also been put forth to explain this disparity. One such effect is the endowment effect. Knetsch (1990) conducted experiments which suggested that individuals measure losses and gains from a neutral reference point and that losses have a greater impact on the individual than gains. What this suggests, is that the individual's value function is not smooth but "kinked" at this reference point. Because of this evidence, Knetsch (1990) suggests that when individuals are experiencing an increase in some commodity, WTP should be used as the welfare measure. If the individual is expecting a decrease in a commodity, then WTA would be the appropriate measure.

Appendix B - Results from the Contingent Valuation Models

Results of the Open Ended Willingness to Pay Responses

A first step in the analysis involved a comparison of the mean WTP between the two sample frames: the northwestern Saskatchewan sample and the province-wide sample. Mean values were calculated for each sample and compared using *t*-tests to determine if the mean values were significantly different between the Canada and Saskatchewan program questions within each sample type. The null hypothesis is $WTP_{ij} = WTP_{kj}$, where i,k represents regions 1 (Northwestern sample) and 2 (Provincial sample); and $i \neq k$. The subscript j represents question order, 1st, 2nd, and alone (0). The null hypothesis could not be rejected at the 99% level. Therefore the mean values across regional samples were not significantly different. Consequently, all further discussion will deal with data not segregated by regional sample frames.

Analysis of the values provided by respondents in the open ended questions involved pooling the results across respondents and calculating mean values. Note that the mean values have to be calculated separately for the provincial and the national level programs. These means and standard deviations are shown in Table B-1 below. All value amounts of over $1000 were identified and removed from the analysis since we felt they represented unrealistically high valuations for the programs; in essence "outliers".[15] This procedure removed only a small number of observations from each of the questionnaire designs. It is noteworthy that all of the values that were removed were over $10,000. All calculated mean estimates were found to be in the $10 to $20 range. The standard deviations were found to be approximately 2.5 times the value of their means.

[15] Outliers are an artifact of the open ended method because the distribution of potential values provided by respondents is unbounded at the upper end. Outliers can significantly distort benefit estimates. Some extreme values (those that exceed respondents income) can be easily identified and eliminated. However, values that appear inconsistent with the respondent's other answers for demands for amenities are more difficult to determine (Mitchel and Carson 1989).

Table B-1: Mean Values per Person Derived from the Open Ended Willingness to Pay Questions

	Caribou Program for Canada			Caribou Program for Saskatchewan		
	Question Order			Question Order		
	By Itself	First in a Series	Second in a Series	By Itself	First In a Series	Second in a Series
Mean	10.86	11.24	17.73	11.75	20.53	12.58
SD	25.61	26.58	46.74	37.34	49.29	26.40
N	272	202	184	228	185	202

Models Explaining the Open Ended Willingness To Pay Responses

Regression analysis was conducted to determine which socioeconomic attributes of respondents influenced their WTP. Models for the Canadian and Saskatchewan programs were estimated for each of the question orders. The distribution of the dependent variable, WTP, was "censored" because values over 1000 were removed from the analysis. To account for this nature of the WTP variable, tobit regression procedures were used. The results of these models are presented in Tables B.2 and B.3 for the Canada and Saskatchewan programs respectively.

Age proved to be the most important attribute in determining an individual's willingness to pay for a caribou maintenance program. The sign on the coefficient was negative for all models (Tables B.2 and B.3). This indicates that the older a respondent is, the less s/he is willing to pay for the caribou maintenance program. Two possible factors may explain this behaviour. First, it is possible that the older generation may not be as aware of environmental issues as the younger generation. Second, work done by Carlen and Muller (1985) indicates that as people age they may not be as willing to pay or take actions that will produce benefits they may not receive. Consequently as people age their time preference may change to the point where they will contribute to future benefits if there is a probable chance they will not benefit from the gains. Younger individuals are more likely to pay more since they may not have realized their own mortality and subsequently their time preference for future benefits will be different than older individuals.

The level of education was a significant variable, at a 95% level, for all models but the Saskatchewan question offered by itself. The sign on the coefficient was positive indicating that the higher the education level of the respondent, the more the individual is willing to pay for a caribou

maintenance program. The reason for this behaviour may be that educated people tend to be well read and more aware of issues that will affect their lives or the lives of others. With the high media profile woodland caribou has received it is not surprising that this group places a higher positive value on the maintenance program.

