# ECONOMIC VALUE OF WILDERNESS PROTECTION AND RECREATION IN BRITISH COLUMBIA 

## WP-6-012

by
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Funding for this study was provided through the Economic and Social Analysis Program of the Canada-British Columbia Partnership Agreement on Forest Resource Development:

FRDA II.

## Acknowledgements

The wilderness survey was a joint project of the British Columbia Ministries of Forests and Environment, Lands and Parks. Terje Vold of the Ministry of Forests' Recreation Branch initiated and guided the survey and provided valuable comments on this report. Brian Dyck of British Columbia Parks and Ted Murray of the Ministry of Forests' Recreation Branch made significant contributions to the study design and implementation. Any remaining errors a omissions in this report are solely the responsibility of the authors.


#### Abstract

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## Disclaimer

The views expressed in this report do not necessarily represent those of the Canadian Forest Service, the B.C. Ministry of Forests, or the B.C. Ministry of Environment, Lands and Parks.

## EXECUTIVE SUMMARY

A province wide mail survey was undertaken in April 1993 to determine provincial residents' views about wilderness issues and the values they place on protecting wilderness and participating in wilderness recreation. The survey was conducted by the Ministry of Environment, Lands and Parks and the Ministry of Forests.

A report released in 1995 entitled Wilderness Issues in British Columbia: Results of a 1993 Province-wide Survey of British Columbia Households presents the key findings of the provincial survey. This highlights report presents residents feelings about the importance of wilderness, benefits and concerns of protecting wilderness, uses that should be allowed in wilderness and other issues.

This report presents the estimated economic values of wilderness in British Columbia based on the results of the provincial survey. The survey questionnaire (Appendix A) was sent in early 1993 to a random sample of 3,000 households spread throughout British Columbia. Following two mailings of the questionnaire, a reminder postcard and phone follow-up, $54 \%$ of the households had returned a completed questionnaire.

Designated wilderness areas were defined as roadless, undeveloped natural areas established and set aside from development by law. This includes roadless portions of national and provincial parks and areas protected under the Forest Act. At the time of the survey about 5\% of the Province, or 4.8 hectares ( 11.8 million acres), was in protected wilderness.

Respondents were asked in the form of a referendum like question how much more taxes and fees their households would be willing to pay for a doubling of protected wilderness from $5 \%$ to $10 \%$ of the land base spread throughout the Province. The hypothetical tax and fee increases would be paid into a special fund to recover the loss of public revenue from logging and mining operations. It is estimated that provincial households would be willing to pay between $\$ 108$ and $\$ 130$, on average, annually in increased taxes and fees for a doubling of designated wilderness. This represents a total annual value of between $\$ 138$ and $\$ 166$ million (1992 dollars).

The value of tripling designated wilderness from $5 \%$ to $15 \%$ of the Province was estimated using the same referendum conditions as for doubling wilderness. Households stated they would be willing to pay an average of between $\$ 149$ and $\$ 156$ in increased taxes and fees annually for tripling wilderness. The total annual value for tripling designated wilderness is estimated at between $\$ 190$ and $\$ 200$ million (1992 dollars).

About $16 \%$ of provincial residents eighteen years of age and over visited a wilderness area in 1992. This represents about 410,000 provincial residents. A wilderness trip is defined as a recreational trip in a roadless, undeveloped area that can be reached only by trails, waterways or air. Wilderness recreationists took an average of 3.5 trips in 1992 for a total of 1,415,000 trips. Each trip lasted an average of 4.4 days. Participants spent a total of 6.2 million days on wilderness trips of which about 5.1 million days was actually spent in wilderness.

Participants in wilderness recreation spent an average of $\$ 218$ per wilderness trip or about $\$ 50$ per day. Total spending was $\$ 309$ million ( 1992 dollars) with the greatest expenditures on transportation, food and beverages, and special equipment. Participants stated they would be willing to increase expenditures on a wilderness trip by $\$ 266$, or $\$ 59$ per day, before they would no longer be willing to take the trip. The net economic value participants placed on wilderness recreation in 1992 was between 192 and 385 million dollars.

The results of the survey show that the protection and use of wilderness is very important to the people of British Columbia. The economic values of wilderness need to be taken into account in planning processes that consider increases in designated wilderness. Perhaps more
importantly, due to the irreversible nature of some wilderness loss, the values of wilderness should be accounted for in assessing activities that adversely impact wilderness.

## Summary of the Estimated Economic Values of Wilderness Protection and Recreation

| Type of Value | Average Annual <br> (\$/household) | Total Annual <br> (\$million) |
| :--- | :---: | :---: |
| Wilderness Protection | $\$ 108-\$ 130$ | $\$ 138-\$ 166$ |
| Doubling Designated <br> Wilderness | $\$ 149-\$ 156$ | $\$ 191-\$ 200$ |
| Tripling Designated <br> Wilderness | $\$ 192-\$ 385$ million |  |
| Wilderness Recreation | $\$ 266 /$ trip |  |
| Total Annual Value of All Wilderness Trips | $\$ 59 /$ day |  |
| Average Value per Trip |  |  |

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## PREFACE

In April 1993, a province-wide mail survey was undertaken to determine the public's feelings about wilderness issues and the value they place on the use and protection of wilderness. The survey was conducted by the Ministry of Environment, Lands and Parks and the Ministry of Forests. A preliminary report entitled Wilderness Issues in British Columbia: Results of a 1993 Province-wide Survey of British Columbia Households released in 1995 presents the key findings of the survey.

The purpose of this report is to present the estimated economic values of British Columbia wilderness based on the results of the provincial survey. The report discusses some of the issues that arise in trying to value environmental amenities, such as wilderness, that are not traded in markets. The values that provincial residents place on doubling and tripling the amount of designated or protected wilderness are presented. The amount of recreational use of provincial wilderness is reported along with the value participants place on this recreation. The values found for British Columbia wilderness are compared to the results of similar studies carried out in other jurisdictions.

The study is restricted to considering the economic values provincial residents place on using and protecting British Columbia's wilderness. However, other Canadians and people from other countries benefit from visits to British Columbia wilderness and knowing that it is being protected. As such, the study underestimates the total economic value of British Columbia's wilderness since it does not include the values of other Canadians. Further, the study is limited to estimating what might be termed traditional economic values. No attempt is made to describe or measure other values that might be associated with wilderness such as spiritual, cultural, scientific or First Nations values to the extent that they are not captured in traditional economic values.

## 1. MEASURES AND TYPES OF ECONOMIC VALUES

### 1.1 Background

British Columbia contains a diversity of exceptional, scenic wilderness. British Columbia's wilderness is home for a wide variety and abundance of flora and fauna. At present, wilderness areas exist in all of the province's vastly different ecosystems which vary from alpine tundra to dry bunchgrass to mild wet coastal rain forests. The protection of wilderness is an issue that receives much media and public attention in British Columbia. Wilderness protection is also the subject of land use planning initiatives by the provincial government.

In order to better understand the public's feelings about wilderness issues, a random sample of the provincial population was surveyed by mail in early 1993. The survey questionnaire asked about a number of issues including what activities the respondent felt should or should not be allowed in protected wilderness areas and their feelings about the current amount of designated wilderness. The survey was also intended to determine the economic values associated with the use of wilderness and different amounts of legally protected wilderness in the Province.

The purpose of this report is to present estimates based on the survey results of the economic values associated with wilderness. The values that provincial residents place on doubling and tripling the present amount of protected or designated wilderness are presented. Also, the expenditures provincial residents made on wilderness recreation trips is reported along with the economic values associated with these trips.

The first part of the report describes what economists mean when they refer to economic values and how these values are measured. The second section describes the survey, the technique used to determine economic values and how the results were analyzed. Section three presents estimates of the values the public places on doubling and tripling the amount of designated wilderness. This section also presents the expenditures made on wilderness recreation trips and the values associated with these activities. Section four compares the findings to results from similar studies. The concluding section describes some of the potential uses and limitations of the results.

### 1.2 Measures of Economic Value

Economic value is measured by how much better off individuals are made by the provision and use of goods and services. Value is determined by the satisfaction or usefulness that consumers derive from goods and services. Any good or service that gives satisfaction or is useful to individuals produces economic value. Economic value can exist even though a financial transaction or flow does not take place. The largest and most obvious example of an economic value that does not typically give rise to a financial payment are services performed by homemakers. Childcare, cleaning, cooking, washing etc. by homemakers are very valuable economic services that do not usually give rise to financial transactions. The economic value individuals place on goods and services is given by the maximum amount they would be willing to pay for each unit they obtain. Typically, individuals place the highest value on the first unit purchased with each subsequent unit being of less value. This is shown by the hypothetical demand curve in Figure 1.1 which relates the quantity of a good $(Q)$ consumers would be willing to purchase at each different price level ( P ). The demand curve is downward sloping because as the consumer increases his consumption of the good the incremental or marginal benefit he derives from each additional unit decreases. In other words, he derives more satisfaction from consuming the first unit than he does from the second unit and more satisfaction from consuming the second unit than from the third unit and so on. If he derives less and less satisfaction from each subsequent purchase of the good he would be willing to pay less and less for each additional unit of the commodity.

At prices greater than $P_{\text {max }}$, consumers would be unwilling to purchase the good as the price would be greater than the benefit that consumers derive from the good. However, if the good was provided free of charge, i.e. $P=0$, then consumers would consume $Q_{\max }$ of the good at which point their demand would be completely satiated. The total value the consumer derives from his consumption is represented by the area under the demand curve up to the quantity purchased. For example, if the quantity were provided free of charge, the total value would be the area $0 P_{\text {max }} Q_{\text {max }}$. If on the other hand a price of $P^{*}$ were charged for the good then the total value would be the area $0 P_{\max } A Q^{*}$.


FIGURE 1.1 A Hypothetical Demand Curve
In the case of purchased commodities, the total or gross price that a consumer would be willing to pay is not an appropriate measure of how much better off the individual is made by consuming the good. This is because there is a cost incurred in producing and purchasing the good given by the purchase price. The price that consumers actually pay for a commodity is usually less than the maximum amount they would be willing to pay. The difference between the maximum amount that an individual would be willing to pay and the actual amount paid represents the net value of the commodity to the consumer. Economists call this measure the consumer surplus. This is represented in Figure 1.1 as the area under the demand curve and above the price line. Thus, if a price of $P^{*}$ were charged for the good, the net value of the purchases to the consumer, his consumer surplus, would be represented by the area $P^{*} P_{\max } A$. If the good is free, i.e. $\mathrm{P}=0$, then the consumer surplus would be the entire area under the demand curve or $0 P_{\max } Q_{\text {max }}$.

### 1.3 Measuring the Value of Non-Market Goods

The measurement of consumer surplus is straightforward conceptually when goods and services are exchanged in markets. However, some goods and services, known as public goods, are not sold at unit prices in commercial transactions. One class of such goods are called common property resources. Most environmental resources have the characteristics of common property resources as distinct from private property resources. That is, no individual or legal entity has ownership rights to these resources. Rather they are owned equally or in common by all the citizens living in the jurisdiction in which they are contained.

Since no private property rights are attached to common property resources they are not usually exchanged in markets. As a result, there are no market prices that signal the value users place on these resources. In order to estimate the value that individuals place on common property resources economists either simulate markets for these resources or observe actual behavior that suggests the value associated with these resources. These two types of approaches have come to be known as the direct and indirect methods. The direct method involves directly questioning individuals about the value they place on the public good. The indirect method observes behavior in a related or similar market and indirectly assigns value to the unpriced resource. Indirect methods include the Hotelling-Clawson-Knetsch Travel Cost Method (Clawson and Knetsch, 1966) and the Hedonic Method (Freeman, 1979).

One direct technique that has been developed to value non-marketed goods, and is used in the present study, is the Contingent Valuation Method (CVM). The CVM involves replicating a market situation that treats the common property resource as if it was a private property resource and then determines the price people would pay for it. Among the earliest studies using this method are Davis (1963) and Hammack and Brown (1974). The CVM is a survey technique that can be conducted through face-to-face or phone interviews or by mail questionnaires. It involves first describing a hypothetical market for an environmental resource and then asks the respondent how much he would be willing to pay for the amount presently being used or changes in this amount. Responses are contingent on the hypothetical market described. There are a number of variations in the design of contingent value questions using different approaches to the way the market is described and also how the price question is posed. A more detailed description of this method can be found in Hanley (1989).

In the United States, the use of the CVM to value resource damages has, in some cases, been given legal status (Portney, 1994). The Comprehensive Environmental Response, Compensation and Liability Act (CERCLA) of 1980 or the Superfund law is intended to identify sites that contain materials hazardous to human health or the environment. Parties responsible for the hazardous material are liable for cleaning up the sites. The Superfund law also gives government the right to sue for damages to resources under its jurisdiction. Regulations drafted by the United States Department of the Interior in 1986, and revised in 1989, endorsed the use of the CVM in calculating lost use and non-use values. A more detailed description of CERCLA and its implications can be found in Kopp and Smith (1993).

Following the Exxon Valdez oil spill, the U.S. Congress passed the Oil Pollution Act of 1990 to reduce the risk of future spills and to provide a mechanism to recover damages. The method of assessing damages was to be developed by the Department of Commerce through the National Oceanic and Atmospheric Administration (NOAA). A panel headed by Robert Solow and Kenneth Arrow was established by NOAA to judge the reliability of the CVM in assessing resource damages. The panel reported (Arrow et al., 1993) that the CVM established a starting point in damage assessments provided the panel's guidelines were followed. The panel's report has stimulated discussion about the CVM and strongly reinforced the call for carefully designed studies.

In using the CVM, the framework of the hypothetical market in which the willingness to pay is to be determined must be clearly specified. This must include, but not be limited to, a description of:

- the institutional rules under which the market operates,
- a description and quantification of the resource being valued, and
- the payment vehicle, that is how the payment would be collected from the consumer.

The respondent's willingness to pay for the resource can be asked once the market framework has been established. Four methods have been used to pose the willingness to pay question. The first method employs an open-ended question which asks the respondent to directly state his
maximum willingness to pay. The second method is an iterative bidding process. With iterative bidding the respondent is asked if he would be willing to pay some starting bid amount. If he is unwilling to pay the initial bid then the bid is lowered in successive amounts until a positive response is received. If on the other hand, he responds yes to the starting bid, the bid is raised successively until a negative response is given. The highest value to which a positive response is received becomes the respondent's maximum willingness to pay. This method can only be used in face-to-face and telephone interview surveys. The third approach uses a payment card format in which respondents are shown a schedule of values to choose from and then asked to indicate the amount they would be willing to pay.

