WILDERNESS PRESERVATION AND PROTECTION OF OLD-GROWTH FORESTS

by

VICTORIA G. WATSON

B.Sc.(Agr.), The University of British Columbia, 1991

A THESIS SUBMITTED IN PARTIAL FULFILLMENT OF
THE REQUIREMENTS FOR THE DEGREE OF
MASTER OF SCIENCE

in

THE FACULTY OF GRADUATE STUDIES
(Department of Agricultural Economics)

We accept this thesis as conforming
to the required standard

THE UNIVERSITY OF BRITISH COLUMBIA

June 1994

In presenting this thesis in partial fulfilment of the requirements for an advanced degree at the University of British Columbia, I agree that the Library shall make it freely available for reference and study. I further agree that permission for extensive copying of this thesis for scholarly purposes may be granted by the head of my department or by his or her representatives. It is understood that copying or publication of this thesis for financial gain shall not be allowed without my written permission.

(Signature)

Department of Agricultural Economics

The University of British Columbia
Vancouver, Canada

Date June 30th /94

DE-6 (2/88)

ABSTRACT

This research on the benefits of increased wilderness preservation has entailed the development of contingent valuation surveys to elicit consumer's WTP for the province of British Columbia. The study came about after the Protected Areas Strategy (PAS) proposed an additional 6% of B.C.'s land base be set aside for protection. Two surveys were used, one survey was distributed province-wide, while the other was issued to third and fourth year university students in both land use and forestry economics.

A dichotomous choice format was chosen as the most appropriate approach due to its simplistic nature and its success in previous studies. Similarly, a logistic model was applied to calculate the probability of a person agreeing to pay to a pre-determined offer amount.

The results of the province-wide survey indicated that respondents valued additional wilderness protection in British Columbia at $371.34 per household per year. Aggregating this amount to include all B.C. households yielded a value of $484 million per year. The results of the classroom survey showed that the respondent's WTP was $326 per year for a total of $716 million when aggregated for the whole adult population in B.C. The differnce between WTP values between surveys is partly due to the fact that the WTP for the classroom survey is on a per person basis while the estimated WTP for the provincial survey is on a per household basis. Similarly, the province-wide survey included individuals of all educational backgrounds while the classroom survey included only individuals with post secondary education.

Finally, while the Government of B.C. has decided to increase the level of wilderness protection to 12 percent, the average desired level of protection for both surveys used in this paper was 10.75 percent.

TABLE OF CONTENTS

Table of Contents cont.

Table of Contents cont.

LIST OF TABLES

LIST OF FIGURES

ACKNOWLEDGMENTS

First I would like to thank my committee chairman, G.C. van Kooten, for introducing me to the field of resource economics and for his encouragement and supervision during my graduate career. Chris Gaston deserves special thanks for reading my thesis, providing me with statistical guidance and correcting statistical errors in my paper.

Many people have provided practical support during the creation of this work. In particular, I thank Gwynne Sykes for her invaluable services in the preparation and organization of the surveys used in my thesis. I also thank Wang Sen for his help in the the endless task of putting the questionnaires together. I thank Kristy McLeod for reading my thesis and providing me with valuable insight. Rita Athwal who shared her knowledge and helped with the programming of the model. In addition, I thank Lorie Srivastava who was most helpful in giving me ideas for my defense. Specifically, I am in debt to Victor Gaspar who was an immense help in the final preparations for my defense and for lending a hand whenever it was needed.

I would also like to thank all those who participated in the province wide and classroom surveys. Without their help this thesis could not have been completed. All those who allowed themselves to be tested on in the begining are also thanked.

CHAPTER 1

INTRODUCTION

1.1 Background

Preservation of species has been an ongoing concern for many years. Since many species have no market value because they are not traded in the marketplace, there remains controversy about how to value these "non-market" goods. As E.O. Wilson wrote:

> "Today as human populations expand and alter the natural environment, they are reducing biological diversity to its lowest level since the end of the Mesozoic era, 65 million years ago. The ultimate consequence of the biological collision are beyond calculation and certain to be harmful...it is a potential source for immense untapped material wealth in the form of food, medicine and other commercially important substances" (Wilson 1989, p. 108).

There are several factors that contribute to the loss of biodiversity. Conditions such as climatic change and natural selection has resulted in the loss of some species through extinction. However, the more recent primary cause of loss of species has been the destruction of the ecosystems in which these species exist, due to human activity (e.g., increasing demand for housing and other consumer goods, and thus encroachment onto agricultural and forest lands).

In British Columbia, harvesting of old-growth forests due to their high commercial value has in fact raised concern over the loss of certain species. Old growth can be

defined in both ecological and non ecological terms. However, it is the latter of which economists are able to evaluate in dollar terms. Aside from the many benefits resulting from preservation, such as intrinsic and watershed values, old-growth forests also constitute an ecosystem where many species reside. Destruction of these forests for commercial use inevitably destroys some of the biota of the species.

In 1991, 81,500 forest workers were employed in B.C.'s forest industry (manufacturing and processing facilities) with an estimated total annual pay and benefits of $4.5 billion dollars (Government of B.C. Statistics 1992). On average, 66% of B.C.'s 94.8 million hectares (ha) is forested and approximately 6.5% (6.2 million ha) of B.C. is currently protected as parks or other wilderness areas. However, due to the 1991 Protected Areas Strategy, the percentage of preserved wilderness areas is expected to roughly double.

Concern over the loss of biodiversity due to harvesting of old-growth timber in the Pacific Northwest has shown up in literature for quite some time (e.g., and has recently come into focus as a result of the highly-publicized Northern Spotted Owl controversy. The continuing debate between environmentalists and timber companies has raised the question of whether "to preserve or harvest" old-growth timber. It is impossible to answer this question without evaluating the costs and benefits associated with each decision. The purely market costs and benefits are relatively easy to determine, primarily since the major market benefit, timber, is traded in the marketplace (i.e., costs being the opportunity costs of preservation). However, for goods not traded in the marketplace, or non-market goods,

the estimation of costs and benefits present economists with a challenge.

It is a difficult task to determine the economic value of wilderness preservation when there does not exist any means to compare these values to commodities traded in the market. Often public goods have intrinsic value, as well as watershed value, amenity value, recreational value, *et cetera.* Nevertheless, these values are often embedded in an individual's utility function and economists try to elicit these values through both indirect and direct measures, and attempt to determine the economic values which under these goods and services.

1.2 Problem Statement

British Columbia is Canada's leading lumber producer and exporter. Only 54% of B.C.'s land base (94.8 million ha) is designatd productive forestland, and about half of this is suitable for timber harvesting. The Government of British Columbia has proposed a number of initiatives that may reduce the amount of timber harvesting activity. In particular, the province's 1991 Protected Areas Strategy (PAS) has increased the current amount of wilderness protected in: regional and provincial parks; conservation areas; recreation areas; wildlife sanctuaries; and ecological reserves, from 6.5% of the land base to 12%.

Protection of old-growth forests cannot be separated from the larger issue of wilderness protection. Old-growth can only be protected in contiguous areas that constitute financially valuable old-growth timber, other financially valuable trees that are

not considered old growth, timber that is uneconomical to harvest, and areas that are barren (e.g., glaciers and mountain tops). Old growth constitutes 4-12% of an area protected under the PAS.

The costs of protecting old-growth forests are obvious in economical terms (e.g., lost jobs, community stability, environmental effects of using non-wood substitutes, and higher prices to consumbers for forest products) but are more difficult to identify and measure for the benefits of preservation. Thus wilderness protection is a controversial issue: preserve wilderness at all costs or to harvest all trees regardless of their classification. In doing so, one is risking the chance of losing some of the critical species both known and unknown to man.

1.3 Objectives

This thesis will consider the problem of the loss of biological diversity as a result of increased timber harvests of old-growth forests in B.C. In particular, the focus will be to determine the non-timber benefits (value) of preserving old-growth forests and how this value changes at the margin. For example, what are the marginal benefits of preserving an additional unit of forest stands?

I will accomplish the aforementioned tasks as follows:

1) It is important to define what is meant by old-growth forests. What are the attributes/benefits that make up old-growth forests? How does the Ministry of Forests define old-growth forests? What constitutes the bundle old growth? Does it exist?

2) A purpose of the study is to determine the maximum amount society is willing to pay to preserve old-growth forests in B.C. given the above attributes and thus find a value for old-growth forests for biodiversity objectives.

1.4 Research Procedure

This paper is structured in the following manner. Chapter 2 provides basic information on the importance of biodiversity and its relationship with old-growth forests. A discussion of the newly proposed doubling of B.C.'s protected wilderness areas by the Province's Protected Areas Strategy, the basis to which this study is centred, is presented in Chapter 3. Chapter 4 provides a review of similar studies and previous results with which to compare the findings of this paper. Chapter 5 presents the theoretical background for developing the empirical models used in this study. The methodology and description of the models used in this paper is presented in Chapter 6. Chapter 7 provides the results as well as a discussion of the quality results, and finally, summary, conclusions and future recommendations make up Chapter 8.

CHAPTER 2

REVIEW OF BIODIVERSITY

2.1 The Importance of Biodiversity

A common definition of biodiversity is as follows:

> "The full range of genetic diversity (species, subspecies and distinct biological populations of plants and animals) as well as the full variety of ecosystems in which plants and animals occur" (Ledec and Goodland 1988, p. 6).

There are six main threats to biodiversity that have been identified by the Global Biodiversity Strategy (WRI/IUCN/UNEP, 1992). These threats are as follows:

1) habitat loss and fragmentation due to encroachment onto wildlands and increased use of natural resources;

2) introduced species that result from one species not native to the area originally but which now plays a detrimental role in the ecosystem for some species;

3) over-exploitation of plant and animal species due to clear-cutting and other practices not properly controlled;

4) pollution of soil, water, and atmosphere that come about from practices not properly governed by provincial or federal authorities;

5) global climatic change as a consequence of increased greenhouse gases which tend to result in increased global temperatures; and

6) industrial agriculture and forestry that has come about as a result of plant and gene

breeding programs which have enabled farmers and foresters to only grow certain plants and trees, or raise only certain livestock due to their enhanced genetic abilities (i.e., higher yielding plants and animal).

Not only do we need to preserve species themselves, but, more importantly, we need to preserve the ecosystems in which they live. For example, in the tropical forests of the Amazon (where perhaps the greatest diversity of species can be found) deforestation is destroying many ecosystems. The reason is that the Amazon region is quite poor relative to the rest of the world and forests are burned so land can be used for other more productive purposes. Policies prohibiting the destruction of habitats must incorporate the benefits of preserving species, and the benefits must outweigh the costs if there is to be an incentive to preserve. Unfortunately the benefits of many species are not yet known or are difficult to calculate.

Although the benefits of species do not have commercial value specifically, this does not imply that they are not valuable to humans in other terms. For example, over 40% of all prescription drugs in the U.S. contain one or more drugs that originate from wild species (generating millions of dollars in sales) (McAllister 1992). More recently are the discoveries of anti-cancer drugs (e.g., rose-periwinkle, taxol). Obviously, these discoveries are essential to the well being of man and the loss of these species could be immeasurable. Furthermore, species diversity can bring us such satisfaction in the knowledge that such species or a particular state of the environment exists, known as

existence value, or simply that the species will be present for future generations to enjoy, known as *bequest value*. Furthermore, there is value just in knowing that there is the option of using the amenity in its given state even if it is never actually used. This is commonly referred to as *option value*. Bequest, existence, and option values are all considered to be preservation values of a particular amenity. For example, people are often willing to pay considerable amounts of money just to ensure the Whooping Crane will be around for future generations to enjoy (bequest value) (i.e., up to $149/year Bowker & Stoll 1989).

2.2 Critical Species

Although it would be desirable to conserve all species, it is impractical and impossible. Thus, there is an immediate need to identify those species that are endangered and the possible consequences if they are lost forever. It is difficult for ecologists to determine which species these are, especially when there is not enough information on every species to identify the critical ones. Therefore, biologists have classified some of the critical species into three categories: keystone species, indicator species and flagship species.

Keystone Species

"Some animals and plants hold central positions in the meshwork of interrelationships that forms a community; if these species are selectively removed, the

community structure begins to collapse" (Malcolm 1988 p. 240). The loss of one of these "key species" implies that any loss in future benefits should include losses accruing to those species that ceased to exist as a result of their extinction. Species on which others depend, therefore, have contributory value in addition to their direct uses (Norton 1988). Some species have roles as prey, predator, symbiont or competitor that accentuate their ecological importance beyond what one might predict from their abundance or biomass. In many complex communities, it may be difficult to identify those species that are keystone species.

Indicator Species

A particular community is characterized by its most typical members, indicator species that are rarely found in other communities in the vicinity. The term indicator species refers to species that have such ecological tolerance that their presence or absence is a good indication of environmental conditions (Malcolm 1988). Indicator species have also been used to warn of environmental dangers. For example, the canary was often used to warn miners of methane gas leakages in the mines, or deaths of the brown pelican provided information as to the danger of certain pesticides. More importantly, however, indicator species can be used to obtain knowledge of the requirements for specific features within a forest and thus provide a basis for determining what aspects of a forest need to be preserved for the survival of the species (Malcolm 1988).

Flagship Species

Unfortunately, when it comes to endangered species some species attract more attention than other animals. For example, if the rat were to suddenly become endangered of extinction, it is unlikely that many would consider this a critical situation (although in Southern California the rat is used to prevent development). However, the real life threat of extinction of the panda bear or the bald eagle caused quite a stir among the public. It is species like the panda that are considered flagship species–a species that can arouse considerable public support and indirectly facilitate the wise conservation of a whole galaxy of species (Malcolm 1988). Conservationists often use flagship species to promote the need to preserve the habitat in which these species live. The spotted owl of the Pacific Northwest is an excellent example of the controversy surrounding the need to protect the ecosystem on which these species depend upon, namely, old-growth forests.

2.3 Issues in Valuing Biodiversity

Economists in particular have determined numerous ways in which to value public goods for which there is no price information available (e.g., preservation value of biodiversity). Two methods in particular include implicit pricing methods and contingent valuation methods. Implicit pricing is defined as an indirect method in which the unpriced amenity of interest can be purchased as a complement to, or a characteristic of, some ordinary unbiased good (Randall 1989) . Examples of this type of method are the well known travel cost method and the hedonic pricing analysis (defined later in Chapter 4).

A more common and more direct approach is the contingent valuation method which will be discussed in Chapter 4.

Despite the fact that environmentalists and economists both try to achieve the same goal (i.e., preserve biodiversity), it is the difference in techniques that causes conflict. Environmentalists are frequently opposed to assigning monetary value to biodiversity. The next section deals with this dilemma.