The other demographic attributes were not consistent across models. For example, it was expected that income would be positively signed and significant but this was not the case for half of the developed models. For the Canadian program question offered second and by itself, and the Saskatchewan question offered first, income was insignificant in predicting willingness to pay responses. In two of these models it had a negative sign. The income coefficient was not robust probably because it was found to be significantly correlated[16] with education. This collinearity may explain the lack of significance of the income variable in these models.

Initially, it was believed that the population distribution between rural and urban residents; and between the Saskatchewan and Northwestern regions would be significant in identifying how much respondents would be willing to pay. The results did not bear this out. In the majority of the models these two factors were insignificant.

In summary, the amount an individual is willing to pay for a caribou maintenance program appears to be affected by two demographic factors. The older the respondent the less s/he is willing to pay for a caribou maintenance program. In most of the models as the education level of the respondent increased the larger the amount the individual is willing to pay for the caribou program. The residence or region an individual lives in appears to have no significant influence on the amount s/he is willing to pay.

The above models were tested to determine if they were significantly different from each other. The null hypothesis assumes that the coefficients for the same variables are not significantly different across regressions (eg. H_0: model 1= model 2). The null hypothesis could not be accepted at a 99% level for any comparison of models. Therefore, the previously described tobit models are significantly different from each other. These results seem to contradict previous *t*-tests which found no significant difference in welfare measures. The reason for this discrepancy is due to the different

[16] A Spearman correlation coefficient (Mason 1982) was calculated between income and education. The results showed a significant amount of correlation between the two variables.

values tested. In the *t*-test the mean WTP values were examined to determine if they are significantly different. These values are not sample population dependent and different populations may value the described programs similarly. However, when testing the tobit models to determine if they are significantly different from each other, the sample populations used for each model can have an impact on the results. The characteristics of the sample populations will influence which variables are significant in determining WTP amounts. It is the different significant variables among the models that has influenced these results. Consequently, the coefficients in the tobit models of the different versions were found to be significantly different. For this reason the individual models for the Canadian and Saskatchewan programs were not merged.

Table B.2: Coefficients and standard errors from Tobit regression analyses where the open ended WTP value for the Canada Caribou Programs was regressed on socioeconomic variables.[1]

Independent variable	Question order		
	Second in a series	First in a series	By itself
Constant	28.153 (60.70)	-20.693 (41.87)	-62.932 (39.47)
Education	7.874 * (3.67)	4.361 * (1.99)	3.594 * (1.85)
Age	-2.054 ** (0.63)	-1.139 ** (0.37)	-0.802 * (0.34)
Rural/Urban	-36.319 * (18.27)	-14.127 (11.28)	3.810 (11.01)
Region	-34.567 * (18.15)	-16.262 (12.55)	2.757 (11.81)
Income	0.128 (3.88)	5.493 ** (2.16)	-1.199 (2.10)
Northwest	5.538 (21.41)	8.231 (11.92)	31.924 * (13.26)
σ	82.893 (7.93)	52.559 (5.24)	58.761 (5.45)

[1] * Significant at a 99% level; ** Significant at a 95% level.

Table B.3: Coefficients and standard errors from Tobit regression analyses where the open ended WTP value for the Saskatchewan Caribou Programs was regressed on socioeconomic variables.[1]

Independent variable	Question order		
	Second in a series	First in a series	By itself
Constant	-34.837 (35.25)	7.355 (60.65)	-12.493 (56.45)
Education	3.912 ** (1.67)	8.020 ** (3.63)	-0.865 (3.218)
Age	-0.917 * (0.31)	-1.792 * (0.62)	-1.421 * (0.55)
Rural/Urban	-16.589 (9.39)	-23.280 (17.99)	37.467 ** (16.89)
Region	-5.814 (10.10)	-19.432 (17.69)	-19.981 (17.50)
Income	5.923 * (1.80)	-2.151 (3.945)	9.350 ** (3.87)
Northwest	14.299 (10.40)	4.158 (21.30)	19.166 (19.31)
σ	45.406 (4.238)	85.192 (7.87)	78.630 (7.85)

[1] * Significant at a 99% level; ** Significant at a 95% level.

Results of the Dichotomous Choice Willingness to Pay Responses

The dichotomous choice CVM WTP models estimated household rather than individual WTP values as in the open ended CVM analysis. This closed ended form of CVM requires the analyst to construct a mathematical function which explains the probability of agreement with paying an amount provided in the question. From this function, welfare measures comparable to those provided from the open ended analysis can be developed. Several specifications and functional forms for the closed ended CVM models were examined. The two linear functional forms described by Hanemann (1984), bid and the log of bid divided by income[17], were estimated. It was determined that for this study the simple linear functional form (bid) was the most acceptable.