A recent development in the application of the CVM is the discrete choice (DC) approach. In this approach, the respondent is asked if he would be willing to pay some given amount, i.e. $\$ x$, for the resource in question. The question is usually asked in the form of voting for or against a given proposal as in a public referendum. The value presented is varied by respondent. An extension of the DC method is called the "double bounded procedure". This procedure follows the initial DC question with a second discrete choice question further probing the value placed on the resource. For example, if the answer to the initial DC question is yes, then this would be followed by a second DC question with a higher value. Similarly, if the initial answer is a no, then this would be followed by a lower value. Kanninen (1993) argues that this technique is more efficient in producing information than the single value $D C$ method.

Each of these approaches has its advantages and disadvantages. In the present study, both the discrete choice and open-ended methods were used in order to provide a means of checking the validity of the results. Much of the recent popularity of the DC approach is because it reduces the burden on respondents since they only have to make a decision about one value. This reduces the high non-response usually found for CVM questions. Seller, Stoll and Chavas (1985) in their study of boating recreation on four lakes in east Texas found that respondents were more comfortable answering DC questions and provided more accurate information than they did for open-ended questions.

While the simplicity of the DC approach increases response, it has some drawbacks. First, it does not force the respondent to decide on the maximum value he would be willing to pay. The respondent can answer yes or no to the particular DC value specified without determining and revealing the actual amount he would pay. The maximum amount of information is not extracted from respondents with the DC format. Since each respondent decides on only one value rather than the full range of values, it is necessary to have a larger total sample with a DC survey to get the same information as with payment card approach.

### 1.4 Types of Economic Value

Economists recognize that economic values may arise for reasons other than the use or consumption of the good or service. This can be especially important in the case of environmental resources. The economic values associated with environmental resources can be classified following Randall and Stoll (1982) according to whether they represent the use or non-use of a resource. An on-site use value derives from actual contact with the resource in the field such as hunting or viewing wildlife, fishing, the use of water for boating or swimming and the use of wilderness for recreation. Off-site use values relate to activities that involve an appreciation or enjoyment of the resource without actual physical contact with the resource in the field. Types of activities that produce off-site values are watching films about wilderness, attending lectures or reading about wilderness. These are sometimes referred to as vicarious uses.

As the name suggests, non-use values refer to values individuals place on environmental resources that are independent of their use of the resource. These values are sometimes referred to as preservation values. The four types of non-use values that are identified to-day were introduced into the literature by Weisbrod (1964) and Krutilla (1967). The latter identified what are known as the existence and bequest values of environmental amenities. Krutilla felt that people
place an existence value on knowing that environmental resources exist even though they may never encounter them. Related to existence value is bequest value, the second type of non-use value identified by Krutilla. This refers to the value that people derive from the knowledge that an environmental resource is being preserved for the use and enjoyment of future generations.

Weisbrod (1964) also argued that individuals would be willing to make a payment for a contract that guarantees them the option to use the resource at some future date. This option value represents a payment now for the right to purchase resource use in the future. It is independent of the value of future use. This can be thought of as a risk premium to compensate for the uncertainty of demand factors such as tastes, income and prices as well as supply factors. Demand uncertainty arises from not knowing the amount of use individuals will make of the resource in the future or the nature of the use. Similarly, supply uncertainty occurs because neither the future levels of opportunities provided by the resource or the nature of these opportunities are known with certainty.

Since the future is uncertain, whether due to demand or supply uncertainty, it can only be described as a set of possible outcomes or expected states of nature and the values associated with them. Cicchetti and Freeman (1971) introduced the term option price to the literature. This refers to the value at a point in time that includes both the value of purchasing an option to consume the good, given by the option value, and the expected value of actually consuming the good some time in the future given by the expected consumer surplus. The relationship among these measures is given by the following:

## Option Price $=$ Future Use Value + Option Value

Option price is the appropriate measure of economic value when there is uncertainty about the future use and availability of the resource.

In summary, the preservation value is equal to:
$\underset{\text { Value }}{\text { Preservation }}=\underset{\text { Value }}{\text { Existence }}+\underset{\text { Value }}{\text { Bequest }}+\underset{\text { Value }}{\text { Option }}+\underset{\text { Value }}{\text { Vuture Use }}$
or
Preservation $=\begin{gathered}\text { Existence } \\ \text { Value }\end{gathered}+\underset{\text { Bequest }}{\text { Value }}+\quad+\begin{gathered}\text { Option } \\ \text { Price }\end{gathered}$

### 1.5 Estimating Values Using the Discrete Choice Contingent Valuation Method

The DC approach requires the use of more sophisticated econometric techniques to analyze the survey results than does an open-ended question or presenting a schedule covering the full range of contingent values. This is because the latter two approaches produce a continuous sample of quantitative values while the DC results in qualitative yes-no responses. As an example of a qualitative variable, respondents that answer yes to a particular DC value are assigned a value of 1 and 0 for those unwilling to pay the price.

We may attempt to explain the DC response values by a single explanatory variable $x$, say the bid value. This relation attempts to determine the probability of a respondent agreeing to each value of $x$. The scatter of points showing observed values of $x$ and the associated willingness to pay, $p=1$, or lack of willingness to pay, $p=0$, is shown in Figure 1.2.

The figure illustrates two problems that arise in trying to apply regression analysis when the dependent variable is discrete. First, due to the spread of observations around the predicted regression line, it is likely that the $R^{2}$ statistic, the coefficient of determination, will be very low
indicating a poor fit to the scatter of points. Due to the nature of this type of regression, $\mathrm{R}^{2}$ is not an appropriate criterion to measure the goodness of fit. A second problem, shown in the diagram, is that low values of x would produce predicted probabilities of willingness to pay that were less than zero while high x values would produce predicted probabilities greater than one. In addition, the respondent's predicted answer can switch between $p=0$ and $p=1$ in the range between $A$ and B.


FIGURE 1.2 Binary Choice Models
In order to correct the second problem described above it is necessary to, in effect, squeeze the estimated probabilities inside the 0-1 interval without actually creating estimates of 0 or 1 . One way of doing this is to truncate the line so that it bends horizontally as it approaches 0 or 1. This is shown in Figure 1.3. In addition to restricting $p$ to values between 0 and 1, the truncated line, unlike the linear estimate, does not suggest that a fixed change in the independent variable will always produce a change of the same amount in $p$. Rather, a given change in the independent variable will produce a smaller change in $p$ as $p$ approaches 0 or 1 .

In order to truncate the line, it is necessary to transform the probability such that when $p$ increases from 0 to 1 , its transform increases from minus infinity to plus infinity. The two most common transformations are the probit and logit transformations. The difference between these transformations is that probit analysis is based on the normal distribution whereas logit analysis is based on the logistic distribution. It can be shown that the normal and logistic density functions are numerically quite close to one another except in the extreme tails. Since for predicted willingness to pay we are not likely to be concerned with values in the extreme tails, there is no reason for preferring the probit to the logit and the logit model is computationally easier to work with.

The use of the logit model can be shown by a cumulative probability distribution function which relates the probability of an individual respondent voting yes $\left(P_{i}\right)$ to some index $\left(Z_{i}\right)$. The index $Z_{i}$ would in turn be a function of a number of explanatory variables $\left(X_{1}, X_{2}, \ldots, X_{n}\right)$. This relationship can be written as:

$$
\begin{equation*}
P_{i}=F\left(Z_{i}\right) \tag{1.1}
\end{equation*}
$$

and

$$
\begin{equation*}
Z_{i}=f\left(X_{1}, X_{2}, \ldots, X_{n}\right) . \tag{1.2}
\end{equation*}
$$

Figure 1.3 shows the logistic distribution function. The logistic cumulative probability distribution function is calculated as:

$$
\begin{equation*}
P_{i}=1 /\left(1+e^{-z}\right) \tag{1.3}
\end{equation*}
$$

where $e$ is the base of natural logarithms.


FIGURE 1.3 Cumulative Logistic Probability Distribution

Figure 1.3 shows that the logistic function has the characteristics desired for specifying the relationship between $P_{i}$ and $Z_{i}$. That is the probability of voting for the proposal would be restricted to the range of values between 0 and 1 , and the effect of changes in the value of index $Z_{i}$ on $P_{i}$ varies in size over the range of $Z_{i}$. The slope of the logistic function is greatest when $P_{i}$ equals 0.5 , which occurs when $Z_{i}$ is equal to 0 . This would imply that changes in an explanatory variable $X_{i}$ in equation 1.2 would have its greatest impact on $P_{i}$, through its effect on $Z_{i}$, when $P_{i}$ was at the center of its distribution. Thus, if $P_{i}$ were at one of the tails of its distribution, then large changes in $X_{i}$ would be required to significantly affect $P_{i}$.

If it is assumed that $Z_{i}$ is a linear function of the bid value $(B V)$ presented to respondents, then:

$$
\begin{equation*}
Z_{i}=\alpha-\beta B V_{i} \tag{1.4}
\end{equation*}
$$

To estimate equation 1.4 we still need to determine the values for the dependent variable $Z_{i}$. This can be found by rearranging terms in equation 1.3 to yield:

$$
\begin{equation*}
e^{z}=P_{i} /\left(1-P_{i}\right) \tag{1.5}
\end{equation*}
$$

Taking the natural logarithms of each side yields:

$$
\begin{equation*}
\mathrm{Z}_{\mathrm{i}}=\ln \left(\mathrm{P}_{\mathrm{i}} /\left(1-\mathrm{P}_{\mathrm{i}}\right)\right) \tag{1.6}
\end{equation*}
$$

which shows that $Z_{i}$ is the logarithm of the ratio of the probability of an individual voting for the proposal to the probability of them voting against the proposal. This log odds ratio is also known as a logit.

The logit function can be estimated using ordinary least squares. However, the problem that arises is that we cannot use observations equal to 0 or 1 for $P_{i}$ because they make $\ln (p / 1-p)$ blow up. Two methods are available to get around this problem. The first is to group observations of individuals of similar characteristics into different cells in which the cell probabilities are not equal to either zero or one. Ordinary least squares regression can then be used to estimate equation 1.4 using the cell data for the observations. A better approach for estimating the logit function, one which preserves the individual observations, is to use a non-linear maximumlikelihood estimation (MLE) procedure. The MLE technique involves speculating about the various possible values the parameters can take in equation 1.4. For each set of parameter values the likelihood of observing the actual pattern of votes is evaluated and the set of parameter values which achieves the maximum likelihood is selected as the estimate for the parameters (see Pindyck and Rubinfeld (1981) for further details).

Once equation 1.4 has been estimated we can trace out the impact changes in bid value have on the probability of voting for the proposal. Figure 1.4 shows a hypothetical example. Given this distribution of the probability of voting for the proposal at each bid value we can calculate the expected or mean value of a respondent's willingness-to-pay (WTP) for the designation of additional wilderness areas. This is done by finding the area under the curve in Figure 1.4 which, stated more formally, can be found by solving the following integral:

$$
\begin{equation*}
\text { WTP }=\int 1 /\left(1+e^{-(\alpha-\beta B V)}\right) d B V \tag{1.7}
\end{equation*}
$$

Loomis (1988) shows that the area under the curve can also be measured graphically in order to give an approximation of the mean WTP.

A problem with using the mean WTP as a welfare measure is that the distribution of willingness to pay is usually skewed to the right since the distribution is restricted to non-negative values. Due to this skew, the mean is usually significantly larger than the median. In a very skewed distribution, the mean is heavily influenced by the tail of the distribution which may reflect the values of only a small proportion of the population. As a result, a variety of other welfare measures have been used in the literature in addition to the mean WTP. This has included a truncated mean and percentiles of the distribution, including the median. A truncated mean is the average WTP value estimated up to a maximum bid value T. This is shown in Figure 1.4 as the area under the curve up to bid value $T$. The truncated mean reduces the influence of the tail and can be aggregated over the population to produce a total value.

One issue in the use of the truncated mean is the determination of the truncation point $T$. Use of the overall mean implies a truncation point equal to infinity. Duffield and Patterson (1991) argue that a truncated mean should be used as the welfare measure and that the welfare measure should be based on the observed distribution up to the maximum bid value used in the survey, and not on any extrapolations beyond the survey's maximum bid value. In determining the level to set T , the authors recommend that the survey should be pre-tested in order to identify a maximum bid value sufficiently large that the probability associated with a bid value larger than this maximum value should approach zero.


FIGURE 1.4 Effect of Bid Value on the Probability of a Yes Vote

Hanemann (1984) on the other hand, recommends the use of the distribution's median as the appropriate measure of welfare value. This represents the bid value at which $50 \%$ of the respondents would give a positive reply. The median can be found by setting $\mathrm{Z}_{\mathrm{i}}$ in equation 1.4 equal to zero and solving for BV. The median has the advantage over the mean that it is not unduly affected by values in the tails of the distribution. However, while the median is not influenced by the distribution tails, it cannot be aggregated over the population to yield a total provincial value. Since one of the purposes of this study is to determine the value British Columbians place on increasing the area of designated wilderness, it is necessary to use mean household willingness to pay in order to aggregate to all provincial households. As a result, the mean value used was a truncated mean, truncated at $\$ 500$, the maximum bid value used in the survey.

### 1.6 Criticisms of the Contingent Valuation Method

The main drawback of the CVM is that it is a survey technique and as such is prone to all the shortcomings associated with surveys. Further, there are some biases that may be unique to the CVM. Studies have looked at such issues as the effect of hypothetical markets on responses, respondents lack of experience in valuing public goods and how respondents behave when asked about their willingness to pay a government tax or fee. In many cases, the effects of these biases are minor or can be adjusted for in the design of the CVM survey. The most complete account of these issues and others can be found in Cummings, Brookshire and Schulze (1986) and Mitchell and Carson (1989).

A concern about the CVM raised by Kahneman (1986) is that questions about the values associated with specific environmental amenities would produce responses that reflected individuals overall value for the environment. A question about doubling the amount of designated wilderness might elicit values that embedded respondents feelings about general improvements in environmental protection. Kahneman and Knetsch (1992) found that respondents placed different values on a good depending upon whether it was assessed alone or as part of a more comprehensive product. They also found evidence of temporal embedding where the value of the product was dependent on the length of the time period over which the price was to be paid. They contend that the lack of sensitivity to scope arises because rather than basing their responses on
the qualities of the public good respondents were basing their values on the moral satisfaction derived from contributing to a good cause.