Is putting a value on biodiversity ethical?

Many environmentalists want to preserve biodiversity, but they are opposed to the idea of putting a "dollar value" on biodiversity. David Ehrenfeld, citing a paper by Clark (1973), in his article "Why Put A Value On Biodiversity?", suggests that putting an economic value on a species may in fact do the opposite of what was intended. Using the example of blue whales in Japan, Clark concluded that economically it was more feasible to kill every blue whale in the ocean as fast as possible and reinvest the profits in growth industries rather than to wait for the species to recover to the point where it could sustain an annual catch (Ehrenfeld 1988).

Another example of the problems associated with putting an economic value on a non-market good is that by Ludwig and Conrad (1991). Ludwig and Conrad (1991) developed an economic model to determine the optimal amount of old growth forest that should be preserved from an economic standpoint, when nontimber benefits such as habitat, recreation and watershed protection are a function of the area of old growth

remaining in a region. The results of their analysis indicated that, when opportunity costs of preserving old-growth forests are taken into account, it is better to harvest the old-growth timber than to preserve biodiversity. The reason for this is that the majority of the opportunity costs were composed of the net revenue from harvesting. These results seem to confirm Ehrenfeld's fear that if a monetary value is placed on a non-market good, it will often be more beneficial to harvest the forest and reinvest the money in a high interest investment.

Ehrenfeld also warned of the danger of using pharmaceutical value as a means to value biodiversity. He claims that reliance on this to promote conservation is only a temporary measure since not far down the road (and currently in progress) drugs which were once thought of as depending on the existence of that species from which it was derived (e.g., the drug taxol) can be reproduced, at a lower cost, "... by computer modelling of the molecular structure, followed by organic synthesis in the laboratory using a host of new technologies, including genetic engineering" (Ehrenfeld 1988, p. 213).

In defence of economists, however, it should be noted that economists are not just concerned about the existing pharmaceutical value, but rather the "potential" pharmaceutical value of species not yet discovered as cures for diseases. The opportunity costs of extinction of a species today that may have potential value tomorrow can be extremely high. It is this uncertainty that causes great concern among economists (this is discussed in more detail later). To summarize, Michael Hanemann (1988) explains the importance of placing economic value on biodiversity:

> "Environmental economists are interested in markets not because they want to use market prices to multiply something but because they are interested in measuring the preferences of individuals and ascertaining their trade-offs between environmental resources and money or conventional market commodities... economists have come to rely quite extensively on simulated markets, or their analogues, in which individuals reveal their preferences through interviews or experimental games involving trade-offs between money and environmental outcomes. Moreover, when they do analyze actual markets, economists are not interested in the market prices per se but, rather, in the patterns of selection and the types of preferences that these imply" (Hanemann 1988, p. 197).

Clearly, economists are not trying to put the value of biodiversity into dollar terms per se, but instead try to illicit its value in terms of how people view it. Thus, the economist uses techniques, such as cost-benefit analysis or implicit pricing, to determine whether or not to harvest old-growth forests or to preserve species like the Spotted Owl.

2.4 Uncertainty

When arguing the need to conserve a certain species that is on the verge of extinction, people will often look at the value of the species as it stands at present. Although this is not incorrect or invalid, one should note that it is not thorough. The true value of a species should be the value of the species today as well as the "potential" value in the future. What this implies is that there are species that we know about but whose potential use is still unknown. If the species is extinct, it is possible that we are losing a valuable resource. This can be further extended to the destruction of ecosystems upon which many species depend for survival. If certain ecosystems are destroyed as a result of deforestation, many species known to man and, perhaps more importantly, those

species not yet discovered may become extinct. The uncertainty as to the possible use of these species is of great concern to economists and ecologists. Once a species is gone, it is gone for good. Uncertainty coupled with irreversibility provide a dilemma for those involved in policy making. Perhaps one of the species yet to be discovered, which becomes extinct, could have become a cure for cancer or another deadly disease. Also of importance are the keystone species. As mentioned earlier, keystone species are those species which are critical for the survival of other species. The problem arises when it is not known for certain which species are keystone species. By accidently removing one species from an ecosystem, inadvertently several species may also become extinct. The risks involved are extremely high especially when dealing with irreversibilities. Furthermore, as time passes more and more information may come available:

> "Because the passing of time brings information about the consequences of present actions, there is a premium on actions that preserve the flexibility to exploit this information. If a current situation is physically or economically irreversible, that flexibility is abandoned. To the extent that decision makers disregard the potential value of future information, they will systematically undervalue policies, such as conservation programs, that maintain flexibility and preserve options for future action" (Hanemann 1988, p. 195).

Moreover, option values and quasi-option values (defined below) are directly related to uncertainty. Option value can now be defined as "the "premium" that consumers are willing to pay to avoid the risk of not having something available in the future. Munasinghe (1992) further goes on to define quasi-option value:

> "Quasi-option value is the value of preserving options for future use in the expectation that knowledge will grow over time. If a development takes

> place that causes irreversible environmental damage, the opportunity to expand knowledge through scientific study of flora and fauna is lost. Uncertainty about the benefits of preservation to be derived through future knowledge expansion leads to a positive QOV. This suggests that the development should be postponed until increased knowledge facilitates a more informed decision. If information growth is contingent upon the development taking place, which is unlikely in an environmental context, then QOV is positive when the uncertainty regards the benefits of preservation, and negative when the uncertainty is about the benefits of development" (p. 29).

Thus, in the case of irreversibility it is not practical to go ahead with a decision and then wait to see what information comes available, but rather it is more appropriate to wait for information to arise before going ahead with the decision.

2.5 Biodiversity and B.C.'s Old-Growth Forests

British Columbia is particularly at risk in terms of loss of biodiversity. There has been much controversy as to the forest practices concerning old-growth forests in B.C.. The most recent and perhaps the most controversial would be that of the Clayoquot Sound. The reason that people are so concerned is that the amount of biodiversity that exists in old-growth forests is particularly high.

Old-growth forests contain trees over 200 years of age[1]; are mainly undisturbed (no harvesting of timber has occurred); contain a variety of large live trees, fallen dead trees and standing dead trees (snags); are often characterized by large canopies (whereby the branches of the trees overlap to form an umbrella-like effect). The canopy provides

---

[1]Old growth is difficult to define since the age criterion varies depending on species, site, etc. (Focus on Resourses & Our Environment by Govemment of B.C. 1992)

protection for a large number of species and functions as habitat for others. Both dead and living trees are capable of supporting a wide variety of species, many of which are dependent on old-growth forests for survival. For example, there are approximately 80 species of terrestrial vertebrates in B.C. which are strongly identified with or reliant on old growth (Ministry of Forests 1992). Thus, old-growth forests are home to many species, and destruction of these forests could lead to their extinction.

British Columbia also has the greatest number of wildlife species in Canada. In particular, 70% of breeding birds, 72% of terrestrial mammals, 49% of amphibians, and 41% of reptiles in Canada are found only in B.C. In terms of forest dwelling wildlife, 77% of the birds are forest dwelling while 81% of mammals live in forests. Furthermore, 24% of forest dwelling wildlife are strongly dependent on old-growth forests (Government Statistics 1992 and Bunnell *et al.* 1991). This is not surprising considering the structure and composition of old-growth forests. Old-growth forests also provide a vast array of benefits to users (timber harvest, hunting and other recreation), visitors (wildlife viewing), and even non-users (e.g., those who benefit from medical cures, education and research).

In contrast second-growth forests (regenerated forests) have developed after an area was logged or naturally denuded (e.g., lightning fire). Generally, these forests are characterized by younger, more sparse, trees with little or no canopy[2]. Furthermore, there is little in the way of dead trees, live or standing, although, second-growth forests can be

[2]Not true for all regions, in some areas it is difficult to distinguish between old growth and second-growth forests due to the different growing conditions in each region.

managed to include these structures.

In B.C., forest structure and composition varies from region to region. Some regions may comprise trees that have a higher market value due to the size and composition of the tree. In the Coastal regions, trees often grow to great ages and sizes (1000 years is not uncommon). Individual dead trees (due to old age) often remain standing in climax forests composed of tolerant species such as western and mountain hemlock, western red cedar and Pacific silver fir. In general, the Coastal region of B.C. has some of the lowest biological risks for growing timber in North America. Overmature forests are fairly resistant to risks of loss due to insects, disease or fire. This could be in part due to the fact that Coastal forests are characterized by high rainfall, long growing seasons, and thus a low risk in growing timber.

Second-growth forests are also remarkably free from insect and disease problems. Nevertheless, there are large differences in the net returns by site type and by species. Cedar, hemlock and spruce are the higher-valued species and the Coastal region of B.C. is the prime location of high volume sites with low restocking costs.

In contrast to the Coastal forests, the Interior forests and boreal forests of B.C. have much greater biological risks. Furthermore, the colder climate, temperature and stresses on trees are more extreme, and thus major fires are more common. In the Interior, trees tend to be even-aged due to blowdown, insects and catastrophic fires. Second-growth forests also tend to be more susceptible to biological risks. The Interior, in general, has relatively little intensive silviculture due to the fact that stand development and yield

prediction of cutover are very uncertain. Since the stands in the Interior do not reach the great sizes as on the Coast, they do not command the same market prices, nor do the stands reach the same high yields as on the Coast. Thus, the stands in the coastal regions of B.C. are much more valuable to producers than those in the Interior forests. However, since the physical characteristics of the Coastal forests are to some, more appealing, they also are more valuable in other terms. Therefore, the costs of preserving old-growth forests are higher on the Coast than they are in the Interior, and consequently the motivation for controversy between conservationists and timber companies is established.

CHAPTER 3

PROTECTED AREAS: WILDERNESS AREAS

3.1 Overview Of B.C.'s Land Base

British Columbia is comprised of 94.8 million hectares (ha). Crown provincial land makes up 86.4 million ha (91%), while 80.7 million ha (85%) are considered Provincial forests (73.8 million ha in timber supply areas and 6.9 million ha in tree farm licences). Roughly 43.3 million ha (45%) of crown provincial forest land is considered productive in timber supply and tree farm licences. Only about 22.6 million ha (23%) of the provincial forests are suitable for timber harvesting, and only 238 969 ha (.25%) of this is actually harvested in a given year. Federal land makes up about 1% of B.C.'s total land base, while the remaining 8% of the land base is held under private ownership.

3.2 Protected Areas

Protected areas can be defined as land formally designated for conservation or recreation purposes. Some examples of protected areas include: Provincial and National parks, Recreation and Wilderness areas, Wildlife Sanctuaries and Ecological reserves, etc. Approximately 6.6% (6.3 million ha) of B.C.'s land base is in protected areas. Current government policy is to increase the amount of the provincial land base protected in parks and ecological reserves to 12% (12.5 million ha) of the land base by the year 2000. The government has devised a strategy whereby new possible parks and wilderness areas will

be considered for protection. In 1992, 23 new parks or wilderness areas were designated as protected areas, and additional areas are being assessed. The protected areas program set up by CORE (Commission on Resources and the Environment) focus on provincial parks and recreation areas as well as wilderness areas. Provincial parks and recreation areas protect representative landscapes and special features for conservation and recreation. Wilderness areas protect wilderness for conservation and recreation while permitting compatible, limited resource use.

3.3 Watershed Protection

A watershed is a drainage area with a boundary defined by a height-of-land upstream and a significant hydrological feature downstream such as a lake or stream confluence (Ministry of Forests 1992). Watershed benefits include flood control, improved water quality due to a reduction in sediment loads in reservoirs, as well as an impact on fishery. An undeveloped watershed is a watershed in which no more than two per cent of the area has been developed by human activity (i.e., timber harvesting, roads and mines) (Ministry of Forests 1992). An unprotected watershed has less than 10 per cent of its area protected within the boundaries of a national park, provincial park, ecological reserve, recreation area, or wilderness area. In contrast, a protected watershed has the entire land area protected within the above areas. An inventory completed by the Ministry of Forests identified a total of 508 undeveloped watersheds in the province (< 5000 ha). This was in addition to 58 undeveloped watersheds (< 1000 ha) on Vancouver

Island. In B.C., less than 10% (47) of undeveloped watersheds are totally protected, while another 93 are within parks and wilderness study areas. Approximately, 85% (428) undeveloped watersheds in B.C. are still unprotected with the remainder of watersheds partially protected. On Vancouver Island, 36% (21 of 58) of the undeveloped watersheds are protected with another 14 in park and wilderness study areas (Ministry of Forests 1992).

CHAPTER 4

LITERATURE REVIEW

4.1 Introduction

This chapter introduces previous studies and literature on topics relevant to the one at hand. Literature on methods (contingent valuation, conjoint analysis, *etc.*) used by economists and scientists in the past will be reviewed as well as literature on old-growth forests and biodiversity. The purpose is to gather information to be used in this research. A critique section will be included to assess the primary method outlined in this chapter, and to make one aware of some of the problems that need to be worked out to have a successful outcome.

4.2 Contingent Valuation Method

There are many methods with which to determine the value of a non-market good. Perhaps the most common form of valuation is the Contingent Valuation Method (CVM). This technique uses surveys to gather information on the respondent's willingness-to-pay or demand for a particular environmental good. The method requires the respondent to state how much they are willing to pay for increments of decrements for the good in question. However, as will be shown later, there are many drawbacks with this approach.

4.2.1 Background

The contingent valuation method (CVM) is used to determine an individual's

willingness-to-pay (WTP) for more or to prevent the loss in the level of an unpriced good. The same approach could be used to calculate an individual's willingness to accept compensation for a decrease/loss in the level of a public good. This approach involves obtaining information on a consumer's preferences by using questionnaires. The questions posed by the surveys are designed to calculate the consumer's WTP. Often, the subject is given a certain scenario (contingency or hypothetical situation) regarding the loss or gain of an environmental good. They are then asked to respond to the situation by indicating how much money (usually stated in the survey in the form of bids) they are willing to pay to prevent the loss or to obtain more of the good. Opponents to this method argue that the problems which arise from the design of the questionnaires may be misleading or may not achieve the desired goals of the researcher. Thus, the values may not give an accurate account of the consumer's preferences. Some of the reasons include:

1) Starting point biases=occurs when the starting value of the bids may be too low or too high, people anchor their willingness to pay on this amount or use this as an approximation of the true value of the good;
2) Strategic bias=the subject may be biased towards the topic and may try to sway the results in his/her favour;
3) Information bias=the respondent may not be familiar with the subject in question;
4) The respondent may feel that his/her opinion will have no bearing on the results and thus may not give a meaningful opinion;

5) The respondent may object to the vehicle of payment, or may feel it is unethical to place values on environmental goods; and

6) The respondent may be trying to please the interviewer by giving answers that he/she thinks the interviewer wants to hear.