An initial model was developed for each dichotomous choice question in the series of questions. A number of independent variables were used to explain the probability of accepting the bid amount. The variable ACTWLD, indicating participation in any outdoor wilderness activities in 1992, was binary and was assigned a value of 1 if the respondents did participate and 0 otherwise. The variable IMP1, which indicated the level of importance of caribou to respondents, was originally ordinal[18] in structure but was transformed into a binary variable where 1 was coded for the categories "important to very important," and 0 for "unimportant to very unimportant".

The results of the logistic regression models are shown in Table B-4. BID was at least significant at a 95% level, with the exception of BID in the Saskatchewan program where it was offered by itself. IMPL1 was significant at the 99% level in all models. The variable ACTWLD was insignificant at a 80% level in all models but the one Saskatchewan model where it was significant at the 99% level.

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[17] Note that "bid" refers to the amount of money that was presented to each respondent in the CV question. The log of (1 - bid) divided by income is approximately equivalent to bid divided by income. This linear form was used in the estimated models. In addition to these linear functional forms a semi-log form was also examined. For the Canada program questions offered first in a series, and separately as well as the Saskatchewan question offered first in a series, the log(bid) value was found to be highly statistically significant. An integration of this functional form was performed and the function did not converge. Consequently, this functional form was deemed unacceptable and was not used in further analysis.

[18] The variable Imp1 was structured on a scale of 1 to 4. No neutral position was available to the respondents.

Table B.4: Coefficients and standard errors from logistic regression models for the dichotomous choice WTP Models.[1]

Independent Variable	Questionnaire version					
	Canada caribou program			Saskatchewan caribou program		
	Second in a series	First in a series	By itself	Second in a series	First in a series	By itself
CONSTANT	-0.725 (0.611)	-0.319 (0.568)	-0.337 (0.652)	0.296 (0.465)	-0.722 (0.610)	-0.690 (0.544)
BID	-0.015 (0.006)	-0.016 (0.006)	-0.015 (0.006)	-0.021 (0.006)	-0.016 (0.007)	-0.007 (0.005)
IMP1	1.869 (0.606)	1.733 (0.505)	1.873 (0.613)	1.394 (0.469)	1.678 (0.577)	1.826 (0.509)
ACTWLD					0.903 (0.372)	
N	149	171	174	169	147	176
McFadden's R^2	0.083	0.098	0.077	0.096	0.129	0.089

[1] The constant was statistically insignificant in all models, BID in column 7 was significant at a 80% level, all other variables shown were significant at least to a 95% level.

The Saskatchewan question in version 9 which used increased expenditures as a payment vehicle produced unusable results. Several specifications and functional forms were attempted, but the bid variable remained highly insignificant. Consequently, no further analysis was performed on this version and no results will be presented[19].

The welfare measures were calculated using the means of the "other" variables[20] and coefficients from these initial models as described in section two. These initial coefficients were

[19] It is possible that the respondents interpreted this question differently then the other questions. Over 90% of respondents accepted the Bid presented. Because this question used increased expenditures as a payment vehicle it was phrased slightly different then the other CV questions. It is possible that the respondents thought they were purchasing more than the caribou maintenance program described.

[20] The term "other" variables references all independent variables, other than BID, that were found to be significant. The means of these variables are used in the calculation of the median and mean willingness to pay values as described by Cooper and Loomis (1992).

incorporated into a Monte Carlo simulation[21] and the variances for the WTP measures were generated assuming asymptotic normality for the parameters. Two Monte Carlo simulations were run for each model. The first set of simulations incorporated the mean values of the independent variable from the individual models. The second set of simulations used "representative" values for the independent variable to mitigate the influences from the different sub-sample populations in the WTP measures and the variance calculations. The initial variances for the dichotomous choice WTP values were high. The Monte Carlo results contained some extreme outliers in the negative and positive value range. Since WTP values must be positive all negative values were discarded. Adamowicz *et al*. (1989) point out that if the coefficients on the price term approach zero it is possible for welfare measures to be infinite. The potential for large variances is possible if the demand parameter has a low *t*-statistic. Therefore, if the WTP value was greater than 1000 it was removed from the observation set[22]. We selected the 1000 value for the same reasons stated in the open ended WTP analysis. Values that were greater than 1000 were considered to be too large of a percentage of the respondents average household income to pay for the described good.