Smith (1992) criticized the Kahneman and Knetsch paper for a number of deficiencies in the study design and argued that most of their results were consistent with economic theory. Loomis, Lockwood and DeLacy (1993) take account of Smith's concerns in their CVM study, yet find some evidence for an embedding effect. However, they found that a small share ( $8.3 \%$ ) of respondents' total willingness to pay was attributable to "satisfaction of giving money to a good cause". Stevens, More and Glass (1994) in their study of values associated with bald eagles in New England distinguished between payments made as a "fair share" and those motivated by a good cause. Of the survey respondents, $29 \%$ cited paying their fair share as the most important factor in their willingness to pay while $8 \%$ selected good cause as being their most important motive. The authors conclude that payment of fair share may represent a lower bound estimate of the resource value while payment for a good cause may or may not bear any relation to the value of the resource.

Carson and Mitchell (1993) examine the issue of "scope" in CV studies, the term they use rather than what they feel is the "ill-defined rubric of embedding". They criticize the results presented by Kahneman; Kahneman and Knetsch; Diamond and Hausman; and others as being based on short telephone surveys or self administered mall-intercept surveys. Further, they argue the questionnaires used in these studies are poorly designed in that they do not clearly set out the nature of the good being valued, the manner of the goods provision or the payment mechanism. Carson and Mitchell review the results of a number of these studies and show that there are significant differences in the results for the samples being compared indicating that respondents are sensitive to scope. Finally, Carson and Mitchell review a number of other well designed studies that show respondents are sensitive to the scope of the resources being valued.

Diamond and Hausman $(1993,1994)$ criticize the CVM especially its use in valuing nonuse values. Their criticism is based on the embedding problem as well as concerns relating to hypothetical questions and insufficient information in using the CVM. They argue that the CVM applied to some environmental resources asks respondents to value amenities that they are not familiar with and not used to valuing. Respondents have insufficient knowledge of the resource in question to provide an informed answer. As a result, it is felt that the values provided by respondents are not an accurate reflection of their true preferences. This is felt to be especially a problem in estimating non-use values. Hanemann (1994) addresses the issues raised by Diamond and Hausman and argues that these concerns are minimized in properly designed studies. He further contends that the evidence presented by Diamond and Hausman is based on a selective reading of the literature. Many of the studies referred to by Diamond and Hausman are subject to bias because they are poorly designed.

Studies have examined the effects on CVM values of changing the amount of information provided to respondents. Boyle (1989) found that increasing the amount of information did not produce a significant change in the mean value for trout fishing in Wisconsin. However, the increased amount of information did appear to reduce the proportion of zero bids, protest bids and non-responses as well as reducing the variance of the bids. Hoevenagel and van der Linden (1993) found that large increases in the amount of information caused a significant change in the mean value for ecological improvements but that small changes did not. Samples et al. (1986) found that providing information had a significant effect on the value attributed to preserving the humpback whale an endangered species. One possible conclusion from these studies is that additional information has a greater impact on the values for amenities that respondents are less familiar with (humpback whale and ecological improvements) than familiar services such as a trout fishery.

## 2. SURVEY DESIGN AND ANALYSIS

### 2.1 Questionnaire Design

The wilderness survey was intended to determine the preservation or non-use values that British Columbians place on doubling and tripling the amount of protected or designated wilderness in the Province. Designated wilderness areas are defined in the survey to be: roadless, undeveloped areas established and set aside by law. This includes the roadless portions of national and provincial parks plus areas protected under the Forest Act. At the time of the survey, about $5 \%$ of British Columbia, or approximately 12 million acres ( 5 million hectares), was designated wilderness. The survey was designed to find out the value residents place on increasing this area to $10 \%$ and $15 \%$ of the Province. The survey was also intended to determine the value provincial residents place on recreational activities in wilderness areas in British Columbia.

The preservation values of increasing the amount of designated wilderness were estimated by posing referendum type questions to respondents. The first referendum was for a proposal to double the amount of designated wilderness from $5 \%$ to $10 \%$ of the Province. The conditions of the referendum were that the new designated wilderness would be spread throughout the Province and that logging and mining would be prohibited in these areas. A special wilderness trust fund would be created to recover the loss of provincial fees and taxes from mining and logging operations. The cost of doubling designated wilderness would be shared by all British Columbians through higher fees and taxes. The revenues would be deposited in the special wilderness trust fund. Given these conditions, respondents were asked if they would vote for or against the proposal if it cost their families an additional $\$ x$ in provincial fees and taxes each year. There was six different posted $\$ x$ bids presented to respondents.

Some recent studies have examined various aspects of the design of posted bids. Duffield and Patterson (1991) developed a model that determines the optimal allocation of the total sample size among the different bid amounts. Cooper's (1993) model extended this to determine not only the sample size for each bid but also the optimal number of bid amounts and the dollar value of each bid amount. However, both these models are based on a given sample size and prior knowledge of the underlying distribution of willingness to pay (WTP) values.

Cooper and Loomis (1992) examine the problem where WTP is sensitive to the specification of the vector of bid values. As an example, if the posted bids are below the true WTP, responses will be clustered at the highest posted bid and an underestimate of the WTP will result. After experimenting with the results of a number of studies, Cooper and Loomis conclude that the most efficient sampling procedure is with the sample skewed toward the higher bid values. Kanninen and Kristrom (1993) questioned Cooper and Loomis' results. They argue that bids in the tails are highly influential but unreliable and with the proper use of a logistic distribution the removal of bids in the tails would not have such a large effect. They conclude that if the model is correctly specified and the bids cover the middle of the distribution rather than the tails, there should be little variance in the estimated WTP.

In determining the most appropriate bid design, the more sub-samples or bids are not necessarily preferable to less. The smaller the sub-sample, the less reliable are the estimates of the percent of the respondents that will pay each sub-sample bid. On the other hand, the more the bids are spread out, the more likely the estimates will bracket the mean WTP. One compromise for dealing with this trade-off in DC bid design is to set equal number of bids at equal distances apart or at quantiles. However, this is only efficient where pre-testing has produced a fairly reliable guess or estimate of the mean and variance.

The set of bids used in the wilderness referendum question was based on the results of four sets of focus groups used to pre-test the ability of respondents to understand and answer preliminary versions of the questionnaire. The amounts for the posted bids were established by
selecting values that a reasonable proportion of respondents agreed to so as to avoid extreme values. Also, the bids were selected so that there was roughly an equal split of those voting yes and no over the full range of the bids. The six bid values for a doubling of designated wilderness were $\$ 50, \$ 100, \$ 200, \$ 300, \$ 400$ and $\$ 500$. The total sample was divided into roughly equal sub-samples so that approximately the same number of respondents were being asked to vote on each of the posted bids.

Following the DC referendum question, respondents were asked to state the maximum amount their households would be willing to pay in increased provincial taxes annually for a doubling of designated wilderness areas. This approach, which asks the respondent to specify the maximum value that they would be willing to pay, is an application of the open-ended CVM described in section 1.3. The open-ended question was included as a check on the replies to the DC question and to provide a preservation value that could be broken down into its component values. Following the open-ended question for doubling designated wilderness, respondents were asked to provide a breakdown of their maximum stated amount according to whether it was a payment for use, existence, bequest or option values. Then, the referendum was posed again with the same conditions except that the amount of designated wilderness would triple from $5 \%$ to $15 \%$ of the Province. Once more, households were asked, using an open-ended CVM question, the maximum amount they would be willing to pay each year in provincial taxes to a trust fund to support the proposal.

The study was also intended to find out the number of wilderness trips provincial residents took in 1992 and the length of time the trips lasted. Respondents were asked if they took a wilderness trip in 1992. If so, they were asked about the number of days and spending on their last wilderness trip in 1992. Respondents were then asked how much their trip expenditures would have to increase before they would have been unwilling to take the trip. This provides an estimate of consumer surplus from wilderness trips.

### 2.2 Sample Size and Response Rate

The questionnaire (shown as appendix A) was sent in early 1993 to a random sample of 3000 households spread throughout the Province. The sample was drawn from telephone directories. The instructions asked that the questionnaire be completed by the member of the household, 18 years of age or older, who most recently had a birthday. As a result, the survey responses represent the views of provincial residents eighteen years of age and older. A postage paid, self-addressed envelope was included for the return of completed questionnaires. The initial mail-out was followed by a reminder postcard. A second questionnaire was sent to households that had not returned a completed questionnaire several weeks after the initial mailing. Finally, an attempt was made to contact by telephone all households that had still not replied. Those contacted were asked why they had not completed and returned the questionnaire and if they would be willing to complete and return the questionnaire or answer three or four questions from the survey. The pattern of contacts was consistent with the Total Design Method suggested by Dillman (1978) to maximize survey response.

Of the questionnaires sent out, 42 were returned as undeliverable and 80 households refused to accept delivery. In total, 1561 completed and usable questionnaires were returned. This represents a response rate of $54 \%$ of the delivered questionnaires. Telephone contact was made with $919(78 \%)$ of the non-respondents to the mailed questionnaire. Of those contacted, $47 \%$ agreed to answer a few questions from the survey, $28 \%$ agreed to complete the questionnaire while the remainder either refused or were unable to answer the questions. A total of 89 completed questionnaires was received from those contacted by phone. The reason most frequently given for not having completed the questionnaire was that the respondent was too busy/had no time.

### 2.3 Adjustment of Discrete Choice Responses

The discrete choice CVM question asking the respondent if they would pay a specified amount for a doubling of wilderness preceded the open-ended CVM question asking the maximum amount households would pay for doubling designated wilderness. However, 224 respondents that agreed to pay a specific DC bid provided a maximum payment that was less than the bid amount. This should not occur because the maximum willingness to pay represents the upper limit for agreeing to a bid. On the other hand, there was 9 respondents that answered no to the referendum even though they gave a maximum amount greater than the bid amount. It is likely that respondents in these two categories did not understand either one or both questions or the relationship between them.

It was necessary to adjust these responses in order to make them consistent. If the stated maximum willingness to pay was less than the agreed to bid amount, then the respondent's yes vote for this amount was changed to a no. If the respondent gave a no to a bid amount that was less than their maximum willingness to pay, their vote was changed to a yes. A total of 224 votes in the referendum question was changed to no votes and 9 were changed to yes votes. Table 2.1 shows how this adjustment changed the distribution of yes votes. The adjusted distribution was used in determining the value for designated wilderness.

TABLE 2.1 Effect of Bid Adjustment

|  | Percent Voting Yes <br> Bid Amount |  |
| :---: | :---: | :---: |
| $\$ 50$ | Unadjusted | Adjusted |
| $\$ 100$ | $62.4 \%$ | $59.8 \%$ |
| $\$ 200$ | $53.0 \%$ | $44.8 \%$ |
| $\$ 300$ | $47.2 \%$ | $28.5 \%$ |
| $\$ 400$ | $41.1 \%$ | $20.6 \%$ |
| $\$ 500$ | $39.7 \%$ | $16.4 \%$ |
|  | $38.2 \%$ | $14.6 \%$ |
| Total | $46.8 \%$ | $30.7 \%$ |

### 2.4 Treatment of Protest Votes and Outliers

In CVM studies using the open-ended technique a large proportion of the stated values can be zeros. Frequently, these are honest responses of those with low incomes or individuals who place no value on the particular good. However, some may be what are called zero protest votes of those unwilling to co-operate or rejecting the payment scenario even though they place a positive value on the good. Zero protest votes can be significant in number. For example, Desvousges, Smith and McGivney (1983) judged that about one-half of zero votes in their study were protests. It is necessary to identify zero protest votes because to treat them as true zero votes leads to an under-estimate of the mean.

The simplest method of identifying zero protest votes is to ask those voting zero why they did so. This makes it possible to distinguish protests from true zero values. An alternative technique used in a number of studies including Randall et al. (1974), Brookshire et al. (1976) and Rowe et al. (1980) is to use questions on the importance attached to the good as well as income to identify respondents who have probably given a zero protest vote. Once a zero vote has been judged to be a protest rather than a true zero, it should be assigned a value or treated as a nonresponse so as not to bias the estimated values.

Of the responses to the open-ended maximum willingness to pay question for a doubling of designated wilderness question, 546 or $41 \%$ were zero bids. For a tripling of designated wilderness, 385 or $35 \%$ of the bids were zero. Each of these zero bids was examined based on the criteria of the respondents attitude to increasing protected wilderness and their income. These two criteria provide an indication of the value the respondent places on increasing protected wilderness and their ability to pay for increased wilderness. Respondents that gave a zero value but felt that there is too little or far too little designated wilderness in British Columbia and had household income of $\$ 30,000$ or more were treated as zero protest votes. Note that since respondents were asked to indicate the income class that best reflected their household income, income was set at the mid-point of the class reported. An income of $\$ 30,000$ was judged to be sufficient for households to be able to contribute to wilderness protection. Based on these criteria, 110 zero bids or $20 \%$ of the zero bids were judged to be protests for a doubling of designated wilderness and 81 for a tripling or $21 \%$ of the zero bids.

A similar procedure was used to test for zero protest votes for willingness to pay increased expenditures on wilderness trips. It is possible that expenditures already made on the wilderness trip exhaust consumer surplus so that a zero bid is quite valid. A valid zero bid can also arise if the respondent is constrained from increasing expenditures by income. As a result, the criteria used to indicate a zero protest vote were that the respondent had not made expenditures on their wilderness trip that were more than double the average expenditures reported by all respondents who took wilderness trips and their income was $\$ 30,000$ or more. The first criterion is to ensure that the respondent had not made exceptional expenditures that might have used up their consumer surplus. Of the 178 respondents that took a wilderness trip in 1992 and provided values for willingness to increase expenditures, 13 provided values of zero. Based on the above criteria, seven of these were judged to be zero protest votes.

Open-ended CVM studies are also susceptible to outliers or extreme values because they are unbounded at the upper end. These can arise when respondents have strong feelings about the good being valued and high incomes. They can also arise when someone is trying to influence the outcome or are unsure of their true values but wish to co-operate with the survey. In most cases, a true outlier is an unreasonable outcome given individual characteristics and stated preferences for the product. The concern with outliers is that they can have a very strong influence on the mean value.