7) In general, consumers have not had to price non-market goods and will have no concept of where a market price may be.

8) Values for various similar non-market goods may not be additive.

Some of these problems can be overcome through careful design of surveys. Depending on the situation, CVM may be the only available approach to calculating the value of unpriced goods.

4.2.2 CVM Studies

There have been many studies aimed at calculating economic values for non-market goods using the Contingent Valuation Method. Stevens *et al.* (1991) examined the validity of CVM for estimating the existence value of four wildlife species recently introduced or reintroduced to New England (Atlantic salmon, coyote, bald eagle, and wild turkey). In the study, two separate CVM mail surveys were sent out (one to Massachusetts for the restoration program of Atlantic Salmon and one to New England for valuing bald eagles, wild turkeys and coyotes).

The surveys were constructed so as to ask questions that would reveal how each

individual valued the species. The questions were designed to analyze each individual's decision-making process and to ascertain whether or not the respondents were consistent in their beliefs.

The results of the surveys indicated that people would be willing to contribute a certain amount of money to the Atlantic salmon, bald eagle and wild turkey; however,

> "80% of survey respondents said that bald eagles, wild turkeys and Atlantic salmon are important to them, but when confronted with contingent valuation the majority refused to pay. They were either uncertain about their valuation, believed that wildlife should not be valued in dollar terms or protested the donation payment vehicle. Moreover, most of those who would pay exhibited behaviour which appears inconsistent with the neoclassical theory underlying the CVM" (Stevens *et al.*, p.399).

The results could be explained by the following:

1) Most respondents were unfamiliar with the commodity being valued;

2) Benefits were primarily viewed as existence values; and

3) Many responses were a result of moral or ethical considerations.

The results of their study suggest that the CVM may not provide a valid measure for existence values. Therefore, a benefit-cost approach would not be an appropriate technique to value wildlife.

Although Stevens *et al.* concluded that the CVM was not the most appropriate means of making decisions about the existence of wildlife, other studies have shown that this is not necessarily true. Mohan Munasinghe (1992), in a recent World Bank working

paper, summarized several studies aimed at estimating existence, option and bequest values for wildlife and endangered species using CVM. Some of the studies are summarized below.

One study looked at the option price and existence values of grizzly bears and bighorn sheep in Wyoming now threatened by human activity. The study was aimed at hunters' WTP for the right to hunt in a newly designated hunting area, and non-hunters' WTP for the knowledge that the animals would exist in the future. The results (from the hunters' WTP) indicated that there was a positive relationship between the probability of an increase in supply of the species and the option price, while the existence value for the grizzly bear (from non-hunter's WTP) was quite high compared to the existence value of bighorn sheep (Brookshire, Eubanks and Randall 1983).

Another study by Walsh, Loomis and Gillman (1984) sought to determine the optimal amount of wilderness area to be protected in Colorado by determining the option, existence and bequest values (i.e., preservation values) for wildlife. Respondents allocated their WTP into a fund for the sole purpose of protecting wildlife in the area. Further, the respondents were asked to categorize their contributions into: recreation use, bequest value, option value and existence value. Total preservation value was calculated as the amount left over once recreation use was subtracted from the total WTP for preserving wildlife. The results indicated that recreation use had a positive influence on option value. Moreover, existence values were positively correlated with scenic amenities, ecosystems and biodiversity. Bequest values, which were constant regardless of the

amount of wilderness that prevailed, followed *a priori* expectations that people gained satisfaction from the knowledge that the species will be there for future generations to enjoy.

Samples, Dixon and Gowen (1986) tested the hypothesis that, as more information about a particular species is disclosed, an individual's WTP is significantly influenced. The study was divided into two sections. The first part of the study looked at how an individual's WTP changed when they were given more information on the species in question. The subjects were asked to give their WTP for the preservation of the hump-back whale before, and then again after, a film of the whale was viewed. The results showed a significant increase in the value of their bids. The authors concluded that part of this may have been attributed to the fact that the respondents had time to re-evaluate their decisions.

The second part of the study consisted of respondents who, given a certain amount of money, were asked to allocate that money among different preservation funds. Each particular fund had a certain amount of information about a species (e.g., endangered status, physical attributes). The results indicated that the more information that was available about the species, the higher the allocation of monies to that species' preservation fund. The study concluded that people are more likely to contribute higher amounts to a preservation fund as more information about the species is released.

All the aforementioned studies (with the exception of Stevens *et al.*) illustrated how CVM could successfully be used to determine preservation values of wildlife. This is not

to say that CVM is not without its shortcomings, however. It does suggest that, if proper measures are taken, CVM could give credible results in appropriate situations for the economist to analyze (Munasinghe 1992).

Contingent valuation studies have been readily used by economists to evaluate a proposed increase (or reduction) in the level of a non-market good such as wilderness areas. Pope and Jones (1990) used CV to examine four proposed increases in wilderness areas in Utah. Using an open-ended framework, telephone surveys were conducted on 280 households in the state of Utah and an estimated WTP was obtained for each level of proposed increase in wilderness areas. The average willingness-to-pay amounts for each increase of 5%, 10% 15% and 30% were $53, $64, $75, and $92 per year per household. These values were then used to derive an aggregate WTP for the whole state of Utah by multiplying the average WTP values for each level of wilderness designation by the total number of households in Utah. The aggregate annual amounts ranged from $27 million for a 5% increase to $47 million for a 30% increase. Furthermore, the authors found that the demand for increased wilderness areas levelled off at about 15% for the state. Thus, the value of setting aside an additional 15% on top of this was not economically advisable.

In a study similar to the one at hand, Rubin, Helfand and Loomis (1991) used a mail-out survey to determine the maximum willingness-to-pay to preserve the Northern Spotted Owl in the Pacific Northwest. The survey was sent to residents in the state of Washington. Of the 1,200 surveys distributed randomly throughout Washington, only 253

residents responded to the survey, but, only 216 surveys could be used in the analysis. The results indicated that individuals are willing to pay as much as $49.72 ($34.84 when adjusted for factors such as education and income levels) to preserve the spotted owl. Although the results were not surprising, the authors did note some problems with the survey. The low response rate was an obvious problem, while the unusually high education and income level (as compared with society as a whole) may have contributed to survey bias. Generally, people with higher education and income levels often tend to support conservation practices.

Likewise, a study by Hagen *et al.* (1991) sought to estimate the non-market benefits of preserving old-growth forests and protect the spotted owl. The authors used a dichotomous choice format for their nationwide mail out questionnaire. The study went one step further than requesting a "yes" or "no" response. The individual was then asked to reveal his/her maximum and minimum WTP. The estimated values obtained from the survey indicate a willingness-to-pay of $86.32 per household per year with an upper limit of $144.28 and lower limit of $47.93. Aggregating these values for the nation gives an estimate of 8.3 billion dollars per year. This is considerably higher than the estimate of $1.5 billion per year obtained by Rubin *et al.* (1991). More surprising is that Hagen *et al.* go even further as to discount the values into the future to arrive at an estimated annual total of $215 billion over 30 years.

A similar study analyzing the value of protecting forest quality (as opposed to wilderness areas) was performed by Walsh *et al.* (1990). Their study involved

interviewing a random sample of households in the Colorado area. An average willingness-to-pay value, obtained using an open-ended approach, was calculated to be $47 per household per year. Only one quarter of this value could be attributed to recreation use value, while the remaining three quarters represented preservation values. Similar to the study by Pope and Jones (1990), the authors constructed a demand curve for forest quality in Colorado. The results indicated diminishing marginal benefits with a maximum of 150 trees/acre and a value of $47 per household. An aggregate value for forest protection was estimated to be $56 million annually (for the state of Colorado). Reliability of the survey is expected to be quite high given the authors provided several checks for a variety of bias.

A study by Hanley and Ruffell (1992) examined the variation in consumers surplus across different forest types by placing values on the physical attributes of individual forests. The authors used both the hedonic travel cost method and the contingent valuation approach. The characteristics obtained were used to help explain total visits to a particular forest. The study included two different CVM studies, one using photographs of forests varying in characteristics (e.g., water features, scenic views, recreational facilities, open sky, *etc.*), and the other using a bid curve analysis where respondents were asked to bid the amount they would be willing to pay for the option to visit the forest given the above attributes. In the photo analysis, respondents were asked to choose between different pairs of photographs, each differing by one characteristic. This itself posed problems for the analysis, since not all possible characteristics could be

represented in the photographs. The use of photographs helped to determine which characteristics were important in deciding which forest to visit. However, for surveys where photographs were not used, the importance of certain attributes decreased. The authors concluded that this is because people visiting the forests had in mind an intended use.

Many economists have compared different methods of estimating values of non-market goods. In particular, Sellar, Stoll and Chavas (1985) looked at three alternative methods for valuing recreational boating at the Four Lakes in East Texas, namely, the travel cost method and two forms of the contingent valuation method (open-ended and closed-ended). The open-ended survey directly elicited the respondent's WTP for the lake they were visiting, whereas the closed-ended questionnaire obtained indirect estimates based on 10 alternative bid amounts ranging from $10 to $300. Results of the study indicated that the open-ended framework gave the lowest WTP values given that respondents were probably unfamiliar with valuing a non-market good. The travel cost method elicited the highest value, but the authors concluded that this was due to the fact that it was for the whole recreational experience and not just the boating experience as in the CV portion of the study. The closed-ended approach seemed to have the closest values of consumer surplus to that of the travel cost method. The authors concluded that, for valuing non-market goods, the closed-ended and travel cost methods were the appropriate tools for estimating consumer surplus.

There have been numerous studies aimed at comparing different forms of CV

(Sellar, Stoll and Chavas 1985; Johnson, Bregenzer and Shelby 1990 ; Bishop and Heberlein 1979; Boyle and Bishop 1988; Kealy, Dovidio and Rocke 1988l; Desvousges, Johnson, Dunford, Boyle, Hudson and Wilson 1992; and Milon 1989). More specifically, Kealy and Turner (1993) compared WTP values across two forms of CV, open-ended and closed-ended (dichotomous choice) questions. The authors developed a test to analyze the difference in willingness-to-pay estimates obtained from both open-ended and closed-ended formats for the same sample population. Furthermore, the authors applied a separate test to examine the difference in estimates using both a public good and a private good to determine if the attributes of the commodity had any influence on the difference. As in other studies, the results of the study indicate that open-ended questions tend to lead to significantly different results than the closed-ended questions. More precisely, the estimates obtained using the open-ended questions were considerably lower than those obtained using the closed-ended format. Regardless of this conclusion, the results did not hold for the private goods. In fact, there was not found to be any significant difference between estimates from the two alternative approaches. The reason for this seemed to be that the private good was a more concrete good where respondents were more familiar with the value of the good and there was likely to be less strategic behaviour involved than in the open-ended, pubic good scenario. The authors also concluded that the respondents may have been unfamiliar with the value of the public good and the fact that there may have been strong incentives for strategic behaviour for a public good. Furthermore, individuals may have not been accustomed to the format of the open-ended

questions as opposed to the simplicity of the closed-ended questions.

Similarly, there have been many studies which have dealt with the appropriate method of estimating WTP values from dichotomous choice questions (Hanemann 1984; Johnson, Bregenzer and Shelby 1990; Ozuna, Jang and Stoll 1993; Duffield and Patterson 1991; and Cameron 1988). Bowker and Stoll (1988) using dichotomous choice to estimate the non-market value of Whooping Cranes examined the difference in estimates of willingness-to-pay across three alternative specifications, two different models of estimation (logit and probit) for each specification, and compared welfare measures obtained using both mean WTP and median WTP. Results of the analysis indicate that a logarithmic specification is superior in terms of goodness-of-fit to both a linear and share specification. Both logit and probit models exhibited similar estimates throughout the alternative specifications suggesting that both models perform equally in dichotomous choice formats. Median and mean estimates of WTP were significantly different among the different specifications. Mean WTP was considerably larger than the median WTP across all specifications, a result that has been found in similar studies. However, the median estimates were much more sensitive to the functional form used. The authors concluded that for their study the logarithmic functional form using the mean WTP provided the best estimate of non-market values of whooping cranes on the basis of statistical fit and other considerations. Thus, caution and judgement should be taken when choosing a functional form or a welfare measure.

A study by Cooper and Loomis (1992) examined the sensitivity of WTP estimates

to the alternative bid values. Using data obtained from previously completed questionnaires, the authors tested the sensitively of the models by removing bids (highest bids, lowest bids, and then every other bid) and re-estimating the models. When willingness-to-pay values were restricted to be nonnegative, the model was more sensitive to the removal of the highest bids than the unrestricted WTP model. However, the opposite is true when the lowest bids were removed from the data. The use of a restricted model is more suitable when valuing improvements in a public resource, therefore; the researcher should be more concerned about the effects of the highest bids in the bid space than the bids in the lower portion on the results. Their results signify the importance of choosing the bid amounts, and thus the sample design, carefully.

4.2.3 Some Critiques of Method

Kahneman and Knetsch (1992) sought to determine the validity of the contingent valuation method; in particular, the authors examined the embedding effect of surveys/questionnaires used in the analysis.[3] A telephone survey was conducted in the greater Vancouver area and the respondents were asked questions pertaining to increased availability of equipment and trained personnel for rescue operations. Three different groups were asked variations of the questions. The questions varied from general questions on environmental services with the primary question to be examined embedded

[3]The embedding effect is defined by Knetch as "the same good is assigned a lower value if WTP for it is inferred from WTP for a more inclusive good rather than if the particular good is evaluated on its own."

in the questionnaire, to questions aimed directly at the question under consideration. The results indicated the presence of an embedding effect. Consequently, respondents in each sample were willing to pay the same amount regardless of the specific good in question. The authors concluded that people were purchasing moral satisfaction rather than actually considering the good in question, and thus the values obtained from a CVM analysis cannot be considered true economic values.

Paul Slovic (1990) examined the role of preference reversals in contingent valuation surveys. His results indicate that, when an individual prefers one object over another object, the individual may reverse his/her preference depending on the method of measurement. For example, in one of his studies he found that the respondents provided a higher WTP for an improvement in word processors than an improvement in air quality. However, when the same respondents were asked to value the two options, the majority of the respondents reversed their preferences. Slovic concluded that, depending on whether or not value is measured by pricing responses or by choice responses, a respondent's preference will rely on the method of valuation. Furthermore, Slovic concluded that, when using contingent valuation as a means of valuing an environmental good, one must determine the rationality behind the decision.