The welfare results are presented in Table B-5. The analysis suggests that household WTP values are similar among the Canadian and Saskatchewan programs. With the exception of version S0 (the version where the Saskatchewan program was offered alone), the median values are similar ranging from $62 to $93 with the most in the $70 range. The mean values generated from the individual regressions show less variation (with the exception of S0) with the majority of the values being in the $80 to $90 range. The mean values generated by the Monte Carlo analysis produced the highest values with the greatest variation, excluding version S0, the mean values ranged from $84 to over a $125. The high variance for the Monte Carlo analysis could be due to the demand parameter having a low *t*-statistic as discussed previously. The median value for S0 was over $125 and the

[21] Monte Carlo simulations use the variance/covariance matrix and the coefficients from the initial models to generate a "new" data set. This set is then used to re-estimate the coefficients. This procedure is repeated 1000 times. For a general overview of a Monte Carlo simulation see Kennedy (1985)and for a mathematical interpretation see Judge et al. (1989).

[22] The extreme upper and lower outliers were discarded and not set to some minimum or maximum value so that the integrity of a normal distribution could be maintained.

mean value generated by the Monte Carlo analysis was over $218. Version S0 showed the greatest differences in the value estimates. Its mean and median values were consistently higher than the other versions and also showed the largest disparities between its median and mean values. In version S0 the linear functional form used produced an extremely low *t*-statistic on the demand parameter. This low *t*-statistic may be the reason for the high value estimates and large variances within this version.

Table B-5: Means and median WTP for the caribou conservation programs derived from the dichotomous choice CVM models for Saskatchewan residents

Welfare measure ($ per household)	Questionnaire version					
	C2	C1	C0	S1	S2	S0
Median WTP	62.15	71.13	92.99	75.55	70.32	125.94
Mean WTP	85.44	88.13	108.53	91.26	80.13	173.98
Mean WTP from Monte Carlo Simulation[2]	99.86	100.00	125.28	105.64	84.80	218.86
SD[2]	50.98	42.80	56.03	54.91	18.40	159.91
Mean WTP from Monte Carlo Simulation[3]	98.94	101.54	119.98	105.64	85.84	217.61
SD[3]	50.54	43.46	53.51	54.91	18.84	158.90
N	996	999	996	990	1000	868

[1] C represents the Canadian caribou program question while S represents the Saskatchewan caribou program. The numbers following the letters represent question order where 1 is first in a series, 2 is second in a series, and 0 is where the question is presented alone.

[2] indicates that the Monte Carlo simulation incorporated the mean values for the independent variables from the sub-samples.

[3] indicates that a "representative" value for the independent variables were used.

Aggregate WTP models were constructed by combining the data for each of the two caribou programs regardless of question order. The results of these are presented in Tables B-6 and B-7. As in the sub-sample models, BID and the importance of caribou (IMP1) are highly significant. The negative sign on BID coefficient was as expected. The coefficient for the IMP1 had a positive sign and was found to be quite robust. Another variable called ENTVQTY was used in the models. This variable involved a respondent's identification of caribou as an indicator of environmental quality and

was coded a 1 if caribou were identified and a 0 otherwise. This variable is highly significant with positive signs in both of the final models. BID is highly significant in the two models presented. The model results suggest that attitudes towards wildlife and the environment play an important role in determining household WTP.

A common method of examining the robustness of the logit model results is to calculate how well the models predict actual responses to the CV question. Both the Canada and Saskatchewan models achieved over an 80% correct prediction rate for bid acceptance. However, they both did not do as well in predicting bid refusal. The average correct prediction rate for bid refusal for both models was just over 40%. Combining the bid acceptance and rejection information the average rate of correct predictions was just over 67% for both models. This disparity in the prediction rates between acceptance and refusal is cause for some concern. Generally, it is desired that prediction rates be approximately equal for acceptance and refusal of the bid amounts. One reason for the disparity could be caused by the low number of bid refusals. For both models approximately 40% of the bids were refused. Although this provides a sufficient level of variation for estimation of logit models it may not be enough to allow these models to predict actual responses accurately. This may also be related to the functional form of the models that was chosen. Further research should be conducted with these models where alternate functional forms and a richer set of independent variables could be examined.

Table B-6: Welfare measures for Saskatchewan residents from the dichotomous choice WTP model for the Canadian caribou conservation program.