Some methods that have been used to identify and eliminate outliers include cutting off values more than a certain number of standard deviations away from the mean or more than a certain percent of income. Rowe et al. (1980) reject bids more than 10 standard deviations from the mean. However, this method is subject to the criticism that it is arbitrary and might create selection bias in the core data base. Mitchell and Carson (1989, 226-27) suggest that the alphatrimmed mean can be used to reduce the influence of outliers. The alpha-trimmed mean is a family of estimators that includes the mean and median and is determined by the value assigned to alpha. This statistic is relatively simple to calculate and avoids the appearance that the data is being manipulated to give a desired result.

For a doubling of designated wilderness, 28 respondents stated a maximum willingness to pay of over $\$ 1,000$. Of these, 6 respondents had incomes of less than $\$ 15,000$. Similarly, for a tripling of designated wilderness, 35 responses were over $\$ 1,000$ with a maximum value of $\$ 20,000$. In the analysis, stated values were treated as outliers if the value was more than $10 \%$ of household income for increases in designated wilderness and 8\% of income for increased expenditures on wilderness trips. Based on this criteria, seven responses were considered to be outliers for a doubling of designated wilderness and 8 for a tripling. Three outliers were found for increased expenditures on wilderness trips/

### 2.5 Item Non-Response

Open-ended CVM questions are subject to high non-response rates. This can arise because respondents do not know the value they place on the resource, do not understand the question or refuse to co-operate. Typically, there are much better response rates to discrete choice CVM questions since the respondent has only to answer yes or no to a single value. The non-response rate to the discrete choice question in the survey was only $5-6 \%$. In comparison, the non-response for the open-ended questions were 227 or $15 \%$ of respondents for doubling designated wilderness and 480 or $31 \%$ for tripling. In the case of willingness to pay increased expenditures for wilderness trips, there was 68 missing values or $31 \%$ of those providing expenditure information. The high non-response rates decrease the amount of information available for estimation thereby reducing the validity of the resulting estimates.

Techniques have been developed to attribute values to respondents who have given zero protest votes, outliers or did not respond. One approach is to assign values based on the values given by respondents with the same social and economic characteristics and feelings toward the product as the non-respondents. The values can be the mean or median values from the appropriate class of valid responses or it can be a randomly assigned value from the distribution of valid responses. The use of the mean or median reduces the variance of the distribution of bids while randomly assigned values can maintain it. Another approach is to use regression or maximum likelihood models to predict relationships based on the estimated equations and characteristics of respondents with valid responses. The characteristics of the protest voter, outlier or non-respondent are then used in the structural equations to give an estimated value.

The respondents with protest bids or outliers were temporarily removed while the valid zero bids were left in the sample. With this sub-sample, regression equations were estimated which show how attitudes towards wilderness and social and economic characteristics affect willingness to pay for increasing designated wilderness and expenditures on wilderness trips. The relationships shown by these equations were used to determine the amount protest voters, outliers or non-respondents would be expected to pay given their attitudes and characteristics. These bid values were attributed to respondents identified as protest voters, outliers and nonrespondents and returned to the sample. A total of 262 bids for a doubling of designated wilderness and 450 bids for tripling wilderness were adjusted using this procedure. There were 51 adjusted bids for increased expenditures on wilderness trips.

### 2.6 Survey Non-Response

The previous section discussed the problem that arises and the adjustment made when respondents failed to answer the questions about increased willingness to pay. The failure to answer a specific question is known as item non-response. A similar problem known as survey non-response arises when part of the sample fails to complete and return the questionnaire. It is possible that those who have completed the questionnaire are more enthusiastic about and place a higher value on the good or service being valued than non-respondents. If this is the case, survey respondents are not representative of the values of non-respondents. Attributing the values of respondents to non-respondents leads to an over-estimate of the true value of the good or service. Similarly, respondents to the second mailing and phone follow-up might be less enthusiastic and place a lower value on the resource than respondents to the initial mailing.

The possibility of survey non-response was tested for by comparing the mean willingness to pay for the sub-samples that responded to the first and second mailings and telephone followup. If the values of non-respondents differ from respondents then this would be indicated by different mean values for the different mailings. The following shows the number of responses and the mean maximum willingness to pay for a doubling of designated wilderness from the two mailings and phone follow-up.

Mailing 1 Mailing $2 \quad$ Phone

| Number | 886 | 372 | 76 |
| :--- | :---: | :---: | :---: |
| Mean | $\$ 148.28$ | $\$ 86.90$ | $\$ 95.85$ |

Statistical tests indicate the means between the first and second mailings were significantly different at the $99 \%$ confidence level. However, there was no statistically significant difference in means between the second mailing and the phone mailing. As a result, these two mailings were combined to give the following sub-sample sizes and means.

| Mailing 1 | Mailing 2 <br> and Phone |
| :---: | :---: |
| 886 | 448 |
| $\$ 148.28$ | $\$ 88.42$ |

The households that responded to the initial mailing had a greater maximum willingness to pay than those that replied to the second mailing and the phone follow-up. Since the value found for respondents to the second mailing and phone follow-up are likely more representative of survey non-respondents values, it is necessary to attribute this value to the non-respondent portion of the original sample in calculating the overall means. This is done by weighting the values of respondents to the second mailing and phone follow-up to also represent survey nonrespondents. A total of 1,851 households from the original sample either did not respond to the questionnaire or responded to the second mailing or the phone follow-up. Of these, 536 answered the questionnaire. In order to represent the full 1,851 , each of these 536 respondents was given a weight of 3.46 which means that each represents 3.46 of the non-respondents and respondents to the second mailing and phone follow-up.

The same procedure was used to test for survey non-response for a tripling of designated wilderness and increased expenditures on wilderness trips. For tripling designated wilderness, there were statistically significant differences between the mean maximum willingness to pay from the first mailing and the means from both the second mailing and the phone follow-up. However, there was no difference between the means of the second mailing and the phone follow-up. Again, the results from the second mailing and phone follow-up were used to weight the results to take account of survey non-respondents. The means of the willingness to pay increased expenditures for wilderness trips were not significantly different between the first mailing and either the second mailing or the phone follow-up. As a result, it was not necessary to adjust increased wilderness trip expenditures for survey non-response.

### 2.7 Effects of the Adjustment Procedures

The net effects of the adjustment and weighting procedures on the survey results are given in Table 2.2. The table shows the mean willingness to pay values, described in detail in the next section, for the doubling and tripling of designated wilderness areas in British Columbia and the sample sizes on which the means were based. For the doubling of designated wilderness the adjustment for protest votes, outliers and item non-response increased the mean and sample size, while the weighting procedure sharply reduced the mean. The combined effects of the adjustment and weighting was a lower mean as compared to the raw data mean. For the tripling of designated wilderness both the adjustment procedure and the weighting procedure lowered the mean value from that of the raw data. In summary, the net effect of the adjustment and weighting procedures used in this study was to lower the estimated values compared to the results from the raw data.

TABLE 2.2
Effects of the Adjustment Procedures on the Mean Willingness to Pay for Doubling and Tripling Designated Wilderness Areas from the Open-Ended Questions

|  | Double |  | Triple |  |
| :--- | :---: | :---: | :---: | :---: |
| Maw Data | 128.18 | 1334 | 192.94 | 1081 |
| Protests, Outliers    <br> and Item Non-Response 132.52 1479 172.96 | 1442 |  |  |  |
| Adjustment | 110.19 | 1334 | 159.28 | 1081 |
| Weighted for <br> Non-Response | 119.01 | 1479 | 156.41 | 1442 |
| Adjusted and <br> Weighted |  |  |  |  |

## 3. RESULTS

### 3.1 Introduction

Presently, about 5\% of British Columbia, or 4.8 million hectares ( 11.8 million acres), is designated wilderness that is protected by law. In order to determine how British Columbians feel about the present amount of designated wilderness in the Province, respondents were asked if $5 \%$ of the land base was too much or too little. Of those that answered the question, about $61 \%$ felt that the present amount of designated wilderness was too little or far too little. Only 3\% thought the amount of designated wilderness was too much or far too much while $36 \%$ felt it was about right.

TABLE 3.1
Opinions about the Present Amount of Designated Wilderness
Percent of Respondents

| Far too much | $0.8 \%$ |
| :--- | :---: |
| Too much | $2.2 \%$ |
| About right | $36.5 \%$ |
| Too little | $40.6 \%$ |
| Far too little | $20.0 \%$ |

### 3.2 Value of Doubling Designated Wilderness - Discrete Choice Method

The discrete choice referendum question asked respondents if they would vote for the proposed doubling of designated wilderness if it cost their households the specified amount each year in increased taxes and fees. After the adjustments and weighting of the results explained in the previous section, the responses to the DC referendum question were analyzed to determine the value provincial residents place on doubling designated wilderness. It is hypothesized that the logodds ratio, Z , is determined by a set of independent variables according to the following linear relationship:

$$
\begin{equation*}
Z=\alpha+\beta_{1} B V+\beta_{2} Y+\beta_{3} A+\beta_{4} E+\beta_{5} T+\varepsilon \tag{3.1}
\end{equation*}
$$

where $\quad Z \quad-\quad \log$ odds ratio or logit, $\ln [P /(1-P)]$
P - probability of voting for the proposal
BV - bid value
Y - household income
A - attitude towards the current amount of designated wilderness
E - education level
T - wilderness trip in 1992, yes=1, no=0
$\varepsilon \quad-\quad$ stochastic error term.
It is expected that as the bid value increases the probability of a respondent voting for the proposal would decrease so that the coefficient for BV should be negative. Respondents were asked to indicate which of the six income classes presented, ranging from $\$ 15,000$ and below to $\$ 80,000$ and over, best represented their household income. The income class mid-points were used in the regressions to represent household income except for the highest class which was set at a value of $\$ 95,000$. The income coefficient is expected to be positive since increases in income increase the ability to pay for additional designated wilderness. The attitude variable measures respondents' feelings about the current amount of designated wilderness using a scale ranging from 1 for far too much designated wilderness to 5 for far too little designated wilderness. The
coefficient on the attitude variable is expected to be positive indicating that the probability of voting for the proposal increases as the desire for more wilderness increases. Education was measured on a scale from 1 for having completed some high school to 7 for having a post graduate degree. There were no a priori expectations about the sign for the education coefficient although other studies have typically found a positive relationship between education and willingness to pay values for environmental amenities. The trip variable was included in the expectation that active wilderness users would place a higher value on additional protected wilderness. The means and standard deviations of the independent variables are given in Table 3.2.

TABLE 3.2
Summary Statistics for Independent Variables Used in the Logit Regression

| Variable | Weighted <br> Mean | Standard <br> Deviation | Minimum <br> Value | Maximum <br> Value |
| :--- | :---: | :---: | :---: | :---: |
| Bid Value | 264.913 | 209.561 | 50.0 | 500.0 |
| Household | 46.817 | 33.234 | 7.5 | 95.0 |
| Income | 3.751 | 1.091 | 1 | 5 |
| Attitude | 3.555 | 2.214 | 1 | 7 |
| Education | 0.153 | 0.482 | 0 | 1 |

The mean value of the discrete choice responses was found using a multivariate logit estimate. The following model was estimated:

$$
\begin{equation*}
Z=F(B V, Y, A, E, T)+\varepsilon \tag{3.2}
\end{equation*}
$$

The logit equation was estimated using a maximum likelihood estimation procedure as explained in section 1.5. The regression results are reported in Table 3.3, which shows that all of the estimated coefficients have the expected signs and are significant at the $95 \%$ confidence level or better. Age and sex were also tested in the regressions but did not have significant coefficients. The equation as a whole is also highly significant with over $83 \%$ of the observations being correctly predicted by the equation. The log likelihood chi-square statistic also shows the equation to be significant at the $99 \%$ confidence level. Table 3.4 provides details on the distribution of bid values and predicted voting probabilities.

Using the regression results we can graph the impact bid values have on the probability of a respondent voting for the proposal as shown in Figure 3.1. The diagram shows the effect the bid value has while holding all other independent variables constant at their mean values. Numerical integration of the area under the curve up to a maximum bid value of $\$ 500$ yields an estimate of $\$ 130.20$ for the truncated mean willingness to pay for a doubling of designated wilderness areas in British Columbia. Based on the results of the 1991 Census of Canada, it is projected that there was 1,276,082 households in British Columbia in 1992. Given this estimate of the number of households and the truncated mean willingness to pay per household, the total annual value for doubling designated wilderness areas in the Province is \$166 million in 1993.

TABLE 3.3
Logistic Regression Results

| Variable | Coefficient | Chi-Square Statistic |
| :---: | :---: | :---: |
| Intercept | -5.7172* | 248.788 |
| Bid Value | -0.00692* | 287.269 |
| Income | $0.00542^{* *}$ | 5.589 |
| Attitude | 1.4019* | 295.754 |
| Education | 0.1603* | 22.128 |
| Wilderness <br> Trip in 1992 | 0.6191* | 18.271 |
| Log Likelihood Chi-Square Correct Predictions Number of Observations | $\begin{gathered} 777.808 \\ 83.4 \% \\ 1314 \end{gathered}$ |  |

* Coefficients significantly different from zero at the 99\% confidence level.
** Coefficient significantly different from zero at the $95 \%$ confidence level.

TABLE 3.4
Distribution of Bid Responses

| Bid Value | Sample <br> Size | Yes <br> Votes | Adjusted <br> Yes Votes* | Probability | Weighted <br> Probability** | Fitted <br> Probability |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| 50 | 254 | 154 | 152 | 0.598 | 0.552 | 0.638 |
| 100 | 230 | 125 | 103 | 0.448 | 0.426 | 0.411 |
| 200 | 232 | 110 | 66 | 0.285 | 0.243 | 0.229 |
| 300 | 286 | 116 | 59 | 0.206 | 0.196 | 0.134 |
| 400 | 238 | 93 | 39 | 0.164 | 0.130 | 0.027 |
| 500 | 239 | 92 | 35 | 0.146 | 0.120 | 0.000 |
| Total | 1479 | 690 | 454 | 0.307 | 0.274 | 0.236 |

* Number of yes responses after making the adjustments detailed in Section 2.3.
${ }^{* *}$ Probabilities after weighting for non-response bias as detailed in Section 2.6.