McKillop (1992) recently illustrated the dangers of using CVM for evaluating how people value public goods. In particular, McKillop focussed on the use of CVM in northern spotted owl studies such as the one by Rubin *et al.* (1991) (see section 4.2.2). McKillop argued that the respondents were not provided with a complete set of

information (i.e., respondents were told half truths). For example the respondents were told that the spotted owl depended heavily on old-growth forests for survival; however, they were not told that there is evidence that the spotted owl also nests in second-growth forests. The respondents were not informed of the major impact on the U.S. timber industry, globally as well as locally (i.e., extreme job losses), nor were they informed as to the true cost of implementing habitat preservation for the spotted owl. Furthermore, McKillop criticized the Rubin *et al.* study for suffering many of the biases commonly found CVM studies, particularly hypothetical bias. McKillop argued that the amount the respondent is willing to pay is generally much higher than what they would be willing to pay in an actual situation. If the respondent does not think they will actually have to pay they are often more generous. Similar results were found in studies by Bishop and Heberlein (1979) and Stevens *et al.* (1991) (see section 4.2.2).

4.3 Alternative Methods

An alternative approach to examining mulitattribute commodities is the pairwise comparison approach whereby an individual is given a choice between two attributes and asked to choose one or the other (a modified version extends this approach by allowing the individual to scale his response). Generally, the individual chooses between attribute A or B by stating which one he prefers. A modified approach to this method was used in a study by van Kooten *et al.* (1986) to evaluate goal hierarchies among farmers. In the study, farmers were given sets of two goal statements and asked to reveal their

preferences by indicating on a line (Goal A at one end, Goal B at the other) the degree to which they preferred one statement over the other. The results enabled the authors to regress the preferences on a set of farm enterprises and household characteristics.

The use of cardinal rating scales to determine how people perceive scenic beauty as a direct result of forest characteristics has been used in several studies (Brown and Daniels 1984; Arthur 1977; Brown *et al.* 1990; Brunson and Shelby 1992). In these studies the authors used photographs to elicit the respondents's preferences of certain characteristics associated with different sites.

Conjoint analysis is another approach for estimating the value of a mulitattribute good. This method can use surveys to get respondents to rank attributes of the good according to their preferences. Conjoint analysis is especially useful in estimating the joint effect of several independent variables on the ordering of the dependent variable. The total utility associated with a combination of attributes can be estimated by summing together so called "part-worths". "A trade-off, representing the amount that one attribute must change to compensate for a change in another attribute (holding utility constant) can be determined" (Patrick *et al.* 1983, pp. 4-5).

Other methods that attempt to price nonmarket goods include *travel cost, hedonic travel cost, hedonic pricing models*, etc. The travel cost method uses interviews to obtain an estimate of the demand for a public good based upon the amount of money one spends to travel to a particular site (e.g., assumes travel cost is a proxy for price, Adamowicz 1992). Thus, a demand curve based on the number of trips taken to a particular site as

a function of the amount of money spent on getting to that site can be determined to evaluate the value of the area.

Similarly there is the Hedonic Travel Model which assumes that individuals are willing to spend more on travel costs for sites with higher quality attributes (Adamowicz 1992). With this model one is able to obain an estimate of the value of certain site characteristics (e.g., estimate the implicit price of quality attributes).

Hedonic price models are generally used to measure the benefits of an improvment in environmental quality from the implicit effects that change in quality has on market prices (i.e., property values).

CHAPTER 5

THEORETICAL CONSIDERATIONS

5.1 Background

When trying to estimate a value for old-growth forests, it is important to have a clear definition of what is meant by "old growth". Moreover, what attributes constitute old-growth forests in British Columbia? How do people value these attributes? In the United States, each U.S. Forest region has a task force to arrive at some form of delineation through surveys and other methods to arrive at 5-6 attributes for old growth in each region. Since the age and composition of species that constitute old growth varies between regions, it is impossible to arrive at one specific definition. In the Pacific Northwest, the Old-Growth Definition Task Group (1986) set out to define old-growth Douglas-fir and mixed-conifer forests. The Old-Growth Definition Task Group, which perceived old growth as an ecological concept, determined the minimum standards for old-growth forests applicable to a variety of species found in the Pacific Northwest and California.

The vast majority of B.C.'s old-growth forests are comprised of softwoods such as true firs, lodgepole pine, spruce, and, to a lesser degree, Douglas-fir, cedars and Hemlock (Government Statistics 1992). Consequently, the minimum standards for old-growth applicable in the Pacific Northwest do not necessarily represent the minimum standards found in B.C.; however, the standards do provide guidelines for defining old growth in

B.C. The four standard characteristics for old-growth forests are (Old-Growth Definition Task Group 1986, p. 4, US Forest Service, and National Park Service):

1) Live trees--number and minimum size of species;

2) Canopy;

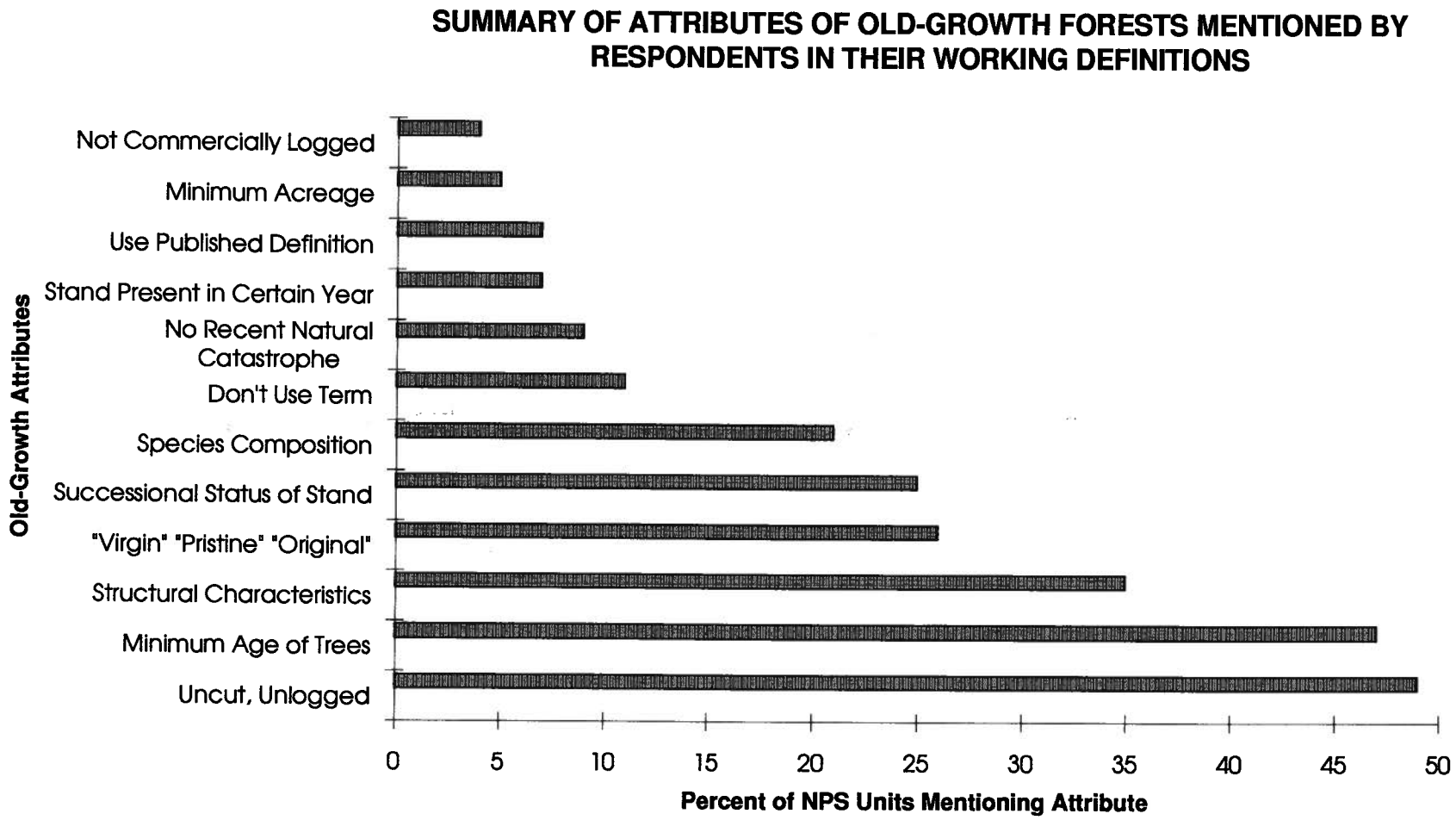
3) Snags--minimum number of standing dead trees of specific size; and

4) Logs--specific size and minimum tonnage of downed logs.

In a study to examine the management and control of old-growth forests on U.S. National Park Service lands, Lucy Tyrrell (1991) sent out questionnaires to rangers in several national parks in the major regions of the U.S. (Midwest, Pacific Northwest, Western, etc.) to determine which attributes they found to be linked with old growth. As shown in Figure 5.1, the attributes defined by the NPS were in much greater detail and included such characteristics as species composition (including wildlife) and logging practices. Tyrrell's questionnaire included inquiries into the amount of species associated with old-growth forests (see Figure 5.2) and which species were explicitly reliant upon old-growth forests for survival. Moreover, Figure 5.3 shows that when asked what they felt was the primary factor affecting old-growth forests, 42% of the respondents indicated logging as a primary disturbance of old growth, while wildfire (28%) and windthrow (20%) also have a major effect on old-growth forests (Tyrrell 1991, p. 20).

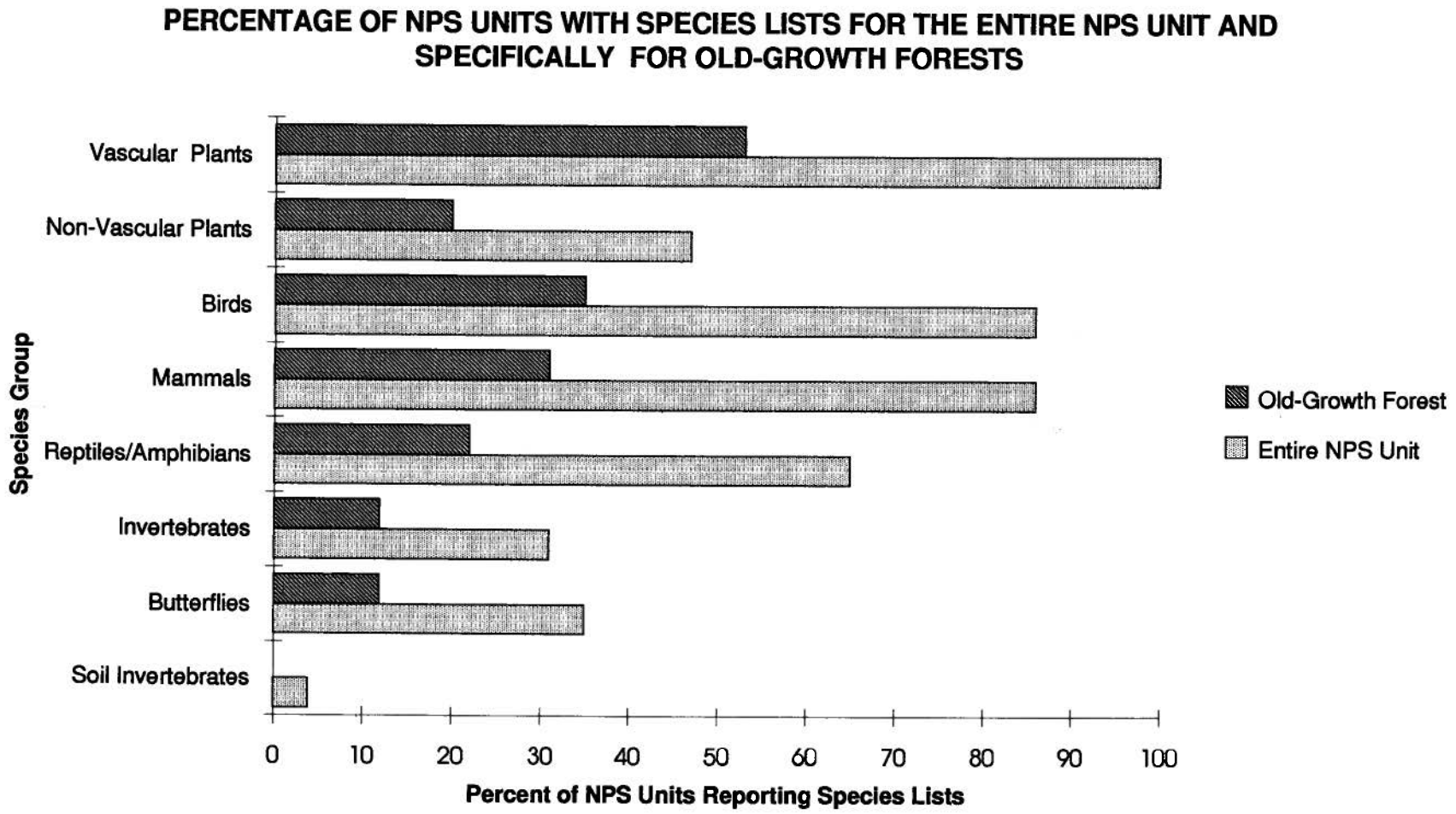
"Towards an Old-Growth Strategy" was a project of the B.C. Ministry of Forests. The purpose of the Ministry's study was to include the following:

Figure 5.1



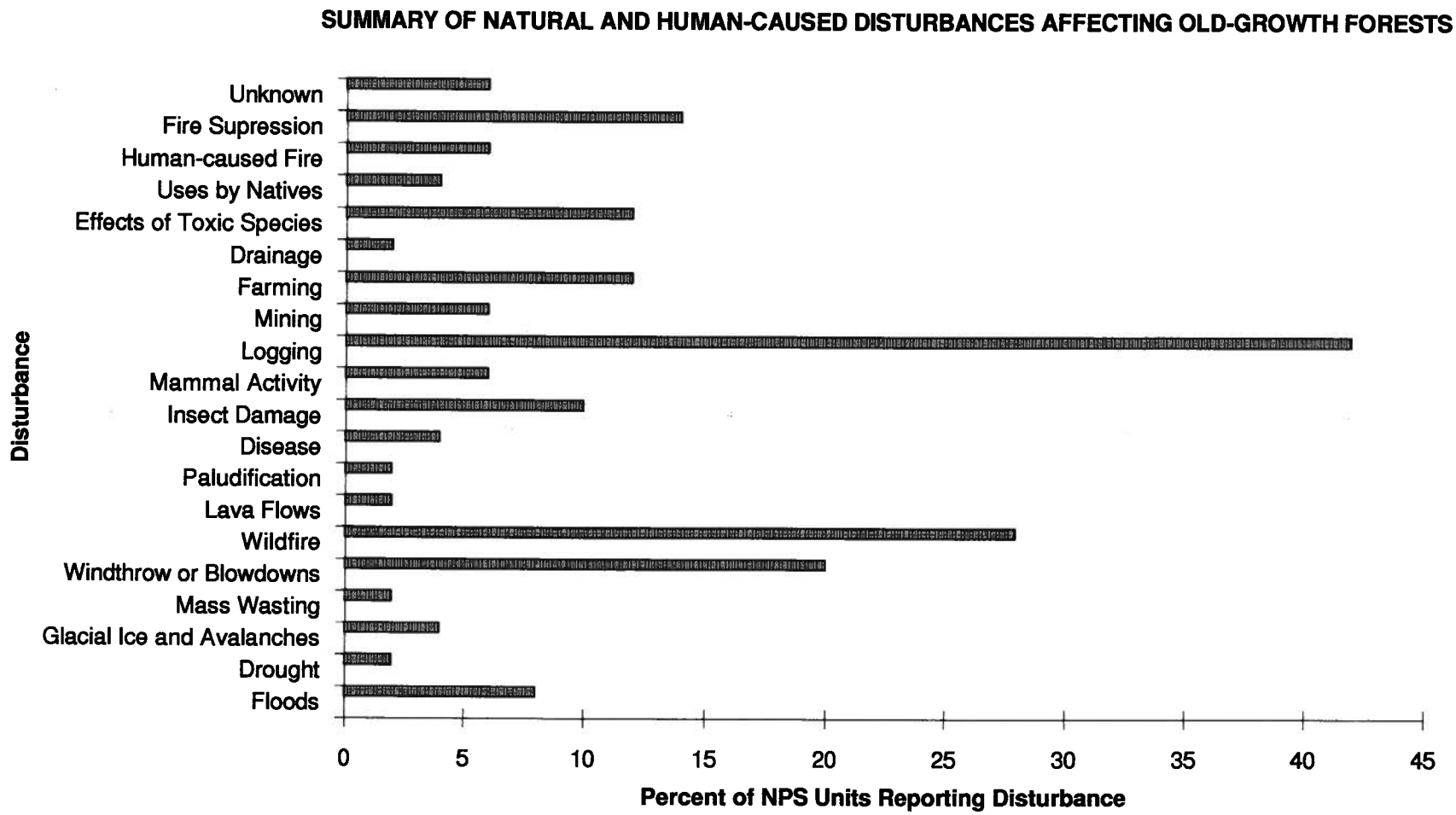
Source: Tyrrell, Lucy E, 1991. Old-Growth Forests on National Park Service Lands: NPS Views and Information, p.12.

Figure 5.2



Source: Tyrrell, Lucy E., 1991. Old-Growth Forests on National Park Service Lands: NPS Views and Informaton, p.17.

Figure 5.3



Source: Tyrrell, Lucy E., 1991. Old-Growth Forests on National Park Service Lands: NPS Views and Information, p.20

i) define old-growth
ii) increase knowledge (amount of inventory of old-growth in B.C., scientific, economic)
iii) forest management objectives (social, economic, environmental, scientific)
iv) recommendations for action
v) priority issues
vi) criteria for developing old-growth forests

Part of the analysis looked at the different values attributable to old-growth forests; some require the consumption of the forest, while others require preservation. Below is a summary of some of the values associated with old-growth forests obtained from the Public Review Draft:

1) biodiversity
2) community recreation
3) community stability
4) gathering
5) geoclimate
6) grazing
7) heritage values
8) wilderness
9) option, bequest and existence values
10) science research and education
11) spiritual and aesthetic values
12) symbolic values
13) timber and manufactured products
14) tourism
15) hydrological features
16) hunting, trapping and fishing

Many of these values are not explicitly attributable to old growth and can be managed for in second-growth forests.[4] Furthermore, it is these values which people are more familiar with (especially without the aid of photographs) and are able to make appropriate judgements when valuing environmental amenities. Thus, the above list of benefits of old growth forests will be used as the basis for evaluating the preferences of the respondents in the survey.

[4]However, many of the ecological characteristics of old-growth forests can not be easily managed for in second-growth forests.

5.2 Theoretical Model

The theoretical model to be used in this paper is based on consumer utility theory. The consumer is considered to have a preference ordering over both private and public goods, x and z respectively. The goods traded in markets (x) are considered to have positive prices (p), whereas the public goods (z) have no prices since they are not traded in the market. A consumer's preference can be characterized by the strictly increasing, quasi-concave, ordinal utility function U(x,z), which is maximized subject to the individual's household income constraint (Y). The individual's problem can be best illustrated as:

(5.1) $$\text{Max}_x\ U(x, z; s) \quad \text{s.t. } Y = px$$

The prices (p) for all other goods (those traded in the market place) as well as the demographic and socioeconomic factors that help influence the consumer's ability to pay or constrain their behaviour (denoted as the vector s) shall be eliminated for the time being since they remain constant throughout the analysis. Thus, the corresponding indirect utility function can be written as follows:

(5.2) $$V(p, z, Y) = \max_x \{U(x, z) \mid px \leq Y\} = U(x(p, z, Y), z).$$

The coinciding expenditure function is:

(5.3) $$e(p, z, U) = \min_x px \mid u(x, z) \geq U^0 = v^{-1}(p, z, Y) = Y$$

The expenditure function is simply the inverse of the indirect utility function and equal to the consumer's household income given the optimal utility level U*. The expenditure function is the minimum amount of income required to achieve (or minimum cost of

achieving) a given level of utility, whereas the indirect utility function is just the maximum utility obtained from the consumer's income and the prices of the goods.

The indirect utility function is non-decreasing, continuous, twice differentiable in p, y and z, and quasi-concave in z. The expenditure function is continuous, twice differentiable in p, y and z, non-increasing and convex in z.

There are four different Hicksian welfare measures for contingent valuation surveys, these are: compensating surplus, compensating variation, equivalent surplus, and equivalent variation. The surpluses differ from the variations in that the former constrain the quantity of the good being considered, while the latter do not constrain the amount of good being purchased. In cost-benefit analysis, the correct method of valuing a non-market good entails using compensating variation or equivalent variation measures.

The Hicksian or compensated demand function, h(p,u), is used to evaluate welfare changes (increments or decrements) in the level of a public good while utility is kept constant. The compensating variation function (CV) is used to determine the amount of money that the consumer would be willing to pay (WTP) for an increase in the public good from z^0 to z^1, where $z^0 < z^1$. The compensating measures assume that the consumer is entitled to the current level of utility or the current endowment of property rights. Similarly, the equivalent variation function (EV) is the minimum amount of money the consumer would be willing to accept (WTA) as compensation to forgo the increase or improvement in the public good.

In this study, a contingent valuation approach is used to obtain a respondent's

WTP, therefore, the appropriate choice of measurement is the compensating variation. One way to measure this is to determine the difference between two expenditure functions. Alternatively, it is the change in consumer's income, coupled with the change in the level of the public good that leaves the respondents' utility unchanged. Thus, CV can be mathematically stated as follows:

(5.4) $$CV(Z^1, Z^0, Y) = Y - e(Z^1, v(Z^0, Y))$$

where z^1 is an increase or improvement in the level or availability of the public good and Y is the consumer's income.

Compensating variation can also be written as:

(5.5) $$CV = e(p, Z^1, Z^0, U^0) - e(p, Z^0, U^0),$$

which implies the amount that is needed to make the consumer as well off as before (i.e., hold U at U^0).

Taking a Taylor series expansion about Z^0 and the mean income level, Y*, gives the following expression for CV[5]:

$$CV = CV(Z^0, Z^0, \bar{Y}) + (Z^1 - Z^0)\frac{\partial CV}{\partial Z} + (Y - \bar{Y})\frac{\partial CV}{\partial Y} + \frac{1}{2}(Z^1 - Z^0)^2\frac{\partial^2 CV}{\partial Z^2} + \frac{1}{2}(Y - \bar{Y})^2\frac{\partial^2 CV}{\partial Y^2} + (Z^1 - Z^0)(Y - \bar{Y})\frac{\partial^2 CV}{\partial Z \partial Y} + R.$$

(5.6)

where R refers to remaining terms. The willingness-to-pay function for a single

[5]As derived by van Kooten (1993).

household for an increase or improvement in a public good is as follows:

$$WTP = \alpha_0 + \alpha_1 \Delta Z + \alpha_2 \Delta Z^2 + \alpha_3 (Y - \overline{Y}) + \alpha_4 (Y - \overline{Y})^2 + \alpha_5 \Delta Z (Y - \overline{Y}) + R,$$

(5.7)

where $\alpha_0 = CV(Z^0, Z^0, Y^*) = 0$ since no change in a public good in CV would be zero; $\alpha_1 = \partial CV / \partial Z$; $\alpha_2 = \partial CV / \partial Y$; $\alpha_3 = 1/2 \partial^2 CV / \partial^2 Z$; $\alpha_4 = 1/2 \partial^2 CV / \partial^2 Y$; $\alpha_5 = \partial^2 CV / \partial Z \partial Y$. The empirical model would be complete once social factors describing attitudes, age, household makeup and size, etc.

CHAPTER 6

METHODOLOGY

6.1 Contingent Valuation

There are many different methods for estimating the value of nonmarket goods (briefly defined earlier in Chapter 2), but in this study, contingent valuation was chosen. There are many different ways of eliciting a consumer's WTP in CV, however, two of the most commonly used methods are the open-ended and closed-ended methods.

With an open-ended questionnaire, the interviewer tries to directly estimate the respondent's willingness-to-pay by asking him or her directly how much they are willing to pay towards the amenity. Although this method directly elicits a WTP value, it too has many shortcomings (see biases in Chapter 4).

6.2 Closed-ended Approach (Dichotomous Choice)

The closed-ended approach (also known as referendum or dichotomous choice) uses an indirect approach to estimate a consumer's WTP. This strategy provides the researcher with a discrete indicator of WTP rather than an actual WTP.

This approach is being used more frequently in analysis of public goods since it does not have as many of the drawbacks as the open-ended approach (many of the biases associated with the open-ended format are avoided with the closed-ended format). The

dichotomous choice (closed-ended) approach provides the respondent with a given price ($X) which he/she must decide whether or not they would be willing to pay for a change in the quantity of the amenity. In other words, the respondent indicates his/her WTP by answering "yes" or "no" to a single stated price. Often this bid is calculated as the estimated actual cost of preserving the good. Moreover, this design is consistent with utility maximization theory (Chapter 5).

One of the benefits that arises from using discrete indicators to elicit a respondent's WTP is that it gives the respondent some sort of guideline with which to evaluate his/her maximum willingness-to-pay for the amenity, especially if the good is one that is unfamiliar to them or hard to evaluate in dollar terms. Whereas in the open-ended format, the individual may have to choose a value without any concept as to the actual value of the amenity, as a result the amount may be unrealistically large or too low. In circumstances where the survey is given absentee of the interviewer or visual aid, this approach is often the preferred choice among researchers.

Another advantage to this approach is that, unlike the open-ended format where an individual may overstate his/her WTP, this approach is considered incentive-compatible. Ideally "...it is in the respondent's strategic interest to say yes if her WTP is greater than or equal to the price asked, and to say no otherwise" (Mitchell and Carson 1989). The benefit of this is the decrease in the probability of strategic bias.

However, the dichotomous choice (DC) approach also has its limitations. One problem the analyst may face is that less information is available about the respondent

than with the open-ended questionnaire. For example, an exact value is obtained from the respondent with the open-ended format, however only whether the consumer's true WTP is greater or less than the amount offered ($X) is obtained in the closed-ended format. Within the DC approach there is the single-bounded model and the double-bounded model which gives the researcher a more precise hint of the true WTP of the respondent.[6] Due to this limitation, a much larger sample size is required.

Similarly, the economist must decide what range of bids to offer in the survey. Too small a range may lead to problems in estimating the probability function, or may not give enough information to the researcher to estimate an accurate demand curve.

Furthermore, Mitchell and Carson (1989) have identified other drawbacks to the dichotomous choice approach. The authors suggest that, like the starting bid bias associated with other methods, the dichotomous choice approach is subject to a nonzero level of yea-saying[7].

Yet another concern is the method by which the mean WTP is obtained. Current researchers have found that using either a logistic or probit regression yields a mean WTP directly from the parameters of the equation (discussed below). However, using either of these functions requires the analyst to make strong assumptions about the mathematical

---

[6]Recent work has involved the use of double-bounded (and even triple-bounded models), whereby the respondent is then given a second offer depending on the response to the first bid. Generally, a doubling of the first bid if the respondent responds with a "yes" or half of the original bid if the respondent answers "no" is the usual approach.

[7]Yea-saying is defined as when a respondent agrees to the bid amount in an attempt to please the interviewer.

form of the valuation function. With the open-ended design, the individual's maximum WTP is calculated directly and gives the researcher a clear indication of how the individual values the amenity.

It is up to the discretion of the researcher which procedure to use, however, the U.S. National Oceanic and Atmospheric Administration (NOAA) panel (Arrow *et al.* 1993) favors the dichotomous choice approach as they find the open-ended approach unreliable.[8]

6.3 Biases

Apart from the biases mentioned earlier in Chapter 4, another bias that may occur in CV studies is *sample selectivity bias*. Sample selectivity bias occurs when the researcher purposely eliminates those respondents for which zero or missing values were found for the valuation question (including endowment bidding and protest bids). Moreover, if one is to assume that the proportion of the sample remaining (those for which a positive value was obtained) is an appropriate representation of the population as a whole, then one must assume that those who did not respond to the survey (nonrespondents) value the amenity the same way that survey participants do. However, one cannot make this assumption without some sort of proof that sample selectivity bias does not exist. One test for this type of bias is the procedure developed by Heckman,

[8]The U.S. National Oceanic and Atmospheric Administration (NOAA) panel was established to give suggestions regarding the use of contingent valuation for valuing environmental goods.

whereby a simple two-stage estimator is used to internalize censored observations (those respondents with positive bids) and to test for sample selectivity bias.[9]

6.4 Protest Responses

Protest responses are those responses whereby the respondent, for reasons of his/her own, refuses to answer a question (closed-ended surveys) or gives a zero bid (as in the case of the open-ended questions called zero response bids). There are many reasons why respondents may refuse to answer questions. First, the respondent may, as in the case of public goods, object to putting a dollar amount on a public good. They may feel that public goods, such as provincial forests, belong to everyone and that their value cannot be captured by a dollar figure. Second, the respondent may be objecting to the payment vehicle. For example, if the payment vehicle is increased taxes per year the respondent may not feel that this is the appropriate method of payment, but prefers an approach where users are charged instead (i.e,. a user fee). Moreover, the respondent may feel that the question is not worded properly and may not fully understand what the interviewer is trying to elicit.