Variables	Coefficient	Std. Error	t-ratio	Prob|t| ≥ X	Mean	Std. Dev. of X
Constant	-0.540	0.329	-1.639	0.101		
Bid	-0.016	0.003	-4.813	0.000	50.21	29.36
Imp1	1.546	0.306	5.046	0.000	0.873	0.33
Envqty	0.777	0.193	4.035	0.000	0.467	0.40

Log-Likelihood Value - 325.54, Restricted (Slopes = 0) Log-Likelihood, - 362.71; Chi-Squared value (3 df), 74.33; p=0.00; McFadden's Pseudo R^2, 0.10; N=535.

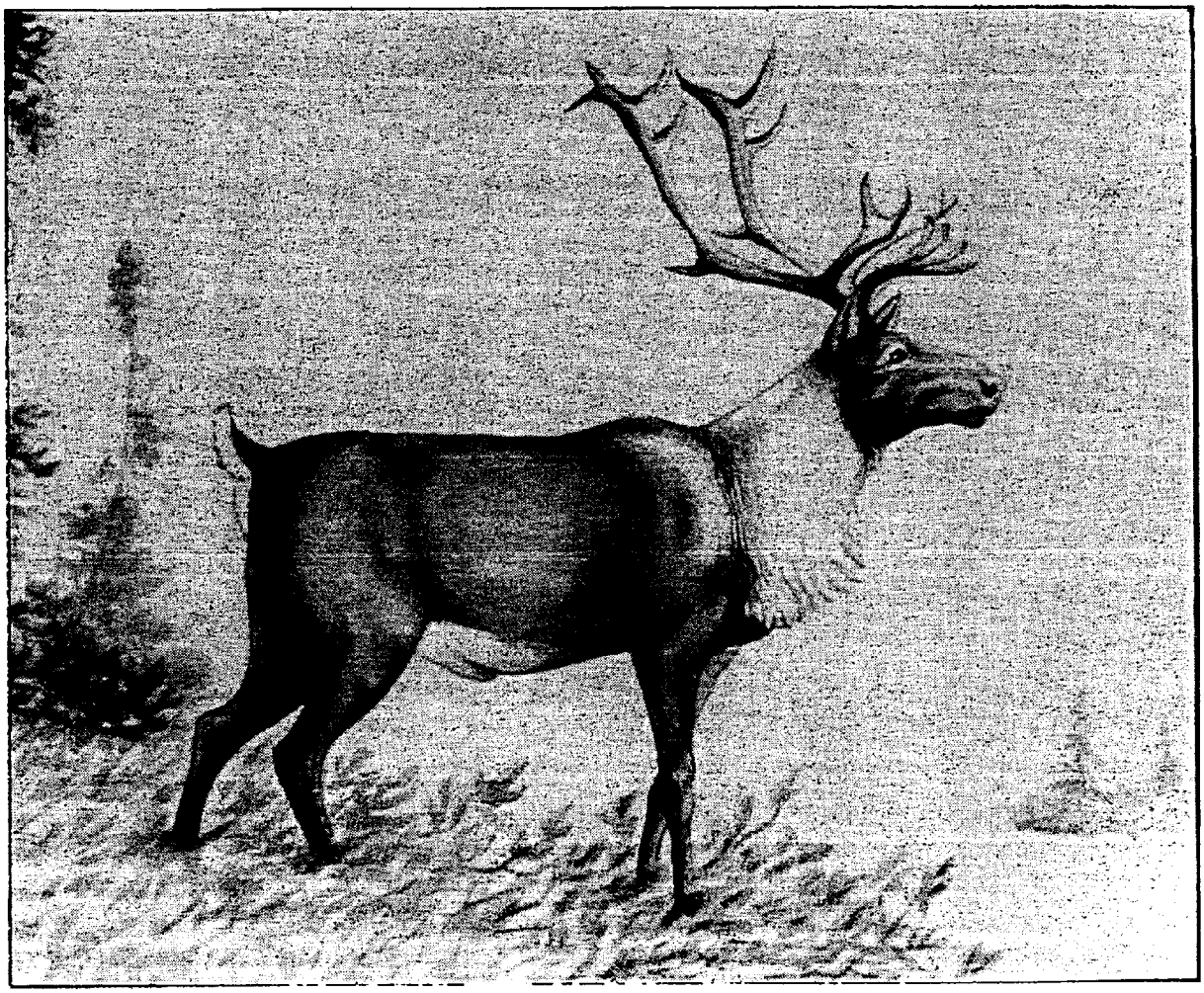
Table B-7: Welfare measures for Saskatchewan residents from the dichotomous choice WTP model for the Saskatchewan caribou conservation program.