FIGURE 3.1 Estimated Effect of Bid Value on the Probability of a Yes Vote
The median value can be found by setting the estimate of equation 3.2 to zero and substituting the mean values of all independent variables except bid value to yield:
$0=0.459735-0.00692 B V$
Solving for BV yields a median value of $\$ 66.40$ which is just over half the value of the truncated mean. The willingness to pay values for doubling designated wilderness found using the DC method are summarized in Table 3.5.

TABLE 3.5
Household Mean, Median And Total Annual Values for Doubling Designated Wilderness, DC Method (1992 Dollars)

|  |  |
| :--- | ---: |
| Mean Household Value | $\$ 130.20$ |
| Median Household Value | $\$ 66.40$ |
| Total Household Value | $\$ 166,082,000$ |

## Effects of Independent Variables

The coefficients from the logit regression cannot be interpreted directly as the size of the change in the probability of voting for the proposal. Rather they predict the change in the logit $Z_{i}$, which is non-linearly transformed into the probability of voting for the proposal by the logistic cumulative probability distribution function. This makes economic interpretation of the coefficients difficult. However, by employing the technique suggested by Cameron (1988), it is possible to convert the logit estimate into an inverse demand function. The conversion is made by dividing the constant and parameter coefficients, other than the bid value coefficient, by the absolute value of the bid value coefficient. With this transformation median willingness to pay becomes the dependent variable and the new coefficients show the dollar value of unit changes in the independent variables. Performing this transformation on our logit regression results yields:

Median WTP $=-826.18+0.78 \mathrm{Y}+202.59 \mathrm{Att}+23.16 \mathrm{E}+89.46 \mathrm{~T}$
Thus, a $\$ 1,000$ increase in household income increases median willingness to pay by only $\$ 0.78$ as compared to a $\$ 202.59$ increase if the index of current attitudes towards designated wilderness increases by one point. An increase in one education level increases the median value by $\$ 23.16$ and the effect of taking a wilderness trip in 1992 increases the median value by $\$ 89.46$.

The effects of changes in the independent variables, other than the bid value, on the truncated mean and median willingness to pay are presented in Table 3.6. The most dramatic impact on the probability distribution was the effect of changes in a respondent's attitude towards the current amount of designated wilderness in British Columbia. The effect of a respondent having taken a wilderness related trip during 1992 was also substantial. Table 3.6 also shows that as household income, attitude, education and wilderness trips in 1992 increased the probability distribution became less skewed as shown by the narrowing of the differences between the mean and the median values. The effects of the changes in the independent variables on the probability of voting to double designated wilderness are illustrated in Figures 3.2 through 3.5.

## Effect of the Truncation Point

As discussed in section 1.5, selection of the truncation point may be important in determining the value of the truncated mean. Bowker and Stoll (1988) examined the effect of the truncation point on the mean in their study of the value of preserving whooping cranes. They found that doubling and tripling the value of the truncation point had little effect on the mean in some cases while in others the mean increased by as much as $75 \%$. The outcome depended on the model specification. The truncation point chosen had little impact on the utility-theoretic specification, suggested by Hanemann (1984), but significant effects on the logarithmic specification. Loomis (1987) in his study of different water levels for Mono Lake in eastern California found estimated values were insensitive to the truncation point. He found that truncating at the highest bid amount respondents were asked to pay excluded only 0.005 of the distribution. Lower truncation points had little effect on the mean.

In this study a truncation point of $\$ 500$ was used which corresponds to the maximum bid value presented in the survey. The effect of setting a higher truncation point, and thus extrapolating past the maximum survey bid value based on the logit regression results, are presented in Table 3.7. The results indicate that as the truncation point is increased, the value of the truncated mean appears to be converging towards $\$ 137$, or $5.3 \%$ higher than if a $\$ 500$ truncation point is used. Given the relatively small increase in the truncated mean resulting from extrapolation past the maximum bid value used in the survey, the use of the maximum survey bid value of $\$ 500$ as the truncation point appears to have been reasonable.

TABLE 3.6
Effect of Changes in Independent Variables on the Truncated Mean and Median Willingness to Pay
(1992 Dollars)

|  | Truncated <br> Mean | Median | Percent of <br> Sample |
| :--- | :---: | :---: | :---: |
| At Mean Values | $(\$)$ | $(\$)$ | $(\%)$ |
| Household Income* | 130.15 | 66.44 | 100.0 |
|  |  |  |  |
| \$15,000 |  |  |  |
| $\$ 15,000-\$ 29,999$ | 113.38 | 35.64 | 8.3 |
| $\$ 30,000-\$ 49,999$ | 119.62 | 47.39 | 19.8 |
| $\$ 50,000-\$ 64,999$ | 127.15 | 61.10 | 30.5 |
| $\$ 65,000-\$ 79,999$ | 134.93 | 84.80 | 20.6 |
| $\$ 80,000+$ | 141.79 | 104.17 | 9.0 |
|  | 152.39 |  | 11.7 |

Attitude Towards Current Amount of Designated Wilderness in B.C.

| 1 - Far Too Much | 4.61 | -490.92 | 0.9 |
| :--- | ---: | ---: | ---: |
| 2 - Too Much | 17.81 | -288.33 | 2.1 |
| 3 - About Right | 61.08 | -85.74 | 36.7 |
| 4 - Too Little | 160.24 | 116.84 | 41.4 |
| 5 - Far Too Little | 298.05 | 319.43 | 18.9 |

Education Levels

| 1 - Some High School | 99.14 | 7.26 | 10.1 |
| :--- | ---: | ---: | ---: |
| 2 - High School or Equivalent | 110.68 | 30.42 | 24.4 |
| 3 - Vocational or Trade School | 122.99 | 53.59 | 11.3 |
| $\quad$ Graduate |  |  |  |
| 4 - Some College of University | 136.05 | 76.75 | 25.0 |
| 5 - College or University Graduate | 149.80 | 99.92 | 19.4 |
| 6 Some Graduate Work | 164.16 | 123.08 | 3.0 |
| 7 - Completed Graduate Degree | 179.07 | 146.25 | 6.8 |

## Took Wilderness Trip in 1992

| $0-$ No | 122.54 | 52.76 | 84.7 |
| :--- | ---: | ---: | ---: |
| $1-$ Yes | 176.45 | 142.23 | 15.3 |

[^0]

FIGURE 3.2 Effect of Income on the Probability of a Yes Vote


FIGURE 3.3 Effect of Attitude towards Wilderness Designation on Probability of a Yes Vote


FIGURE 3.4 Effect of Education on the Probability of a Yes Vote


FIGURE 3.5 Effect of Wilderness Trip Experience on the Probability of a Yes Vote

TABLE 3.7
Effect of the Truncation Point on the Truncated Mean

| Truncation <br> Point | Truncated <br> Mean | Increase <br> Over Base | Marginal <br> Increase | Percent <br> Increase |
| :---: | :---: | :---: | :---: | :---: |
| 500 | 130.15 | n.a. | n.a. | n.a. |
| 600 | 133.61 | 3.46 | 3.46 | 2.7 |
| 700 | 135.38 | 5.23 | 1.77 | 4.0 |
| 800 | 136.27 | 6.12 | 0.89 | 4.7 |
| 900 | 136.72 | 6.57 | 0.45 | 5.0 |
| 1000 | 136.94 | 6.64 | 0.07 | 5.2 |

## Alternative Functional Form

The functional form used in equation 3.2 assumed that the logit was linearly related to the bid value. It was decided to test the effect of using the natural logarithm of bid value, $\ln (\mathrm{BV})$ the double log form, in place of bid value on the estimated willingness to pay value. The regression results are listed in Table 3.8, which shows that again all estimated coefficients have the expected signs, are statistically different from zero at the $95 \%$ level of significance or better, and that the equation as a whole is significant at the $99 \%$ level. The alternative functional form performs marginally better than the original form.

Figure 3.6 compares the effect the bid value has on the probability of voting for the proposal for both the original and alternative functional forms. There are three differences of note. First, the alternative form has a relatively thicker tail than the original form which suggests that the alternative form has an even more skewed distribution than the original. Second, the area under the curve for the log form does not converge to a finite number. As a result, while a truncated mean can be calculated for the alternative form, an overall mean cannot. Third, the probability of voting for the proposal always converges to one as bid value approaches zero for the alternative form. This results from the use of $\ln (B V)$ which approaches infinity as BV approaches zero. This is an undesirable result as it suggests that all respondents would vote for the proposal at a bid value of zero, regardless of their attitudes and economic and social characteristics. This would include people who responded that there is "far too much" or "too much" designated wilderness already. This result is implausible and calls into question the use of the alternative functional form.

Numerical integration of the alternative functional form up to a bid value of $\$ 500$ yields a truncated mean willingness to pay of $\$ 131.27$ as compared to $\$ 130.15$ under the original specification. The median value was $\$ 73.80$ for the alternative form as compared to $\$ 66.44$ for the original form. The effect of the alternative functional form on the truncated mean is negligible and, given the undesirable statistical and theoretical characteristics of the alternative form, would suggest that the original form be retained. Loomis (1987) tested for the effects of different functional forms by estimating his model with the bid variable entering in log form. The resulting change in the estimated mean was approximately $5 \%$ of the original estimate.

TABLE 3.8
Logistic Regression Results for the Alternative Functional Form

| Variable | Coefficient | Chi-Square Statistic |
| :---: | :---: | :---: |
| Intercept | -0.6306* | 2.054 |
| $\operatorname{In}$ (Bid Value) | -1.3223* | 324.560 |
| Income | 0.00551 ** | 5.713 |
| Attitude | 1.4243* | 298.135 |
| Education | $0.1732^{*}$ | 25.347 |
| Wilderness | 0.6663 * | 20.971 |
| Trip in 1992 |  |  |
| Log Likelihood Chi-Square |  |  |
| Correct Predictions |  |  |
| Number of Observations |  |  |



FIGURE 3.6 Effect of Alternative Functional Form on Probability of Voting Yes

### 3.3 Value of Doubling Designated Wilderness - Open-Ended Method

The discrete choice referendum question was followed by the open-ended question asking the maximum amount households would be willing to pay for doubling designated wilderness. Since open-ended questions are more difficult to answer, it was hoped the discrete choice question would set the stage by having the respondent decide whether or not they would pay a specific amount before thinking about their maximum amount. The mean maximum household willingness to pay for a doubling of designated wilderness is $\$ 119.00$ per year. The
median maximum household willingness to pay is $\$ 100$. The total annual value for doubling designated wilderness using the open-ended method is estimated to be about $\$ 152$ million dollars.

TABLE 3.9
Household Mean, Median and Total Annual Values for Doubling Designated Wilderness - Comparison of the Discrete Choice and Open-Ended Results (1992 Dollars)

|  | Open-Ended <br> Method | Discrete Choice <br> Method |
| :--- | ---: | ---: |
| Mean Household Value |  |  |
| Median Household Value | $\$ 119.00$ | $\$ 130.20$ |
| Total Household Value | $\$ 100.00$ | $\$ 66.40$ |
|  | $\$ 151,867,000$ | $\$ 166,082,000$ |

The mean value found using the discrete choice method was slightly greater than the mean for the open-ended method. Studies such as Seller, Stoll and Chavas (1985) that have compared means using the two methods have typically found the mean using the discrete choice method larger than the mean for the open-ended method. Kealy and Turner (1993) also obtained this result and examined some possible explanations for the difference in means found for public goods but not private goods. The difference in means found in the present study was examined by calculating the confidence intervals for the means. For example, the confidence interval for the open ended method was $+/-\$ 11.20$ around a mean of $\$ 119.00$ at the $95 \%$ level of confidence. Therefore, 95 out of one hundred times we draw a sample from the population it would be expected to have a mean between $\$ 107.80$ and $\$ 130.20$. It was found that the confidence intervals for the two means overlap. As a result, it is not possible to conclude that there is a statistically significant difference in the means found using the two methods.

### 3.4 Components of Value

Respondents were asked to give a percentage breakdown of their maximum willingness to pay amounts according to the different types of values described in section 1.4. There were four types of values considered. These included the value placed on the future use of the newly designated wilderness as well as the option value for the assurance the areas will be available for future use. The bequest value derives from knowing that these areas will be available for future generations. Finally, the existence value is from knowing that these areas exist and are protected even though no one may make use of them.

Table 3.10 shows the breakdown for the mean maximum willingness to pay for doubling designated wilderness areas according to the four types of values. Over $76 \%$ of the value for increasing protected wilderness is due to the existence and bequest motives. This result is very similar to the findings of other studies that have looked at the component values. For example, Walsh et al. (1990) found that almost three-quarters of the total value attributed to the protection of forest quality in Colorado was due to preservation values. Loomis, Lockwood and DeLacy (1993) found that two-thirds or more of the value of protecting forests in southern Australia was due to existence and bequest values.

TABLE 3.10
Types of Values for Doubling Designated Wilderness

|  | Percent <br> Distribution | Average <br> Annual Values |
| :--- | :---: | :---: |
| Use Value | $10.3 \%$ |  |
| Option Value | $13.2 \%$ | $\$ 12.30$ |
| Bequest Value | $38.7 \%$ | $\$ 15.70$ |
| Existence Value | $37.8 \%$ | $\$ 46.10$ |
| Total | $100.0 \%$ | $\$ 44.90$ |

One explanation for the minor share of use value in total value is that a small proportion of the population place a value on expected future use or the option for use. Even though these people may place a high value on their expected use, when averaged over the provincial population these values become quite low. On the other hand, it is likely that a large share of the population attach existence and bequest values to increased designated wilderness.

### 3.5 Value of Tripling Designated Wilderness

The maximum willingness to pay question for tripling designated wilderness was posed under the same conditions as for doubling designated wilderness. Tripling designated wilderness would increase the area of British Columbia that is protected from $5 \%$ to $15 \%$. The mean maximum household willingness to pay increased taxes and fees for tripling designated wilderness is $\$ 156.40$ per year. The median value is $\$ 100$. As is to be expected, the mean value for tripling designated wilderness is greater than for doubling wilderness. However, the first five percent increase in protected wilderness, from $5 \%$ to $10 \%$, is more valuable than the second five percent increase from $10 \%$ to $15 \%$. Again, this is to be expected as subsequent increments in goods and services decline in value. The total annual value that provincial residents place on tripling the amount of designated wilderness is estimated at over 199 million dollars.