6.5 WTP Model

The first step in calculating the welfare measure is to estimate the parameters of the probability function. There are several techniques which can be applied; these are the

[9]For a more detailed explanation of Heckman's procedure, see Edwards and Anderson 1987.

linear probability model (LPM), the logit model and the probit model. However, the LPM is rarely used as a means of estimating parameters because the error structure is heteroskedastic and non-normal, and probability predictions can be outside the zero to one range. Conversely, logit and probit regression models are unbounded and linearly related to the independent variables, while the probabilities are restricted to 0-1 and related to the independent variables by a logistic or cumulative normal function. Thus, the probit and logit models are considered to be more suitable techniques when dealing with binary response models.

Often, binary response models (dichotomous choice) use a transformation approach. In these models, an index variable, $Z_i=X_iB$, representing the utility difference is used. The larger the Z_i, the greater the probability that the event (respondent says "yes") will occur. Thus, a monotonic relationship between the probability of the event taking place and the index variable is established. When this situation occurs, the probability function takes on the characteristic of a cumulative distribution function (c.d.f.). The two most frequently used c.d.f.'s are the normal and the logistic functions resulting in the probit and logit regression models. The logistic function is often preferred to the normal function because of its ease of estimation and that it closely approximates the normal function. It is also for this reason that the logistic function was used in this study. Two methods that can be used to estimate the parameters for dichotomous choice models are the maximum likelihood method and generalized least squares (GLS). In this study, a maximum likelihood method was used to estimate the parameters.

The standard logistic function is as follows:

$$(6.1) \qquad \hat{P}_t = \frac{1}{1 + \exp(-\hat{X}_t\beta)} = \frac{1}{1 + \exp-(\beta_0+\beta_1 X_1+..+\beta_n X_n+\varepsilon i)}$$

where P_t is the probability that the respondent will respond with a "yes" (or "no" depending on the analyst's objective) to the offer. The independent factors that influence the respondent's decision are represented by the variables $x_1...x_n$. The parameters to be estimated are β_0, β_1, β_2,..,β_n, etc. Thus, the probability of the respondent accepting (rejecting) the offer can be written as:

$$(6.2) \qquad 1 - \hat{P}_t = \frac{1}{1 + \exp(\hat{X}_t\beta)}$$

The functional form of the explanatory variables (f(x,b)), depends upon several factors, such as economic theory and what functional form best fits the model. Economic theory has been used to help specify the proper functional form by relating it to utility theory. Some researchers (Sellar, Chavas and Stoll 1986) have argued that using linear functional forms to specify the explanatory variables is incorrect when using data obtained in dichotomous choice models. The authors claim that the linear form does not satisfy the properties of consumer theory (the Hicksian demand curve is not downward sloping) (see Sellar, Chavas and Stoll 1986 p.386-387 for proof). Other researchers concluded that

as long as the functional form meets the minimum requirements for utility theory, then the model which is best able to predict observations, best fits the data, and gives the best goodness of fit is the more appropriate model (Hanemann 1984; Bishop and Heberlein 1979; Stynes and Peterson 1984). Thus, the majority of researchers use either the linear or the log-linear functional form.

6.6 Welfare Measures

Another important issue to consider when using logit models is whether to use a truncated model or to integrate to infinity when calculating the expected willingness-to-pay. A truncated model uses the maximum bid as the truncation point rather than infinity, which can yield exceptionally high values for the amenity when the estimated function has a "fat tail". When one truncates the model with the highest offer, care must be taken to ensure that the probability of a respondent accepting (rejecting) an offer above this value is sufficiently low.

Furthermore, the median should be used as the appropriate welfare measure instead of the expected value, since the median is less affected by the size of the tail than the mean. The mean or average of the distribution F(x) implies that the respondent's WTP is greater than the offered bid. However, the mean may be heavily influenced by the upper tail of the distribution and may represent the values of only a small percentage of the population. The median is $F^{-1}(0.5)$ and represents the largest amount that at least 50% of the population would be willing to pay (the amount of money the individual would

require to keep them at the point of indifference between paying for the item and doing without it). The median is often preferred to the mean because it is likely to be less sensitive to outlying (unusual) observations that may affect the estimate of the distribution, although it should be noted that both methods of estimation are consistent with ordinal utility theory. However, one problem with using the median instead of the mean is that the median cannot be aggregated over the entire population even though it is not influenced by the upper tail of the distribution. One solution to some of the aforementioned problems, arising from both the mean and the median, is the truncated mean which assigns a truncation value T to all WTP values above T before computing the mean (Duffield and Patterson 1992).

Unlike the truncated mean (the difference between two indirect utility functions), the censored logistic regression approach involves specifying a form of the expenditure function. This approach enables the researcher to directly calculate the mean WTP by reparameterizing the estimated coefficients obtained through logistic regression, or preferably, through optimization of the censored logistic regression through maximum likelihood procedures. Thus, E(WTP) can be calculated by inserting the mean of the explanatory variables or the values for each respondent into the corresponding censored logistic regression equation.

Another slightly different welfare measure is the non-parametric approach proposed by Kristrom (1990). Kristrom's approach is simple: calculate the sequence of proportion of "yes" responses to derive the probability of acceptance of the bid amounts. Graphing

the probabilities of an acceptance with the bid amounts yields an empirical survivor function. Linear interpolation of the function allows the researcher to calculate the ends of the function (i.e., where the probability of zero intersects the bid axis). The mean is simply the area under the survival function, and the mean is calculated directly from the graph at p = 0.5. Kristrom claims that this method is equally comparable to the parametric approaches and is more robust and simpler to calculate.

The estimated willingness to pay for an individual respondent can then be calculated by taking the integral of the above expression (i.e., calculating the area below the estimated cumulative density function (c.d.f.)).

(6.3) $$E(WTP) = X_{max} - \int_0^{X_{max}} \frac{1}{1 + \exp-(\beta_0 + \beta_1 X_1 + .. + \beta_n X_n)} dX$$

To see how this equation was derived, see Sellar, Stoll and Chavas (1985).

6.7 Survey Instrument Design

Two separate surveys were used in this study. The first survey used a bidding game format. A total of 1,230 questionnaires were sent to individuals within British Columbia. A second survey, using a dichotomous choice format, was distributed among 146 students in forestry and land use courses at the university. Both surveys included an introductory and background page informing the respondents of the issues involved. The mailout surveys included a personalized cover letter to introduce the importance of the

respondent's participation in the survey and assured them of confidentiality. Opinion questions were included in the survey to try and achieve some indication of the attitudes of the respondents regarding the subject matter, as well as for consistency of results obtained in the valuation questions. The valuation questions, although similar in intent, differed in design between the two surveys. Finally, a section on socioeconomic factors (demographics, income, etc.) was included for statistical purposes. (See Appendix 1a and 1b for the questionnaires).

The first section was designed to help assess individual's opinions of B.C.'s forestlands. The individuals were asked to evaluate the characteristics of old-growth forests (based upon attributes determined by the Old-Growth Definition Task Group) on a scale of importance.

The second section of the survey was designed to obtain an estimate of an individual's WTP. Using a dichotomous choice format, respondents were given information regarding the current level of preserved forestlands in B.C. For the mailout survey, the question then listed eight levels of possible amounts of land that could be preserved. A dollar amount was associated with each level of preservation, an approximation of the cost to put aside the specified amount of land. The respondent was asked if they would pay at each level. The payment vehicle used in both surveys was increased taxes per year. The respondents also had the option to indicate whether they believed the current amount of protection was adequate. The in-classroom survey varied slightly in that it allowed the respondents to choose the level of preservation itself.

Furthermore, offers of $75.....$1,200 dollars were randomly distributed among the students. Students were then asked to respond "yes" or "no" if they would pay the given amount for the level of preservation specified by the student himself/herself. Further questions would try to reveal the upper or lower limit of the individual's WTP.

Section two of the mailout questionnaire was possibly misleading in its wording. The heading of the section read "Protecting Old-Growth Forests from Timber Harvest", however, the rest of the details given to the respondent were with respect to B.C.'s wilderness areas. It is, therefore, difficult to speculate on whether people were responding to increased wilderness protection in B.C. *per se*, or were responding to preservation of old-growth forests. A sample of 15 individuals (not included in the mailout survey) were given the questionnaire and asked to indicate whether they felt the question was worded to imply preservation of old-growth forests or increased wilderness protection in B.C. All 15 sampled indicated that wilderness preservation was the focus of Section Two.

The third section (included in the mail surveys only) was designed to determine if the respondents were consistent in their views. They were told to allocate a given budget for the protection of forests in B.C. A partial list was provided utilizing several of the attributes from the first section with room to add their own specifications on how the budget should be distributed.

The fourth and final section of the questionnaires consisted of a personal information page involving questions about age, sex, income, education, # of persons per household as well as information concerning their charitable support for environmental

causes. For the classroom survey, the question regarding income was modified to "How much do you expect to be earning five years after completion of ALL your post secondary education?" For obvious reasons this section is to be regarded with scepticism. Also included in the classroom simulation, was a section which enabled the interviewer to separate the protest bids from actual zero bids by asking the respondents to indicate their reasons for giving a "no" response or not answering the questionnaire.

6.8 Implementaion Procedures

6.8.1 The Study Area

The province of British Columbia is divided into six different forest regions; 1) Vancouver; 2) Prince Rupert; 3) Kamloops; 4) Prince George; 5) Nelson; and 6) Cariboo. Vancouver and Prince Rupert regions are coastal regions while the remaining districts are interior, and different forest characteristics are associated with each classification (coastal vs. interior). For example, in the interior the diameter of old-growth trees is not as large as in the coastal forests. Furthermore, species type may differ among regions due to environmental conditions such as climate, soil quality, temperature and physiographic (topographical elements) considerations. People who live in these regions view old growth differently from those who live in other regions, with some more dependent on the forest industry for employment (i.e., logging and harvesting) than others. Depending on the nature of the region, opinions may vary dramatically among the six regions.

6.8.2 The Data

The data (name, address, phone number) used in the survey was purchased from Dominion Directories (an independent company who supplies the phone numbers to businesses across Canada). The data contained a random list of 5,000 individuals within the province of B.C. The number of people per region depended upon the density of the population of that region (i.e., the greatest population was the greater Vancouver region). From the list of 5,000, a random sample of 1,230 names was selected using the same regional distribution .

The data for the classroom surveys came from two third year courses. One course was a forest economic course comprising of mainly forestry students while the other was a land use economic course which students from many disciplines.

CHAPTER 7

RESULTS AND IMPLICATIONS

7.1 Participation Rate

7.1.1 Mailout Survey

Results of the province wide mailout survey are summarized in Tables 7.1, 7.2 and 7.3. Of the 1,230 surveys mailed out, 35 were undeliverable, and 279 were returned (for a response rate of 24%), but only 246 were usable for summary statistics due to missing information. Table 7.1 indicates response rates by region. Prince Rupert exhibited the highest response rate of 45%, but only 11 surveys were sent to that region. The greatest proportion of surveys were mailed to the Greater Vancouver Area, but only 22% of the sample participated in the survey. The lowest participation rates were in the Nelson and Cariboo Forest Regions (8% and 0%, respectively); however, only 1.6% of the 1,230 surveys were mailed to these regions compared with the 86% mailed to the Vancouver Region.

Although this survey did not have a particularly high response rate, surveys by Helfand *et al.* (1991), Adamowicz *et al.* (1991), and Mannesto and Loomis (1989) have had similar results. Due to lack of funding it was not possible to send the follow-up letters, pre-letters or make follow-up telephone calls as recommended by Dillman (1978). Similarly, the data provided by Dominion Directories for use in the survey appeared to have been out of date. Many of the envelopes were returned unopened because the

occupant had passed away or had moved to another location.

Table 7.1: Response By Region

FOREST REGION	MAIL OUTS	RESPONSES	RESPONSE RATE
Vancouver	1055	232	22%
Prince Rupert	11	5	45%
Kamloops	105	32	33%
Prince George	39	9	23%
Nelson	13	1	8%
Cariboo	7	0	0%

7.1.2 Class Survey

The class survey was distributed among two third year University courses--a land use course and a forestry economics course. A total of 146 students participated in the survey (88 students from the land use class and 66 students from the forest economics class).

7.2 Summary Statistics

7.2.1 Mailout Survey

Socioeconomic factors and demographics of survey respondents are summarized in Table 7.2. The statistical means of the respondents are compared those of all B.C.

residents to inspect for sampling error bias. The results show that the mean household size of the respondents was 2.5 persons compared to a provincial average of 2.6 persons (1991 Census). Similarly, the mean household income level of respondents was $40,000 - $50,000 per year, while the mean for B.C. residents was $46,909 per year. The mean age of B.C. residents is 34.3, while it was slightly higher for survey respondents (36-45) (Statistics Canada 1992). Although the average level of post secondary education of B.C. residents was not available for 1991, the Statistics Canada 1986 average education level was just over 12 years. Comparatively, the mean level of education for respondents in our survey was 14.3 years (high school plus 1-2 years post secondary education). It is concluded that survey response bias is not a problem with this survey.

Table 7.2: Statistical Means

ITEM	MEANS
Version -Totals:[a] I (II)	138 (141)
Sex -Totals: Female (Male)	98 (181)
Average Age	36-45
Average # People Per Household	2.5
Average Education (Total Years)	14.3
Average Annual Income[b]	$40,000-$50,000
WTP	$439/hsehld/yr

[a]Version I arranges WTP questions in ascending order whereas Version II is in descending order.

[b]Total household income before taxes

The mean willingness-to-pay for respondents was $439/year/household. Adjusting for the respondents who were considered to have given zero values for preservation lowers this mean to $373.15 (i.e., multiplying by the number of those who valued the amenity at some number greater than zero).

Endowment bidding, or bidding a high percentage (~6-10% or more) of one's earnings, accounted for only 5% of the total number of responses.

7.2.2 Class Survey

Of the 146 students who participated in the survey, 68% of the students were male and 32% were female. The majority of students were 25 years or younger. The average expected income five years after completion of their post secondary education was $40,000-$50,000 per year. The average WTP was $215 per student per year for an average of 10.75% of wilderness protection.