Variables	Coefficient	Std. Error	t-ratio	Prob|t| ≥ X	Mean	Std. Dev. of X
Constant	-0.287	0.285	-1.006	0.315		
Bid	-0.015	0.003	-4.677	0.000	47.350	29.73
Imp1	1.343	0.273	4.929	0.000	0.856	0.35
Envqty	0.806	0.195	4.132	0.000	0.442	0.50

Log-Likelihood Value, -326.8902; Restricted (Slopes = 0) Log-Likelihood, -362.7835; Chi-Squared value (3 df), 71.786; p=0.00; McFadden's Pseudo R^2, 0.10; N=543.

Appendix C - Example of Survey Instrument

Saskatchewan Woodland Caribou Survey



University of Alberta
Edmonton

Canada–Saskatchewan Partnership Agreement in Forestry

Entente d'association Canada–Saskatchewan en foresterie

Saskatchewan Woodland Caribou Survey

You have been chosen to participate in a survey to determine the importance of Woodland Caribou to the people of Saskatchewan. It is important that you take the time to complete the questionnaire and return it as soon as possible. The information collected can then be used to better manage one of our natural resources.

This first section asks about your interest/participation in outdoor recreation activities (canoeing, hiking, fishing, wildlife watching, etc)

1. During the last year [from (1/Jan./92) to (15/Nov./92)] have you (**please** ☑)

- Read books, magazines or articles on wildlife or outdoor activities? ☐ **Yes** ☐ **No**
- Watched films or T.V. on wildlife or outdoor activities? ☐ **Yes** ☐ **No**

2. During the last year [from (1/Jan./92) to (15/Nov./92)] (**please** ☑)

- Did you hunt or fish? ☐ **Yes** ☐ **No**
- Were you involved in other wildlife activities (some examples are: viewing, feeding, attracting or photographing wildlife)? ☐ **Yes** ☐ **No**
- Were you involved in other outdoor activities (some examples are: canoeing, cross country skiing, hiking or camping)? ☐ **Yes** ☐ **No**

If you answered **yes,** to any of the above in **Question 2,** please state the approximate total number of days that you participated in these activities during the last year.

_____ **days**

3. Are you a member of a wilderness/environmental/outdoor activity club/organization, such as Ducks Unlimited or The Canadian Parks and Wilderness Society? (**please** ☑),

☐ **Yes.** ☐ **No**

If **yes**, please indicate approximately how much in total you spent on memberships etc. and about how many days you were involved in club activities.

$ _____ spent on memberships/donations
_____ days active in club activities

Please circle the response that best describes your attitudes towards wildlife and wildlands for each statement below.

4.

	Strongly Agree	Moderately Agree	Moderately Disagree	Strongly Disagree	No Opinion
Wildlife is important for people to use and enjoy	4	3	2	1	N
Even wildlife which has no direct benefits to people should be protected and preserved	4	3	2	1	N
Species of wildlife that can damage property or harm people should not be protected	4	3	2	1	N
Wildlife is important but people's needs should come first	4	3	2	1	N
Preserving wildlife for the future is not important as the future will take care of itself	4	3	2	1	N
People have a moral obligation in preserving the environment	4	3	2	1	N

The following questions ask for your opinions about Woodland Caribou. The Woodland Caribou is a member of the deer family which lives in mature forest and muskeg areas in the Northern Canadian Evergreen forest zones. Both the male and female grow antlers, with the female's antlers being smaller in size. The caribou of the woodlands do not travel great distances like their cousins in the north, the Barren-Ground Caribou. As a result, this species has been shown to be sensitive to logging and associated activities.