TABLE 3.11
Household Mean, Median and Total Annual Values for Tripling Designated Wilderness
(1992 Dollars)

|  |  |
| :--- | ---: |
| Mean Household Value | $\$ 156.40$ |
| Median Household Value | $\$ 100.00$ |
| Total Household Value | $\$ 199,592,000$ |

A test of difference between means was performed on the open-ended means for doubling and tripling designated wilderness. Confidence intervals were also found for the two means. These tests were conducted to determine if there was any indication of embedding or problems of scope, described in section 1.6, in the results. If respondents embedded values, the payment would not increase as the amount of protected wilderness increased from $10 \%$ to $15 \%$ of the Province. Rather respondents would pay the same amount for doubling and tripling designated wilderness for the moral satisfaction of giving to a good cause. The test of significance did not support the hypothesis that the means are the same. Further, the confidence intervals for
the means do not overlap. These results do not lend support to the claim that respondents embed values and base willingness to pay on moral satisfaction rather than the value of the good or service.

### 3.6 Regression Analysis of the Open-Ended Results

Regression analysis of the open-ended results was undertaken to determine the factors which affected respondents willingness to pay values for increasing designated wilderness. The same explanatory variables used in the logit regression (equation 3.2) were included in the openended willingness to pay equations for both the doubling and tripling of designated wilderness areas. The reason for including the discrete choice bid value as an independent variable is discussed below. As with the logit regression, a linear functional form was used which yields the following equation to be estimated for both the doubling and tripling of designated wilderness:
(3.5) $\quad$ WTP $=\alpha+\beta_{1} B V+\beta_{2} Y+\beta_{3} A t t+\beta_{4} E+\beta_{5} T+\varepsilon$

The signs of the coefficients were expected to be positive for all variables including bid value (the reason for this is explained below). The equation was estimated for the maximum willingness to pay for doubling and tripling designated wilderness using weighted least squares regression analysis and the results are presented in Table 3.12. The weights used were those described in section 2.6 to account for survey non-response bias. Both equations were highly significant, as shown by the F statistic, and all coefficients had the expected signs and were significant at the $95 \%$ confidence level or better. Table 3-13 provides some summary statistics on the observations included in the regressions.

TABLE 3.12
Regression Estimates for Open-Ended Values

| Variable | Doubling Designated <br> Wilderness | Tripling Designated <br> Wilderness |
| :--- | :---: | ---: |
| Constant | $-360.31^{*}$ | $-510.78^{*}$ |
| Bid Value | $(16.57)$ | $(17.17)$ |
|  | $0.23^{*}$ | $0.29^{*}$ |
| Household Income | $(9.60)$ | $(8.82)$ |
|  | $0.69^{*}$ | $0.97^{*}$ |
| Attitude | $(4.43)$ | $(4.56)$ |
| Education | $92.82^{*}$ | $130.37^{*}$ |
|  | $(19.83)$ | $(20.36)$ |
| Trip in 1992 | $11.36^{*}$ | $16.84^{*}$ |
|  | $(4.87)$ | $(5.27)$ |
| Adjusted R² | $38.49^{*}$ | $29.29^{* *}$ |
| F | $(3.62)$ | $(2.01)$ |
| Number of Observations |  |  |
|  | 0.30 | 0.30 |

Values in brackets are the absolute values of the "t" statistics for each coefficient.

* Coefficient significantly different from zero at the $99 \%$ confidence level.
** Coefficient significantly different from zero at the 95\% confidence level

TABLE 3.13
Summary Statistics of the Independent Variables

| Variable | Weighted <br> Mean | Standard <br> Deviation | Minimum <br> Value | Maximum <br> Value |
| :--- | ---: | ---: | :---: | :---: |
| WTP for Doubling | 127.503 | 219.415 | 0 | 2000.0 |
| WTP for Tripling | 164.771 | 299.789 | 0 | 3000.0 |
| Bid Value | 264.339 | 209.669 | 50.0 | 500.0 |
| Household Income | 46.753 | 33.257 | 7.5 | 95.0 |
| Attitude | 3.750 | 1.092 | 1 | 5 |
| Education | 3.555 | 2.215 | 1 | 7 |
| 1992 Wilderness Trip | 0.152 | 0.481 | 0 | 1 |
|  |  |  |  |  |

Comparing the coefficients of the willingness to pay for the doubling of designated wilderness to the coefficients of the inverse demand equation derived from the discrete choice model (equation 3.4) shows the coefficients to have the same sign and to be of a comparable magnitude, particularly the income coefficients. Comparing the coefficients of the equation for doubling designated wilderness to the equation for tripling shows that, as expected, the coefficients for bid value, household income, attitude and education were higher in the tripling equation than in the doubling. Surprisingly, the coefficient for having taken a wilderness trip in 1992 dummy variable was lower in the tripling equation, however the coefficient was not as statistically significant as it was in the doubling equation.

## Effect of Bid Value on Open-Ended WTP Values

The variable called bid value in the regressions refers to the bid amount that was posed to the respondent in the discrete choice question. The positive and significant coefficient for this variable indicates that the DC bid amount influenced the respondents open-ended WTP values. The discrete choice question was asked before the open-ended question in order to give respondents a starting point in thinking about their replies to the open-ended question. However, in doing so, the question order may have led respondents and created a form of starting point bias (see Boyle, Bishop and Welsh (1985)). By presenting a value in the DC format, some respondents may have interpreted this as representing a socially acceptable amount or the answer that is correct or expected. In such cases, the respondent is likely to answer the open-ended question by stating the value already given in the DC question or a slight deviation above or below it even though it is not their true value.

As shown earlier, the mean values found for doubling designated wilderness using the DC and open-ended methods were not significantly different. This is even though most other studies using the two approaches have found them to produce significantly different results with the mean using the DC method being greater than the mean for the open-ended method. The present study used the different approaches on the same sample. Since the DC bid appears to influence the open-ended value this has the effect of equalizing the values found using the two methods. In contrast, most of the other studies applied the CV and open-ended methods to different samples and would not be affected by this starting point bias. While the bid values used in the survey were distributed over a range of values, the mean of the bid values offered to respondents was approximately $\$ 260$. This is above the mean willingness to pay values for both the doubling and tripling of designated wilderness. This suggests an upward bias in the willingness to pay values as more bid values were above the mean willingness to pay than below and thus there is a need to adjust our estimated mean values. The adjustment for bid value bias was done as follows:

$$
\begin{equation*}
\text { Adjusted WTP = WTP - } \beta \text { (BV - WTP) } \tag{3.6}
\end{equation*}
$$

where WTP is the respondent's stated willingness to pay for doubling or tripling designated wilderness, BV is the bid value presented to the respondent and $\beta$ is the coefficient for bid value from the appropriate regression given in Table 3.12. Thus, the willingness to pay was decreased (increased) if the bid value was greater than (less than) the stated willingness to pay value. After this adjustment the mean willingness to pay value for the doubling of designated wilderness using the open-ended method was $\$ 108.30$ or $\$ 10.70$ less than the unadjusted mean value. For the tripling of designated wilderness areas the adjusted mean willingness to pay value was $\$ 149.50$ or $\$ 6.90$ less than the unadjusted mean.

Using the adjusted willingness to pay values as the dependent variables, new regressions were run with household income, attitude, education and the wilderness trip in 1992 dummy variable as independent variables but which excluded bid value. The results are presented in Table 3.14. The equations are highly significant and the coefficients have the expected signs and are significant at the $95 \%$ level or better. Comparing the coefficients in Table 3.14 to the earlier regressions given in Table 3.12 shows the new coefficients to be somewhat higher than the old but of the same relative magnitude and sign.

TABLE 3.14 Regression Equations for Willingness to Pay Values Adjusted for Bid Value Bias

| Variable Dou | Doubling Designated Wilderness | Tripling Designated Wilderness |
| :---: | :---: | :---: |
| Constant | $\begin{array}{r} -321.14^{*} \\ (13.31) \end{array}$ | $\begin{array}{r} -513.71^{*} \\ (14.51) \end{array}$ |
| Household Income | $\begin{gathered} 0.72^{*} \\ (3.95) \end{gathered}$ | $\begin{gathered} 1.11^{*} \\ (4.15) \end{gathered}$ |
| Attitude | $\begin{gathered} 93.67 * \\ (17.06) \end{gathered}$ | $\begin{gathered} 144.60^{*} \\ (17.94) \end{gathered}$ |
| Education | $\begin{gathered} 12.70^{*} \\ (4.64) \end{gathered}$ | $\begin{gathered} 19.84^{*} \\ (4.94) \end{gathered}$ |
| Trip in 1992 | $\begin{gathered} 45.30^{*} \\ (3.63) \end{gathered}$ | $\begin{aligned} & 40.17^{* *} \\ & (2.19) \end{aligned}$ |
| Adjusted R ${ }^{2}$ | 0.22 | 0.23 |
| $F$ statistic | 93.30 | 98.51 |
| Number of Observations | ns 1322 | 1322 |

Values in brackets are the absolute values of the "t" statistics for each coefficient.

* Coefficient significantly different from zero at the $99 \%$ confidence level.
** Coefficient significantly different from zero at the $95 \%$ confidence level.


## Income Elasticities

An elasticity is a unitless measure of how responsive the dependent variable is to changes in one of the independent variables. An elasticity is calculated as the percentage change in the dependent variable divided by the percentage change in the independent variable. For example, the income elasticity for the willingness to pay for doubling designated wilderness areas shows the percentage change in willingness to pay for a given percentage change in household income. A point income elasticity, the instantaneous responsiveness, can be calculated as:

$$
\begin{equation*}
\eta=\frac{\partial W T P}{\partial Y} \cdot \frac{Y}{W T P} \tag{3.7}
\end{equation*}
$$

Substituting the coefficients for household income from the regressions in Table 3.14 for the partial derivative in equation 3.7 and using the mean value for $Y$ given in Table 3.13 plus the adjusted means for the willingness to pay values, the income elasticities for the willingness to pay for the doubling and tripling of designated wilderness were estimated to be 0.31 and 0.35 , respectively. This means that a $10 \%$ increase in household income would result in a $3.1 \%$ increase in willingness to pay for the doubling of designated wilderness and a $3.5 \%$ increase in the willingness to pay for tripling designated wilderness.

Economists generally consider that the dependent variable is "inelastic" or unresponsive to changes in an independent variable when the elasticity has an absolute value of less than one. As our estimated elasticities are well below this threshold, this suggests that willingness to pay is not particularly responsive to increases in household income. This is confirmed by calculating the income elasticity for willingness to pay for doubling designated wilderness using the inverse demand function from the discrete choice model given in equation 3.4. Using this equation the household income elasticity was estimated as 0.55 which is close to our earlier estimate of 0.31 and still less than one.

### 3.7 Amount and Value of Wilderness Recreation

It is estimated that $16 \%$ of provincial residents, eighteen years of age and over, took a wilderness trip in 1992. This represents about 410,100 provincial residents. This is based on a projected provincial population, eighteen and over, of $2,563,399$ in 1992. A wilderness trip is defined as a recreational trip in a roadless, undeveloped area that can be reached only by trails, waterways or air. This includes trips to all wilderness areas whether they are designated or not.

Participants in wilderness recreation in 1992 took an average of 3.45 trips that year. This is even though $50 \%$ of wilderness users only took one trip. British Columbia residents, eighteen and over, are estimated to have made a total of $1,415,000$ wilderness trips in the Province in 1992. Each trip is estimated to have lasted 4.35 days including travel to the wilderness area and back. This represents a total of 6.15 million days spent by provincial residents on wilderness trips in 1992. Wilderness users actually spent, on average, about 3.6 days of their trips in wilderness areas. This represents a total of about 5.1 million days of wilderness recreation by provincial residents not including travel to and from the area.

Respondents that took a wilderness trip in 1992 were asked to state their expenditures for their last trip. Respondents were asked to report on their last trip in attempt to reduce recall bias. Table 3.15 shows the average amounts spent per trip on different expenditure categories. For some categories, the average trip expenditure appears very low. This is because few participants had expenditures on items such as guide outfitting. Spending on guide outfitting may have been substantial for individuals using the service but since it is averaged over all participants reporting expenditures it appears quite small. The table also shows that provincial residents, eighteen years of age and above, are estimated to have spent over 309 million dollars on wilderness recreation in 1992. This represents average daily expenditures for wilderness trips of \$50.20.

TABLE 3.15
Mean and Total Expenditures on Wilderness Trips
(1992 Dollars)

| Expenditure | Mean Trip <br> Expenditure | Estimated Total <br> Expenditures <br> $(000$ 's) |
| :--- | :---: | :---: |
| Transportation | $\$ 66.80$ | $\$ 94,451$ |
| Lodging | $\$ 18.10$ | $\$ 25,569$ |
| Food and Beverages | $\$ 57.00$ | $\$ 80,683$ |
| Special Equipment | $\$ 50.20$ | $\$ 71,075$ |
| Guiding/Outfitting | $\$ 7.00$ | $\$ 9,863$ |
| Other | $\$ 19.40$ | $\$ 27,423$ |
| TOTAL | $\$ 218.50$ | $\$ 309,064$ |
| Average Daily Expenditures | $\$ 50.20$ |  |

Following the expenditure question, wilderness recreationists were asked how much their expenditures on this last trip would have had to increase before they would no longer be willing to take this trip. This value is the marginal value of the last wilderness trip, not the average value for all wilderness trips taken by the respondent. Table 3.16 shows the average willingness to pay for the last wilderness recreation trip grouped by the total number of trips taken by the respondents during 1992. While there is considerable variation in the means as the total number of trips taken increases, the trend does indicate a declining marginal value. This is also shown by the plot of the mean values by number of trips given in Figure 3.7.