7.3 Zero Bids and Protest Responses

7.3.1 Mailed Survey

Zero bids were considered to be those bids where respondents felt that the current level of protection was adequate. Since the mailout survey failed to include a section for respondents to indicate their motives for not paying for more protection, it is impossible to detect protest responses from valid zero bids. Protest responses were, however, considered to be those respondents who failed to answer the valuation questions, or, as

in the case of several of the surveys returned, offered their own reasons for not paying. All protest responses were dropped from the analysis. A test for sample selectivity bias using the Heckman model indicated that no sample selectivity bias existed (lambda was rejected at the 0.15% level)[10]. Thus, only responses with WTP > 0 were used in the regression analysis and were considered to be representative of protest bidders as well as positive bidders. Furthermore, the issue of non-response bias was not considered to be a significant problem due to the wide distribution of responses including zero bids.

7.3.2 Classroom Survey

Unlike the provincial survey, a section at the end of the survey provided the respondents with an opportunity to indicate their reasons for not paying the specified bid offer or completing the questionnaire. This enabled us to identify and separate the protest bidders from the zero bidders. Of the 146 students surveyed, 42 (28%) were identified as protest bidders (similar results have been found in other studies). The number of protest bidders is exceptionally high given the number of students surveyed. One reasonable explanation for this situation is that the students (many of which were in forestry) may be biased against the idea of placing a value on public land. A second possibility is that those in the discipline of forestry may feel threatened that future job possibilities may begin to decrease if the number of forest related jobs diminish due to increased preservation. Approximately 30% of those students in the forestry class gave

---

[10]Lambda is simply the inverse mill's ratio.

protest responses compared to the 27% from the land use course which comprised of students from all disciplines including many from forestry. Interestingly, the regression analysis indicated that the students in the land use class were less likely to pay to preserve more land than those in the forestry class. The Heckman (1979) procedure was performed here and the lambda was found to be insignificant as well. Thus sample selectivity bias was not found to exist.

7.4 Attitudes and Opinions About Wilderness

7.4.1 Province-wide Survey

The opinion questions used in the regression did not show any real pattern or meet prior expectations. Four of the 14 opinion questions were found to be significant, and of the expected signs. Tests of multicollinearity plus a principal component analysis, indicated that multicollinearity was not a problem.

Although the opinion variables did not show any significant influence on WTP, the majority of people who were willing to pay the offered amount had strong views on wilderness protection. Figures 7.1(a) and 7.1(b) show that people who consider recreation, biodiversity and general ecosystem benefits as being "extremely important" are willing to pay more than those individuals who indicate wood products and future goods and services as being "extremely important" to them. Of those individuals who indicated a WTP of $1200, only 5 percent felt that timber and manufactured forest products were "extremely important" to them. Likewise, only 14% felt that provision of goods and

services for the future was "very important".

Similarly, those respondents who presented a zero bid (i.e., felt the current amount of wilderness protection was adequate) valued the benefits of timber products more highly than habitat protection and recreation. Fifty-five percent of all zero bidders found timber and manufactured products were "extremely important" compared to the 30% and 21% who felt habitat protection and recreational benefits were of "extreme importance".

7.4.2 Classroom Survey

In the classroom survey, the opinions of zero bidders and those who were willing-to-pay the offered amount are summarized in Figure 7.2 (a) and 7.2 (b). The graphs show that people who did not want to pay anything indicated that timber and manufacturing products were "extremely important" (i.e., 60% of the people who valued wood products highly were not willing to pay for increased wilderness protection), while only 44% found wildlife habitat was of significant importance to them. In comparison, of those respondents with a WTP > 0, only 34% of the individuals who valued wood products favourably were willing to pay anything. Fifty-six percent of the individuals who said habitat protection was "extremely important" were also willing to pay some given amount.

The differences between the zero bidders and the people who had WTP > 0 are more noticeable when one examines the latter portion of the graph. Apparently preservation values (option, bequest, and existence values) play a more significant role in determining whether or not a person agrees to the offer than other values, such as the

Figure 7.1 (a)

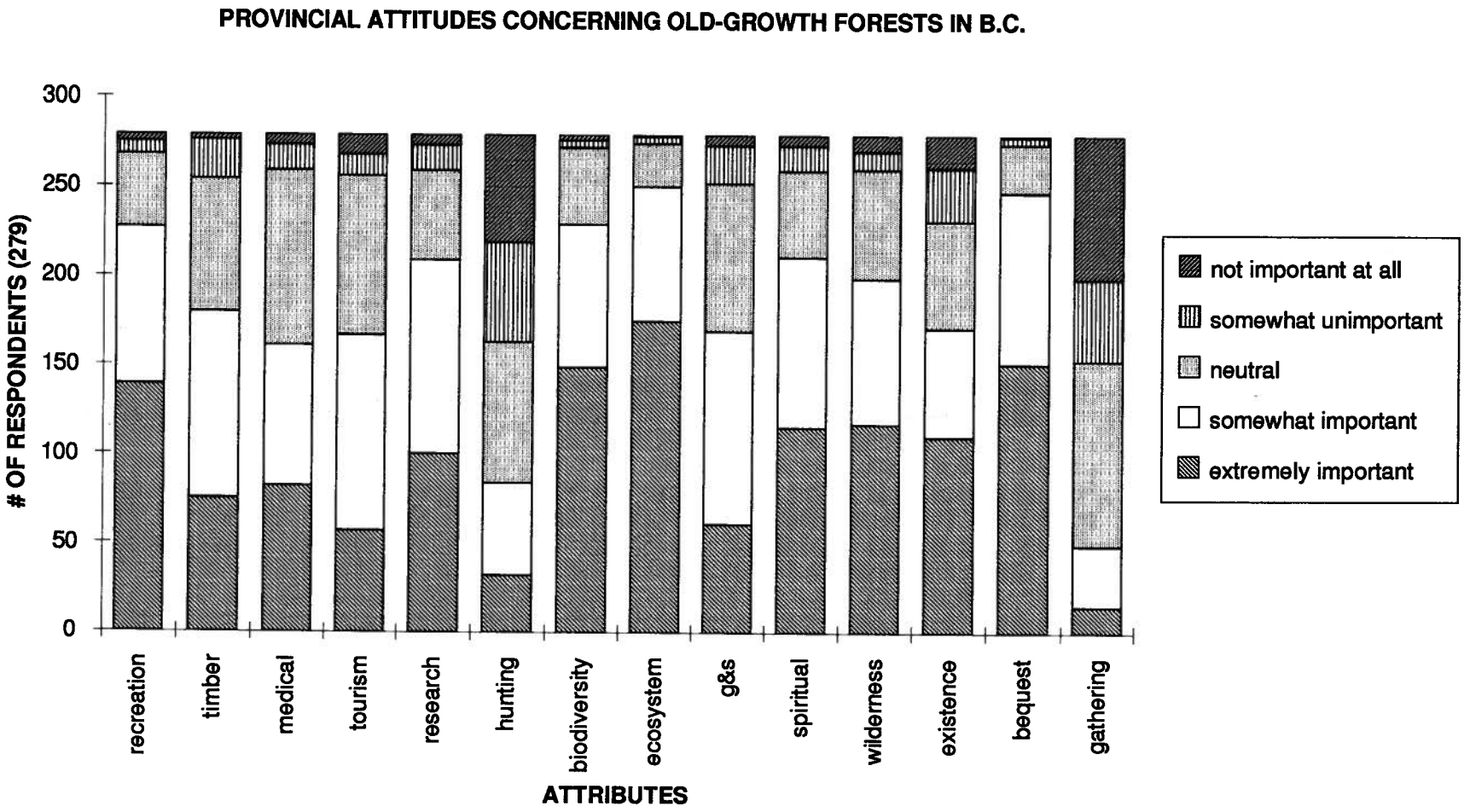
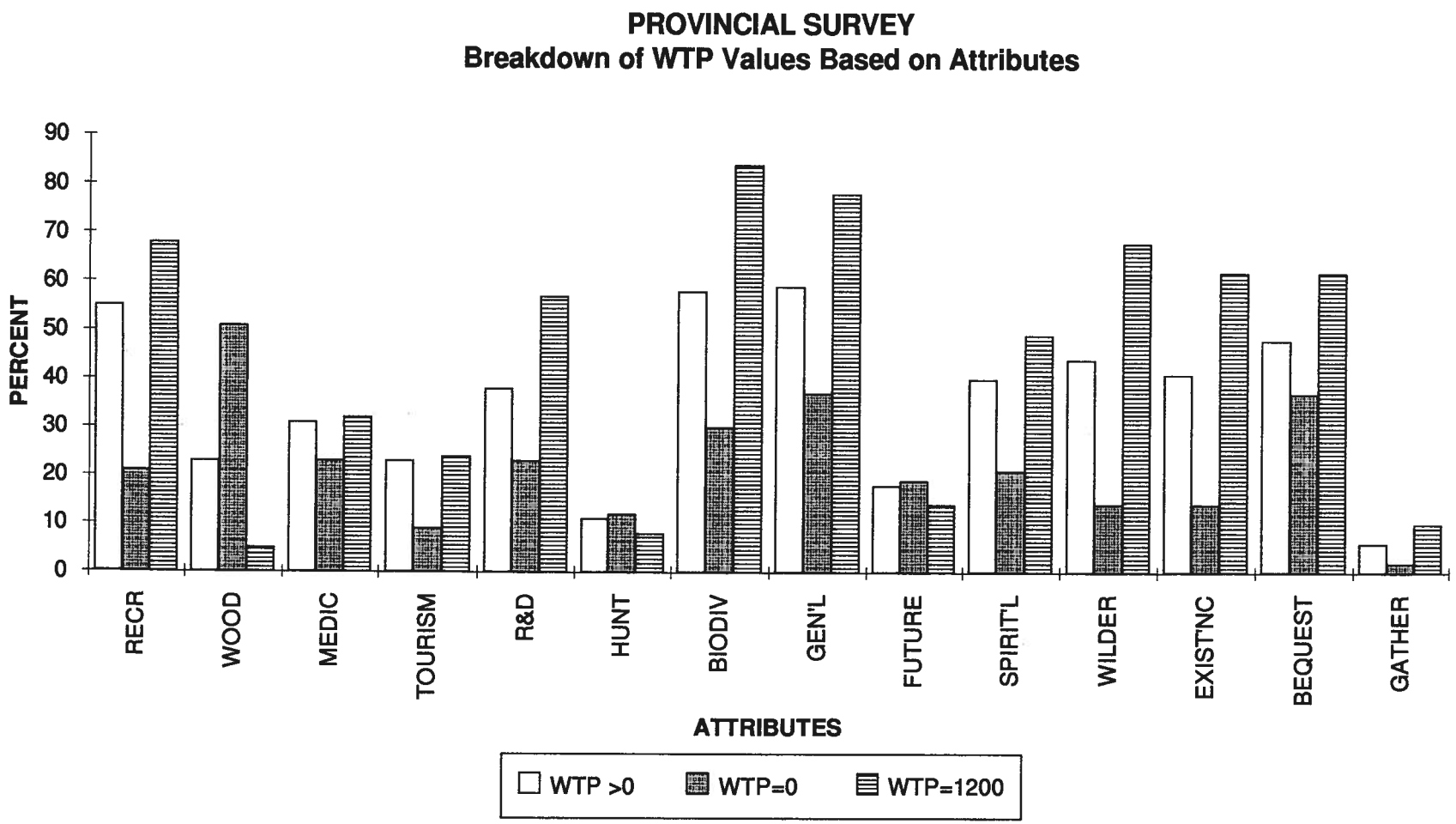

PROVINCIAL ATTITUDES CONCERNING OLD-GROWTH FORESTS IN B.C.
OF RESPONDENTS (279)
300
250
200
150
100
50
0
recreation
timber
medical
tourism
research
hunting
biodiversity
ecosystem
g&s
spiritual
wilderness
existence
bequest
gathering
ATTRIBUTES
not important at all
somewhat unimportant
neutral
somewhat important
extremely important

Figure 7.1 (b)


PROVINCIAL SURVEY
Breakdown of WTP Values Based on Attributes
PERCENT
90
80
70
60
50
40
30
20
10
0
RECR
WOOD
MEDIC
TOURISM
R&D
HUNT
BIODIV
GEN'L
FUTURE
SPIRIT'L
WILDER
EXIST'NC
BEQUEST
GATHER
ATTRIBUTES
WTP >0
WTP=0
WTP=1200

value of timber products. However, since most of the signs of the variables did not conform to *a priori* expectations and were insignificant when included in the regression analysis, this could not be proven.

7.5 Willingness-to-Pay For Increased Protection of B.C.'s Wilderness Areas

A description of the variables to be used in the regression analysis can be found in Table 7.3. The variable "Version" was only used for the provincial survey only to test whether or not the ordering of the questions had any effect on the results. Likewise regional dummy variables and the opinion variables were included in the province wide mailout survey but not in the classroom surveys. These variables are self-explanitory and thus not explained in the table.

7.5.1 Provincial Survey

The results from the regression analysis are reported in Table 7.4. The regression analysis included not only the socioeconomic factors but the opinion questions as well. The results indicate that men are generally more likely to pay for increased wilderness protection than are women. As expected, the higher the income class, the more respondents are willing to pay. This result is often found in CV studies.