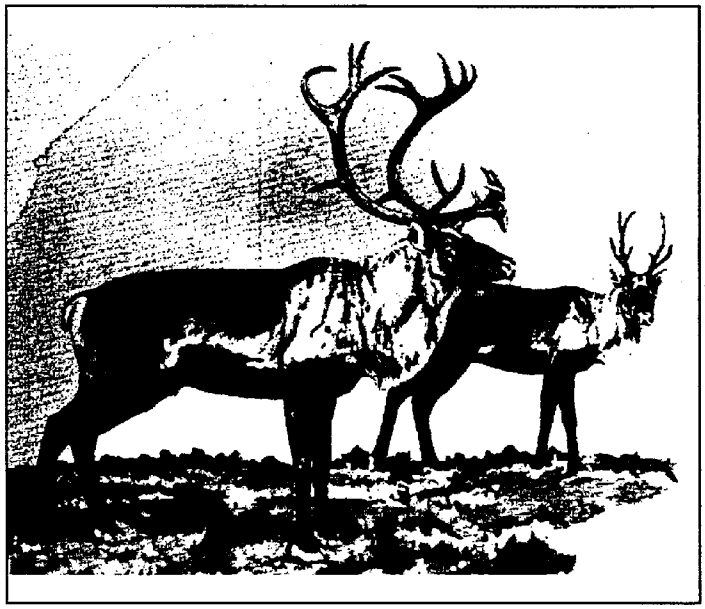


Figure 1. Male (Left) and Female (Right) Woodland Caribou

5. Have you heard of Woodland Caribou before this survey? **(please ☑)**

☐ **Yes** ☐ **No**

If you answered **No** please **go to Question 7**

6. Have you ever seen a Woodland Caribou in the wild? **(please ☑)**

☐ **Never** ☐ **A few times (1-5 times)** ☐ **A lot of times (more than five times)**

7. How important/unimportant is it to you that Woodland Caribou exist?
(please circle appropriate number)

Very Important			**Not at all Important**	**No Opinion**
4	**3**	**2**	**1**	**N**

8. Which of the following statements best describe the reasons why Woodland Caribou are important to you (**please check** the appropriate box(es))?

a) ☐ I want the chance to see a caribou in the wild.

b) ☐ All animals including caribou, have a right to exist.

c) ☐ Woodland Caribou should be preserved for future generations.

d) ☐ I feel Woodland Caribou are an indicator of environmental quality.

e) ☐ There should be opportunities for others (family, friends, etc) to view Woodland Caribou.

f) ☐ I feel Woodland Caribou are important for maintaining the balance of nature.

g) ☐ Woodland Caribou are a part of our Canadian heritage.

h) ☐ I feel Woodland Caribou are important for hunting.

9. If you chose more than one of the above please identify the response you consider most important. (Place **letter** from above responses in blank provided)

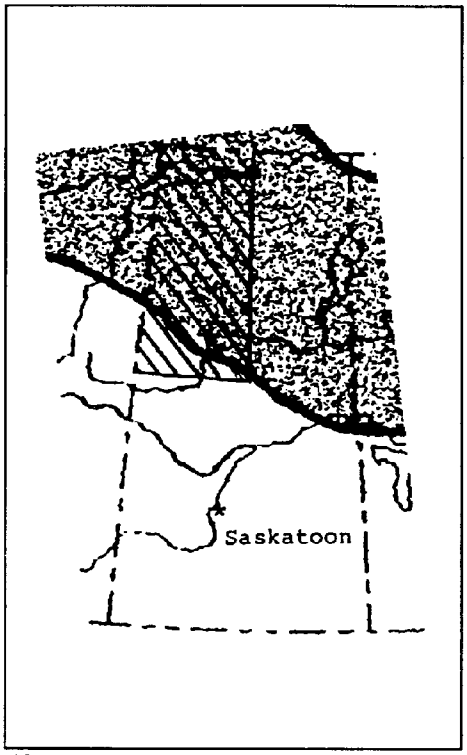
Most Important _____

The Preservation of Woodland Caribou.

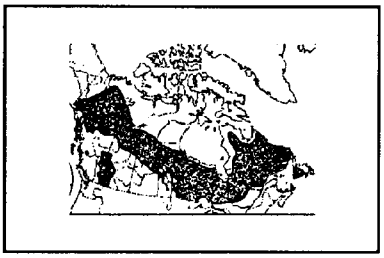
Woodland Caribou live in mature forest and treed muskeg regions. Mature forests are considered areas in which the forest has reached a state of slower tree growth and a closed canopy. Treed muskegs are wet areas that have moss ground cover and small scattered black spruce and tamarack. Since world demand for forest products is increasing, areas that were once not considered for logging are now being cut. The result of this action is a changing forest (a greater amount of younger trees) and increasing access to remote areas. The logging of these forests allows for the stability of consumer prices for paper and wood based products. An additional benefit from logging is the creation of jobs in small remote communities in Canada's more northern regions.

A consequence of these changes from logging, has been a gradual decline of Woodland Caribou populations in localized areas due to increased hunting (from man and wolves) and to a lesser extent loss of habitat. Therefore the removal of the forest in remote areas may not hurt the Woodland Caribou directly, but the associated actions and outcome of logging does have an impact on them. Some of these effects may be offset through the development of regulations to retain critical habitat and limit access.