TABLE 3.16
Stated Willingness to Pay for the Last Wilderness Trip by the Number of Trips Taken During 1992

| Number of Trips <br> Taken During 1992 | Average <br> Willingness to Pay | Number of <br> Observations |
| :---: | :---: | :---: |
| 1 | 326.55 |  |
| 2 | 319.94 | 103 |
| 3 | 296.22 | 16 |
| 4 | 239.38 | 32 |
| 5 | 163.63 | 16 |
| 6 | 245.08 | 8 |
| 7 | 100.00 | 13 |
| 8 | 200.00 | 2 |
| 9 | 150.00 | 2 |
| 11 | 242.86 | 3 |
| 13 | 103.50 | 7 |
| 16 | 50.00 | 4 |
| 21 | 15.00 | 1 |
| 34 | 46.00 | 2 |
| 51 | 0.00 | 1 |



FIGURE 3.7 WTP Increased Expenditures on the Last Trip by the Total Number of Trips Taken

Regression analysis was undertaken to determine which factors affected respondents marginal willingness to pay for wilderness recreation trips and to provide a means of converting the marginal value for the last trip to a total value for all wilderness trips taken by a respondent during 1992. The two following linear models were examined for this purpose:

$$
\begin{align*}
& \text { MWTP }=\alpha+\beta_{1} Y+\beta_{2} \text { Days }+\beta_{3} \text { Trips }+\varepsilon  \tag{3.8}\\
& \text { MWTP }=\alpha+\beta_{1} Y+\beta_{2} \text { Days }+\beta_{3} \text { TD }+\varepsilon \tag{3.9}
\end{align*}
$$

where: MWTP = marginal willingness to pay for increased expenditures on the last wilderness trip;
$\mathrm{Y}=$ household income;
Days = total number of days spent on the last wilderness trip;
Trips = total number of wilderness trips taken by the respondent in British Columbia during 1992;
TD = 1 if more than one trip in 1992, 0 if only one trip in 1992; and
$\varepsilon \quad=$ stochastic error term.
The signs of the coefficients for household income and the number of days on the last wilderness trip were expected to be positive. The total number of trips taken during 1992 and the trip dummy variables were expected to have negative coefficients. This is because the marginal value of a trip is expected to decline as the number of trips increases. Equations 3.8 and 3.9 were estimated using ordinary least squares regression analysis and the results are presented in Table 3.17. Both regressions were significant, as shown by the F statistic, and all coefficients had the expected signs and were significant at the $95 \%$ confidence level or better, with the exception of the constant term for equation 3.8. Table 3.18 provides summary statistics on the observations included in the regressions.

The regression which included the dummy variable for other wilderness trips during 1992 slightly out performed the regression which included the variable for the number of trips taken during 1992. The negative and highly significant coefficient for the dummy variable provides further evidence to confirm our hypothesis about the declining marginal value of wilderness recreation trips. However, the functional form is not one which can be used to determine the value of the other wilderness trips taken during 1992.

TABLE 3.17
Regression Equations for Willingness to Pay for the Last Wilderness Recreation Trip

| Variable | Model One | Model Two |
| :---: | :---: | :---: |
| Constant | $\begin{gathered} 86.110 \\ (1.78) \end{gathered}$ | $\begin{gathered} 111.818^{* *} \\ (2.35) \end{gathered}$ |
| Household Income | $\begin{aligned} & \text { 2.038* } \\ & (2.78) \end{aligned}$ | $\begin{aligned} & 2.124^{*} \\ & (2.97) \end{aligned}$ |
| Days | $\begin{gathered} 24.580^{*} \\ (6.46) \end{gathered}$ | $\begin{aligned} & \text { 26.956* } \\ & (7.16) \end{aligned}$ |
| Total Trips | $\begin{aligned} & -8.296 * * \\ & (2.23) \end{aligned}$ | - |
| Other Trips Dummy Variable | - | $\begin{gathered} -140.196^{*} \\ (3.62) \end{gathered}$ |
| Adjusted R ${ }^{2}$ <br> F statistic <br> Number of Observations | $\begin{gathered} 0.22 \\ 20.28 \\ 201 \end{gathered}$ | $\begin{gathered} 0.25 \\ 23.75 \\ 201 \end{gathered}$ |

Values in brackets are the absolute values of the " t " statistics for each coefficient.

* Coefficient significantly different from zero at the 99\% confidence level.
** Coefficient significantly different from zero at the 95\% confidence level

TABLE 3.18
Summary Statistics for the Independent Variables Used in the Last Wilderness Trip Regressions

| Variable | Weighted <br> Mean | Standard <br> Deviation | Minimum <br> Value | Maximum <br> Value |
| :--- | ---: | ---: | ---: | ---: |
|  |  |  |  |  |
| WTP for Last Trip | 282.776 | 314.508 | 0 | 2000 |
| Household Income | 51.032 | 26.980 | 7.5 | 95 |
| Days | 4.960 | 5.165 | 1 | 31 |
| Total Trips | 3.527 | 5.301 | 1 | 51 |

The estimated marginal willingness to pay function based on the regression results for equation 3.8 can be written as:

$$
\begin{equation*}
\text { MWTP }=86.11+2.04 Y+24.58 \text { Days - 8.30 Trips } \tag{3.10}
\end{equation*}
$$

Substituting the average value for household income and the average number of days per trip into equation 3.10 reduces the equation to a function of the number of trips taken during 1992, as shown in Figure 3.8. The diagram shows that the marginal value of a wilderness trip would fall to zero by the thirty-eighth trip meaning that the trip's expenditures would just equal the value of the trip and no net value would exist.


FIGURE 3.8 Marginal Willingness to Pay Function for Wilderness Recreation Trips

The area under the curve in Figure 3.8 represents the total value of all wilderness recreation trips taken by a respondent who had household income and trip length equal to the averages given in Table 3.18. This area can be found by integrating the marginal willingness to pay function with respect to the number of trips taken during 1992. Integration of equation 3.10 requires that we first assume that all wilderness trips taken by a respondent were of the same length. Based on this assumption equation 3.10 was integrated to yield the following total willingness to pay function for all trips taken during 1992:

$$
\begin{equation*}
\text { Total WTP }=\left[86.11+2.04 \mathrm{Y}+24.58 \text { Days] Trips }-\left[8.30 \text { Trips²}^{2}\right] / 2\right. \tag{3.11}
\end{equation*}
$$

Equation 3.11 was then used to calculate the total willingness to pay for all wilderness recreation trips taken during 1992 for each respondent. In cases where the estimated total willingness to pay for an individual was less than the individual's marginal willingness to pay times the number of trips he took during 1992, the total willingness to pay was set equal to the marginal willingness to pay times the number of trips.

The results of this procedure are presented in Table 3.19, which shows that the estimated total willingness to pay for all wilderness trips taken during 1992 for each recreationist averaged almost $\$ 939$. The average value of all wilderness trips was $\$ 266.10$. This is $\$ 16.70$ less than the average for the last trips taken. The reason for the narrow difference between the average and the marginal values is that $50 \%$ of recreationist took only one wilderness trip so that their marginal value equals their average value. The average value of the last trip is greater than the average of all trips because those individuals that took more than one trip tended to spend more days on their last trip than the average number of days on their earlier trips. As a result, the value of the last trip tends to be greater than the earlier trips. However, the average value over all days of \$59.20 is greater than the average value per day of $\$ 57.00$ on the last trip taken.

In using the sample results to estimate the total provincial value of all wilderness trips taken during 1992, we must first decide if the values are household values or individual values. The questionnaire asked for individuals' wilderness activities and values. However, it would seem likely that in many cases households would take their wilderness trips together rather than separately which suggests that the values may represent household values. Since there is no way to determine how frequently this occurred the sample results were expanded both by the number of households and by the number of individuals in the Province. Based on a provincial adult population of $2,563,399$ in 1992, and an estimated wilderness recreation participation rate of $16 \%$, we estimate that 410,100 provincial residents took wilderness recreation trips during 1992. Using the average value of $\$ 938.56$ for all trips taken during 1992, the total annual provincial value would be $\$ 384.9$ million for 1992. If on the other hand we use the total number of private households in 1992 of 1,276,082 and the $16 \%$ participation rate we would get an annual provincial value of $\$ 191.6$ million. The two results should be taken as representing the upper and lower bounds of the total annual value of wilderness recreation in British Columbia.

TABLE 3.19
Estimated Values of Wilderness Trips by British Columbia Residents During 1992

|  | Respondent Average |
| :--- | :---: |
| Marginal Value of a Trip | $\$ 282.80 /$ trip |
| Daily Value of the Marginal Trip | $\$ 57.00 /$ day |
|  |  |
| Total Value of All Trips Taken During 1992 | $\$ 938.60 /$ participant |
| Average Value of All Trips | $\$ 266.10 /$ trip |
| Average Value per Day | $\$ 59.20 /$ day |

## Total Provincial Value of All Wilderness Trips Taken During 1992

$\begin{array}{ll}\text { Method } 1 \text { - Expansion to Individuals } & \$ 384.9 \text { million } \\ \text { Method } 2 \text { - Expansion to Households } & \$ 191.6 \text { million }\end{array}$

### 3.8 Assessment of the Contingent Valuation Method

While there is no consensus about the seriousness of the possible valuation biases discussed in section 1.6, they are nonetheless potential problems that must be addressed in CVM studies. In an attempt to minimize potential embedding and insufficient information effects, the present study thoroughly and clearly defined the product to be valued. The valuation of doubling designated wilderness was carefully framed in the referendum question so as to leave no doubt about what was being valued and how it was being valued. Also, an attempt was made in pre-testing to design a question that asked respondents if their answers might encompass values
other than for designated wilderness. That is, whether their responses might include values for a broader spectrum of environmental issues. However, a high proportion of the members of the focus groups either could not understand the question, were offended by it or objected to being asked to provide the same value twice. Since there was no obvious way to re-design the question, it was dropped from the questionnaire.

The discrete choice referendum was followed by a question asking respondents why they voted for or against the proposal. This was done in an attempt to determine whether respondents clearly understood the conditions of the referendum and what they were being asked to value as well as the payment mechanism. While this does not provide conclusive evidence, it does give an impression whether respondents had sufficient information and are possibly embedding other values in their responses.

For the most part, responses were quite articulate and frequently expressed strongly held views. One of the themes common to many of the responses is that designated wilderness ensures the preservation of ecosystems including animals, plants, fish and scenic views. It is important to many that the natural heritage of British Columbia be protected. A few expressed the view that they are stewards of the environment. Some felt that wilderness was irreplaceable and that impacts on wilderness were irreversible. Others did not go this far but felt that it was more efficient and less expensive to preserve wilderness than attempt to restore it once it had been damaged. A few stated that the amount and type of reforestation were inadequate to ensure future wilderness.

The most commonly stated reason for supporting a doubling of the amount of designated wilderness is that it guarantees sufficient wilderness would be available for future generations. $A$ large proportion stated they would be willing to pay the specified amount in order to have wilderness for their children and their children's children. Some elaborated by explaining they wanted areas protected for their offspring to be able to see wilderness, hike, fish and hunt. This strong emphasis on increasing protected wilderness for future generations is consistent with the significant percent of value that is attributable to the bequest motive. Moreover, this information was volunteered by respondents prior to them being asked the percents of their maximum willingness to pay that would go to bequest and other motives. A small number of respondents supported the referendum because they felt the value of their use of these areas would out-weigh the costs. A number of respondents stated that the tax was a low price to pay for the increase in designated wilderness. A small number supported the referendum when they expressed the tax as a cost per day or week. One suggestion was to use the revenue for the re-training of forest and mine workers who lose their jobs.

Among those opposed to the referendum, some felt the current amount of protected wilderness was sufficient and as a result voted against the proposal. Some opposed the proposal because designated wilderness is used by very few and tends to be unproductive. It is felt that designation of more wilderness is satisfying a small, vocal minority of users. A few opposed the proposal because they believed there is plenty of wilderness in British Columbia. Others were not necessarily opposed to more designated wilderness but thought others such as users and tourists should pay for it. There was also some suggestions that the logging and mining industries should pay for increased designated wilderness. Some felt that priority for funding should be given to other needs.

The most common reason for opposing the referendum was that the tax price was too high. The frequency of this response increased as the tax specified rose. A few indicated they would be willing to support the proposal at a lower price. It appears that respondents compared the tax price to their income with some voting against the referendum because they had low or fixed incomes. Many of those opposing the referendum indicated that taxes were already too high and they were unwilling to pay increased taxes. There was also the fear expressed that the amount of the annual payment would be increased in the future. Finally, there was some suspicion that money from the trust fund would be diverted to general revenue.

An increase in designated wilderness was also opposed because many respondents recognized the trade-off with activity in the forestry and mining industries. A number of respondents stated they voted against the proposal because they felt the loss of employment opportunities in logging and mining was too high.

The replies to why the discrete choice referendum question was supported or opposed suggests that respondents were familiar with the amenity being valued and did not confuse it with other environmental resources. Wilderness was, for the most part, recognized as being composed of a number of attributes including plants, animals, fish, geological formations and scenic views. The awareness of wilderness is probably not surprising since land use controversies are now quite common in British Columbia and receive a good deal of media attention. Also, at the time of the survey, a process was underway to evaluate and recommend additions to the Province's protected areas and received substantial press coverage. Only a handful of responses mentioned environmental resources other than wilderness which suggests there is little problem with embedding of values for other amenities in the responses.

The reasons given for voting for or against the referendum further suggests that most respondents seriously weighed the amount they were asked to pay and were familiar with the payment vehicle. Many stated that the $5 \%$ increase in protected wilderness was or was not worth the tax price they were asked to pay. Those favouring the proposal frequently judged the payment in terms of stewardship, bequest or use values to themselves. There was explicit recognition that in some cases the respondent could not afford the payment due to the constraint placed on them by their income. Respondents were conscious that voting for the proposal would entail an increase in provincial taxes. There was a feeling among a number of respondents that taxes were already too high and should not be raised further. Opportunity costs of activity and employment in the logging and mining sectors were used in judging the referendum by a number of respondents.

Only a handful of respondents gave the impression that they were confused or required more information. There were questions about why it was necessary to pay for protecting wilderness. A few felt that if wilderness were left alone it would be okay. They did not appreciate that in many areas there are mining and timber harvesting rights that might have to be bought out as well as the loss of government revenues from royalties and stumpage fees. There were also a few questions about what areas would be protected and what taxes would be increased.

### 3.9 Summary

Table 3-20 summarizes the estimated economic values for wilderness preservation and recreation. The lower bound for the average household value for the doubling of designated wilderness is based on the open-ended willingness to pay question after adjustment for potential bid value bias while the upper bound comes from the discrete choice question. These estimates of the average annual household value, when expanded to all British Columbian households, yields an estimated total annual value of between $\$ 137.8-\$ 166.0$ million. For the tripling of designated wilderness areas, the mean annual household values were derived solely from the open-ended willingness to pay question with the upper and lower bounds being the mean values before and after adjustment for any potential bid value bias respectively. On expansion to all British Columbian households, these average annual values yield an estimated total annual value of between $\$ 191.8-\$ 199.6$ million. The average value of a wilderness recreation trip was estimated by deriving a marginal willingness to pay function for the last wilderness trip from the open-ended question on respondents' willingness to increase expenditures on their last wilderness recreation trip taken during 1992. The marginal function was then integrated to yield a total value of all wilderness trips taken during 1992. The total value of all wilderness trips taken by British Columbians during 1992 was estimated to be between $\$ 191.6-\$ 384.9$ million depending on whether the expansion is made to all British Columbian households or to the entire British Columbia adult population.

TABLE 3.20
Summary of the Estimated Economic Values of Increasing Designated Wilderness and from Wilderness Recreation Trips Taken During 1992

| Type of Value | Average Annual <br> Value <br> $(\$ /$ household $)$ | Total Annual <br> Value <br> (\$million) |
| :--- | :---: | :---: |
| Wilderness Protection |  |  |
| Doubling Designated <br> Wilderness | $108-130$ | $137.8-166.0$ |
| Tripling Designated <br> Wilderness | $149-156$ | $190.8-199.6$ |
| Wilderness Recreation |  |  |
| All wilderness trips in 1992 <br> Per wilderness trip <br> Per wilderness trip day | 939 | $191.6-384.9$ |
|  | 59 |  |

## 4. COMPARISON TO OTHER STUDIES

### 4.1 Introduction

A small number of studies have examined the values associated with protecting specific, select wilderness sites. Among these are Barrick and Beazley (1990) and Gilbert et al. (1992). The two studies reported on below are similar to the present study in that they are concerned with evaluating a general increase in the amount of protected wilderness in a jurisdiction.

### 4.2 Value of Designated Wilderness in Colorado

Walsh, Loomis and Gillman (1984) estimated the recreation and preservation values state residents placed on different amounts of designated wilderness in Colorado. Walsh et al. defined preservation values as the willingness to pay for a bundle of non-use satisfactions separable into option, bequest and existence values. Designated wilderness is roadless, natural areas on public lands that prohibits logging and mining. This is almost identical to the definition of wilderness used in the present study. Respondents were presented with maps that showed the 1.2 million acres or $2 \%$ of the state that was designated wilderness at the time of the study in 1980 and the 2.6 million acres or $4 \%$ of the state protected in 1981. Third and fourth maps showed 5 million acres or $7.5 \%$ of the state in designated wilderness and then 10 million acres or $15 \%$ of the state protected.

A sample of 218 Colorado households responded to the mail survey. They were asked using the open-ended CVM how much they would be willing to pay annually into a special fund for the existing amount of designated wilderness and the three increments of wilderness shown in the maps. Respondents were then asked to allocate their maximum total payment into consumer surplus value for recreation use and option, existence and bequest values. The fund was to be used exclusively for protecting wilderness. It was stipulated that all residents of Colorado would be required to pay into the fund in order to minimize the free rider problem and strategic bias.

Consumer surplus values for recreation use of Colorado wilderness in 1980 was estimated using a variant of the travel cost method. The dependent variable was the number of trips taken in the previous twelve months to existing and potential wilderness areas. Projections were made of the use and value through future years with the increased amounts of wilderness. The following table shows the results reported in Table 3 of Walsh et al. expressed in 1992 Canadian dollars. This was calculated using the Consumer Price Index for Denver to put values into 1992 dollars and the Canadian-U.S. exchange for 1992 to convert to Canadian dollars.

The method Walsh et al. employ and the breakdown of preservation values into its components are very similar to the open-ended method of the present study for doubling designated wilderness. Nevertheless, both the average daily recreation and mean annual preservation values found in the present study are larger than the corresponding values in Walsh et al. The average daily recreation value of $\$ 59.20$ for British Columbia is significantly larger than for Colorado. Part of the difference may be due to the use of the travel cost method versus the CVM in the present study.

The mean annual preservation value for British Columbia households was $\$ 106.70$ for doubling designated wilderness, excluding the consumer surplus of expected future use. This is larger than any of the values found for Colorado. Only the option value of $\$ 15.70$ was similar to the values for Colorado residents. The existence and bequest values of $\$ 44.90$ and $\$ 46.10$, respectively, were double the largest values found by Walsh et al. However, many of the factors that affected the preservation values Colorado residents placed on designated wilderness were the same as found in the present study. Walsh et al. also found that income, education and having taken a wilderness trip had positive and significant effects on preservation values for designated wilderness.

TABLE 4.1
Value of Designated Wilderness in Colorado (1992 Canadian Dollars)

|  | $\begin{gathered} 1.2 \text { million } \\ \text { acres } \\ \hline \end{gathered}$ | $\begin{gathered} 2.6 \text { million } \\ \text { acres } \\ \hline \end{gathered}$ | 5 million acres | 10 million acres |
| :---: | :---: | :---: | :---: | :---: |
| Recreation use |  |  |  |  |
| Per day | \$29.00 | \$29.00 | \$29.00 | \$29.00 |
| Total (millions) | \$27.4 | \$43.6 | \$68.7 | \$120.8 |
| Preservation Value |  |  |  |  |
| Option Value |  |  |  |  |
| Per household | \$ 8.40 | \$11.40 | \$15.40 | \$19.40 |
| Existence Value |  |  |  |  |
| Per household | \$10.20 | \$13.80 | \$18.50 | \$23.40 |
| Bequest Value |  |  |  |  |
| Per household | \$10.40 | \$14.10 | \$19.20 | \$24.00 |
| Total Recreation and |  |  |  |  |
| Preservation Value (millions) | \$59.7 | \$87.2 | \$127.70 | \$195.00 |
| Area in hectares (millions) | 0.486 | 1.052 | 2.023 | 4.047 |

One difference in the products being valued in the two studies might explain why the values found for British Columbia are larger than those for Colorado. At the time the present study was initiated there was almost 12 million acres ( 4.77 million ha.) of designated wilderness in British Columbia. This is ten times the amount of protected wilderness in Colorado in 1980 and more than four times the amount in 1981. Doubling designated wilderness in British Columbia increases by about twelve million acres to almost 24 million acres ( 9.55 million ha.) whereas in Colorado the corresponding increase is only about 2.5 million acres ( 1.01 million ha.) to a total of about 5 million acres ( 2.02 million ha.). Since British Columbians are valuing a much larger amount of wilderness and increases in wilderness than residents of Colorado, it is expected that they would have greater values.

The residents of British Columbia placed a larger aggregate value on wilderness protection than did Colorado residents because of the much larger increase in area being proposed for protection in British Columbia. However, when the preservation value per acre protected is estimated, the results for British Columbia and Colorado are very similar. It is estimated that the average annual household preservation values per acre of designated wilderness are 0.00088 cents ( 0.0022 cents/ha.) in British Columbia and 0.00073 cents ( 0.0018 cents/ha.) in Colorado.

### 4.3 Value of Designated Wilderness in Utah

A study by Pope and Jones (1990) examined the values that residents of Utah placed on different levels of designated wilderness in the State. The study employed an open-ended CVM phone survey to determine the preservation values of increased designated wilderness. At the time of the survey in 1986, 0.8 million acres ( 0.32 million ha.) or between 1 and $2 \%$ of Utah was designated wilderness. The survey considered four levels of designated wilderness suggested by different groups in Utah. The increased amount of designated wilderness under these proposals were $1.9,5.0,6.4$ and 17.2 million acres ( $0.77,2.02,2.59$ and 6.96 million ha.), respectively. For purposes of the survey, introduction of each of these proposals would raise the total designated wilderness as a percent of the land base of Utah to $5 \%, 10 \%, 15 \%$ and $30 \%$, respectively.

Respondents were asked how much their households would be willing to contribute to a fund to preserve the four different levels of wilderness in Utah. The questionnaire asked the willingness to pay question in three forms. The first did not contain any lead-in information on bids. The second and third asked the same question but stated that a preliminary survey found average willingness to pay of $\$ 40$ and $\$ 500$, respectively, by Utah residents. It was specified that in the absence of a contribution wilderness would not be protected. The sample for the phone survey was drawn using a stratified random selection process. Interviews were conducted during October and November of 1986. Of the sample contacted, $62 \%$ or 291 households completed an interview. Of the total number of interviews, 11 provided bids that were judged to be protest votes or outliers.

Table 4.2 shows the percent and millions of acres of Utah that would be protected under the different proposals. The table also shows the average household willingness to pay for the different levels of designated wilderness. The values have all been converted to 1992 Canadian dollars to make them comparable to the results of the present study. Pope and Jones did not ask respondents to disaggregate their preservation values to the component values. Also, they did not ask about recreation values associated with wilderness use.

TABLE 4.2
Preservation Values for Protected Wilderness in Utah
(1992 Canadian Dollars)

| Percent of State | $5 \%$ | $10 \%$ | $15 \%$ | $30 \%$ |
| :--- | :---: | :---: | :---: | :---: |
| Million Acres | 2.7 | 5.4 | 8.1 | 16.2 |
| Average Willingness <br> to Pay | $\$ 90.9$ | $\$ 110.90$ | $\$ 129.60$ | $\$ 159.00$ |

The present study found the average household value of doubling designated wilderness to be between $\$ 108$ and $\$ 130$ and the value of tripling designated wilderness to be between $\$ 149$ and $\$ 156$. These values are similar to the results found by Pope and Jones for designating 10$30 \%$ of Utah as wilderness. The increase in areas set aside in Utah would be roughly similar to the additional areas protected in British Columbia.

As found in the present study, Pope and Jones' willingness to pay values were influenced by suggesting a value to respondents. The mean willingness to pay value with a reference bid of $\$ 40$ was significantly lower than the means found when either no reference bid was given or the benchmark was $\$ 500$. Pope and Jones also found that respondents who felt wilderness preservation is very important have values several times larger than those who think it is slightly
important or not important at all. It was also found that household income and education had a positive effect on willingness to pay. Further, participation in outdoor recreation had a positive effect on the value of increased designated wilderness. These findings are all consistent with the results of the present study.

Pope and Jones' estimated preservation value for increasing protected wilderness when expressed on a per acre basis is similar to the results found for British Columbia and Colorado. For an increase in protected wilderness from $5 \%$ to $10 \%$ of the State, or by 2.7 million acres (1.09 million ha.), Pope and Jones' preservation value is 0.00074 cents per acre ( 0.0018 cents/ha.). This is very similar to the estimates of .00088 cents per acre ( 0.0022 cents/ha.) and .00073 cents per acre ( 0.0018 cents/ha.) found for British Columbia and Colorado, respectively, as discussed in the previous section.

## 5. DISCUSSION OF THE STUDY RESULTS

### 5.1 Uses of the Results

There are a number of uses that can be made of the economic values of wilderness designation presented in this report. Perhaps the most important is to make both the public and public policy-makers aware of the significant economic values the residents of British Columbia attach to the protection of wilderness. As the amount of wilderness shrinks and competing land uses threaten the remainder, it is necessary to have as full and clear an understanding and representation of the value of wilderness as possible. This is especially so since many of the competing land uses are devoted to products that are fully and readily valued in the market. While most people feel it is desirable and beneficial to protect wilderness, they probably do not think in terms of the economic values associated with wilderness designation. However, it is the fact that provincial residents are made to feel better off as a result of the protection of wildlife that gives rise to the economic values associated with wilderness designation. As this report has documented the economic values of wilderness designation are substantial. The public and decision-makers must be aware of the significant opportunity costs incurred when competing land uses impact on wilderness.

The results of the survey reveal that provincial residents place substantial economic values on doubling and tripling designated wilderness as well as the use of wilderness for recreation. Economic evaluations of land use planning options that impact the amount of wilderness should take account of the economic benefits or costs of increasing or decreasing the amount of wilderness. The economic values of wilderness protection are as real as the values of other sectors, such as forestry, mining, agriculture, grazing etc., that may be affected by land use planning exercises. Information presented in this report can assist in valuing changes in wilderness for land use planning exercises.

In recent years, there has been some discussion about the need to protect wilderness in British Columbia and elsewhere. The protection of wilderness is the subject of a current land use planning initiative of the provincial government. One of the criteria that can be used in deciding whether wilderness or a particular site should be protected is the economic costs and benefits of designation. The benefits of increasing the amount of designated wilderness, as set out in this report, can be compared to the costs measured by the alternative uses of the site that would be prohibited or restricted. If the benefits of designation exceed the costs there is an economic efficiency argument for designation.

The results of the study can also be used to value the impacts on wilderness of competing land uses and assess the amount of compensation and mitigation that is warranted. Activities such as logging, mining, agriculture, grazing, etc., initiated in pristine areas may destroy these areas as wilderness. The value of the lost wilderness can be measured using the results from this study. Although, once wilderness is lost it cannot be restored, it may be possible to reduce the impacts of these activities through mitigation. These refer to measures taken during the planning, construction and the operational phases of the activity to reduce the effects on wilderness. The costs of the mitigation should be compared to the expected benefits to determine whether the measures should be undertaken. Similarly, compensation measures undertaken to replace lost wilderness should be judged by the criterion of economic efficiency.

### 5.2 Limitations of the Results

The economic values presented in this report are for specific discrete changes in the amounts of designated wilderness in the Province. The Province of British Columbia has announced recently a number of new parks and wilderness areas. While the survey results provide information about the value of aggregate changes in the amount of designated wilderness, it gives little guidance as to the value of any individual protected area. It should also
be cautioned that the values for protected wilderness and wilderness recreation apply to different land areas. The values for designated wilderness refer to areas protected in the form of parks and under the Forests Act whereas recreation occurs in any wilderness area whether it is protected or not. As a result, the preservation and recreation values cannot be summed to give a total value of wilderness protection.

As discussed in section 1.6, the CVM is suspected of and accused of a number of different types of biases. A substantial literature has developed that examines the presence and significance of these biases and discusses ways to reduce or eliminate their effects. The present study was designed to minimize the effects of the more serious suspected types of bias and sensitivity analysis was conducted to show the effects of changing assumptions. Nevertheless, the results of the present study could still be subject to bias. As a consequence, the results should be treated with the appropriate caution. The results provide an impression or ballpark estimate of the value provincial residents place on wilderness preservation and recreation rather than precise, immutable measures of these values.

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[^0]:    * Calculated at the income class mid-points.