The following is a hypothetical situation and is not being considered as part of any government policy.



Northwestern Region of Saskatchewan (Cross Hatch) and Woodland Caribou Range



Present Range of Woodland Caribou in Canada

To the left is a map that shows the present range of Woodland Caribou within Northern Saskatchewan (shaded area). The cross hatch area is the Northwestern region of Saskatchewan. It is estimated that 3,600 Woodland Caribou live in this area. This region is also an area where logging activity is expected to increase in the coming years.

Suppose you have a choice between two options, given below. The action described will be carried out for the option that receives the majority of votes.

10. *Option A, Have* ***No Maintenance Program*** *to preserve Woodland Caribou. Local populations will disappear within 10 years of logging activities due to increased hunting from people and wolves, habitat loss and animals leaving the area. The end result is that Woodland Caribou populations will decrease to 1,800 in Northwestern Saskatchewan by the year 2002.*

Option B, Have every household in Saskatchewan pay $\underline{\$64}$ ***per year*** *for the next ten years into a trust fund to be spent on a* ***Caribou Maintenance Program.*** *This maintenance program will be run by an* ***independent foundation*** *and will maintain the* ***current range and numbers*** *of approximately 3,600 Woodland Caribou within Northwestern Saskatchewan.*

Given the opportunity to vote for **Option A or B** which one would you choose? **(please ☑)**

☐ **Option A** ☐ **Option B**

The following is a hypothetical situation and is not being considered as part of any government policy.

Present Range of Woodland Caribou in Canada

The above map shows the present range of Woodland Caribou within Canada (shaded area). It is estimated that the Canadian Woodland Caribou population is approximately 700,000 and is not considered a threatened species. This region also represents areas in which logging, mining and recreational activities are taking place or are being considered.

Suppose you have a choice between two options, given below. The action described will be carried out for the option that receives the majority of votes.

11. *Option A, Have No Maintenance Program to preserve Woodland Caribou. Local populations will disappear within 10 years of logging and mining activities due to increased hunting from people and wolves, habitat loss and animals leaving the area. The end result is that Woodland Caribou populations will decrease to 350,000 in Canada by the year 2002.*

    Option B, *Have every household in Canada pay* $\$\underline{90}$ ***per year*** *into a trust fund over the next ten years to be spent on a* ***Caribou Maintenance Program.*** *This maintenance program will be run by an* ***independent foundation*** *and will maintain the* ***current range and numbers*** *of approximately 700,000 Woodland Caribou within Canada.*

    If you could vote for either **Option A or B** which one would you choose? (**please** ☑)

    ☐ **Option A** ☐ **Option B**

    If you wish you may go back to the previous question and change your vote.

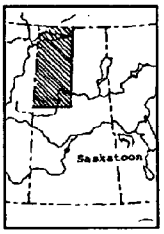
12. If you voted for **Option A** for either of the previous two questions, please give your reason for doing so: **(please ☑ only one)**

- ☐ I do not receive any benefits from Woodland Caribou.
- ☐ I am not interested in spending my money on the preservation of Woodland Caribou.
- ☐ I do not think Woodland Caribou should get in the way of the forestry industry.
- ☐ Other (please specify) _____

_____

_____

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



Map showing Northwestern Saskatchewan

13. What is your sex? **(please ☑)** **Male** ☐ **Female** ☐

14. How old are you? _____ years

15. Have you ever been to Northwestern Saskatchewan? **(please ☑)**

Yes ☐ **No** ☐

16. Size of present place of residence? **(please ☑)**

☐ **Rural, Farm** ☐ **Village (less than 1000)** ☐ **Urban (more than 1000)**

17. What is your place of residence (name of nearest city or town)? _____

18. Number of individuals who reside in your household (Including yourself)? ____

19. Please check one of the following categories that best represents the **TOTAL ANNUAL HOUSEHOLD INCOME** from all sources before taxes in 1992? **(please ☑)**

☐ **$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**	

20. Please **circle** the highest number of years of education completed.

- Elementary School **1 2 3 4 5 6 7 8**
- High School **9 10 11 12**
- University/Technical School **13 14 15 16**
- Post-Graduate **17 18 19 20 20+**

21. What is your occupation? _____

22. If you have any concerns or opinions you would like to share concerning the questionnaire or wilderness preservation, please use the space provided below.

If you have questions about this survey please call Mark Tanguay 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