Education had the correct sign on the coefficient and was statistically significant at the 0.025 level. There is a positive relationship between the level of education and the respondent's WTP. The coefficient on the variable for age had the correct sign but was

Figure 7.2 (a)

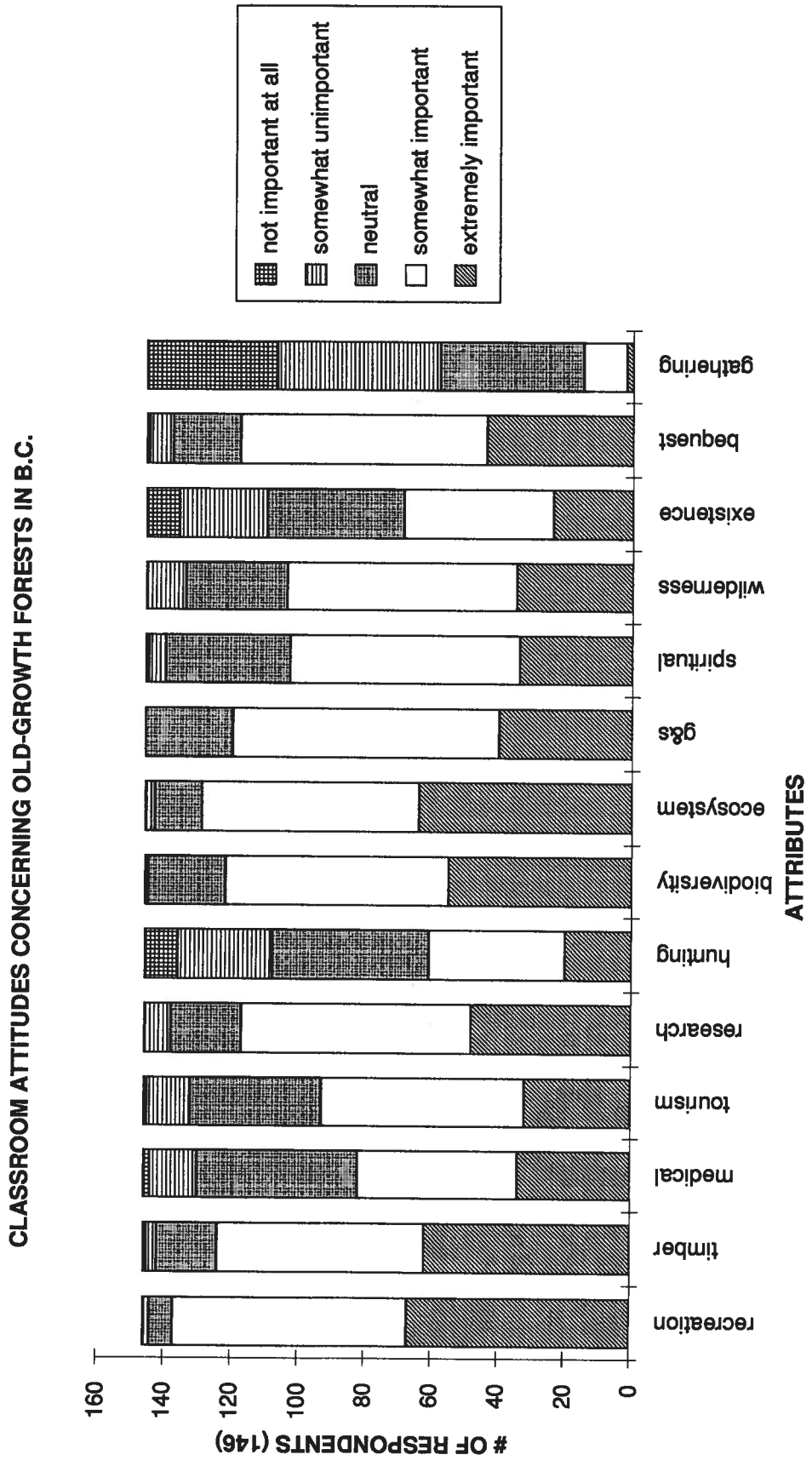
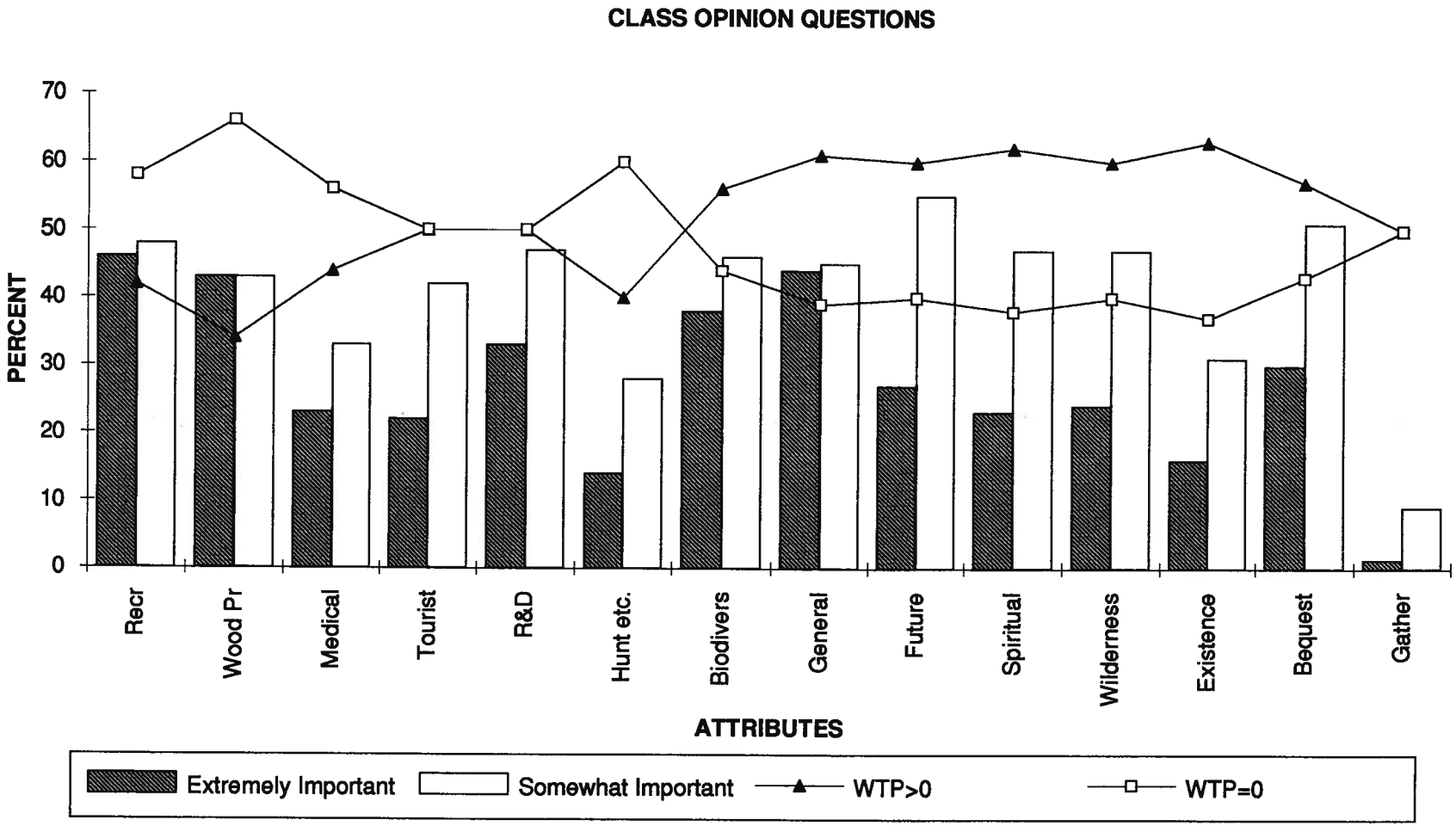

CLASSROOM ATTITUDES CONCERNING OLD-GROWTH FORESTS IN B.C.
not important at all
somewhat unimportant
neutral
somewhat important
extremely important
OF RESPONDENTS (146)
0
20
40
60
80
100
120
140
160
ATTRIBUTES
recreation
timber
medical
tourism
research
hunting
biodiversity
ecosystem
gas
spiritual
wilderness
existence
bequest
gathering

Figure 7.2 (b)



HL

statistically insignificant at the 0.05 level.

Table 7.3 A Description Of The Variables Used In The Regression Analysis

Variable	Description
WTP	Dependent variable used to indicate the individuals WTP
Amount	Amount of the offer made to an individual ($)
Preservation	The amount of land preserved as desired by the individual (ha)
Gender	Dummy variable used to identify gender; 1 if male, 0 if female
Income	The household income ($/yr)[a]
Member	Dummy variable used to indicated whether the respondent was a member of any environmental organizations; 1 if member; 0 otherwise
Contribution	Dummy variable used to indicated if the respondent contributed regularly to some environmental agency or charity; 1 if contributed, 0 otherwise
Age	The age of the respondent
Class	Dummy variable to indicate which class the questionnaire was issued; 1=forest econ; 0=land use
Version	1=ascending order 0=decending order

[a]In the classroom survey, income was the expected annual income five years after completing all post secondary education.

Table 7.4: OLS Regression Estimates For the Classroom Survey

VARIABLE NAME	ESTIMATED COEFFICIENT	STANDARD ERROR	T-RATIO 230 DF
Version (I=1)	-110.30	45.54	-2.422[b]
Gender (M=1)	83.832	54.28	1.545[d]
Age	-29.127	18.18	-1.602[c]
Family	-21.382	20.36	-1.05
Education	20.453	10.20	2.005[c]
Income	19.981	12.57	1.590[d]
Recreation	-1.358	31.95	-0.0424
Wood Products	-52.531	27.28	-1.925[d]
Pharmaceutical	20.493	25.88	0.7919
Tourism	-7.452	26.08	-0.2858
R&D	37.321	28.79	1.296
Biodiversity	59.776	38.06	1.570[d]
Ecosystem Ben.	19.458	38.94	0.5021
Scenic Quality	-11.974	30.98	-0.3866
Wilderness Val.	-3.493	33.78	-0.1034
Existence Value	58.464	27.25	2.145[c]
Bequest Value	-2.404	37.76	-0.0636
Contribution	43.446	65.20	0.664
Membership	97.014	79.16	1.225
Vancouver	542.74	364.40	1.734[c]
Prince Rupert	494.90	397.70	1.325[d]
Kamloops	457.62	371.90	1.398[d]
Prince George	459.67	388.50	1.418[d]
Constant[a]	-818.15	426.60	-0.8405

[a]The Nelson Forest Region is captured in the constant term.
[b]Significant at the 0.01 level; [c]significant at the 0.05 level; [d]significant at the 0.10 level

Of great interest was the sign of the coefficient for the variable describing the version of the questionnaire. There is a negative correlation with the order in which the bids are asked. Respondents who received a questionnaire with the offer amounts in ascending order ($75-$1200) were not willing to pay as much as those who received the offer amounts in descending order. In other words, when faced with a higher starting point, respondents were willing to pay more than respondents who received a lower starting bid ($75 versus $1200). It is possible that respondents receiving the questionnaire where the first bid offered was also the lowest bid, became tired of answering the iterative questions and ended the procedure before their maximum bid was obtained. These results support the theory that the order in which the interviewer asks questions can influence the respondent's decision (see Chapter 4 of this paper). Kahneman and Knetch (1991) suggested that the respondent views the starting bid as a true approximation of the value of the good and may agree to the offer simply because he/she feels that this is the appropriate thing to do.

The four regional dummy variables (for five regions, with the sixth region excluded since there were no responses from this region) were all significant at the 5 and 10 percent levels. It is likely that the few who participated in the survey viewed the Nelson Forest Region as a community which relies on logging practices, and thus, would be averse to preservation of more forest land. Furthermore, respondents may have felt the percentage of forest land presently preserved there was adequate.

7.5.2 The Classroom Results

The second questionnaire was distributed to 146 students; its results are summarized in Table 7.5. The average WTP per respondent was $200 per year to preserve 10.75% of the province's land base. The results are consistent with *a priori* expectations. The negative sign for the offer amount suggests that, with an increase in the offer amount, the more likely it is that the respondent will reject the offer. The positive sign on the variable for income suggests that as income increases the greater the probability that the person will accept the offer. This is not unusual since, the more disposable money they have, the more they may be willing to give to causes such preservation of wilderness. However, in this part of the survey the respondent was asked to estimate his/her possible income within the next few years so one should be cautious about the significance of the variable. The sign of the constant is negative as expected implying that the estimated c.d.f. (cumulative density function) is decreasing. Unlike the maillout survey, the results indicated that the male respondents were less likely to accept the offer than the female respondents. Although most studies find the opposite, the results are the same as that found by Stevens *et al.* (1991). One explanation is that more than 66 percent of the students surveyed were male students and in the forestry economics class whereas the majority of the females surveyed were in the land use class. Similarly, the probability of a "yes" increases as the level of preservation increases. This result was expected since the greater the level of protection the more it is worth to the respondent. As expected the variable for membership in an environmental organization was positive

but insignificant at the 10% level. The students in the forestry class were not willing to pay as much as those in the land use class. This was not unexpected as those in the forestry class may have had a vested interest in the forestry profession.

Table 7.5: Logit Estimates of The Probability of Answering "Yes" to Preserving X% of B.C.'s Land Base

Variable	Estimated Coefficient (t-Statistics)	Standard Error
Preservation Amount	0.3324 (4.0820)[a]	0.814E-01
Amount	-0.16369E-02 (-2.5746)[a]	0.636E-03
Gender	-0.84678 (-2.0972)[b]	0.404
Income	0.22380 (1.5569)[c]	0.144
Membership	0.68192 (1.0390)	0.656
Class	-0.54141 (-1.3796)[c]	0.392
Constant	-2.8748 (-2.7428)	1.048
Sample size	146	
Correct Predictions (%)	69	
Maddala R^2	0.18	
pseudo R^2	0.16	
X^2 (-2log(L0/LN))	28.28	

[a]Significant at the 1% level; [b]Significant at the 5% level; [c]Significant at the 10% level.

As shown, all coefficients used in the final regression exhibited the correct signs indicating a good model. Other tests for goodness of fit were the pseudo R^2, Maddala R^2, McFadden R^2, and the percentage of correct predictions. The pseudo R^2 of 0.16 is good (a fit between 0.2 and 0.4 is considered to be a good fit). When more of the explanitory variables were included the value increased significantly. The Maddala R^2 of 0.18 is also quite high, and other studies, such as that the one by Stevens *et al.* (1991), had the same value. The percentage of correct predictions (69%) is quite good. However, when all variables were included in the regression the amount increased to 78%. Similarly, all the goodness of fit indicators increased as more of the explanitory variables were added. A log-linear model was also estimated (not shown) which showed the estimates only varied slightly from the linear and the goodness of fit tests increased slightly.

7.6 Biases

Information bias was not a factor in either survey. The survey was designed to inform people and present all possible sides of the problem. The survey was designed so as no to influence the respondent in one direction or another. Although starting point bias can occur, a regression of the offer amount only on WTP showed that the bid amounts did not depend on whether people responded favourably or negatively to the bid. Furthermore, the random range of fixed offers varied from $75 to $1200, thus reducing the likelihood of both starting point bias and strategic bias. However, in the province-wide survey (as previously mentioned), the order in which the questions were asked (high

to low bids versus low to high bids) appeared to have some influence on the level of WTP. Still, this is not necessarily a case of starting point bias, but perhaps a bias in the ordering of questions.

Importance bias may also have had some influence in the results of the survey. The survey sought to make the respondent feel that his/her participation was of importance in order to persuade him/her to complete the survey, which is compatible with Dillman's (1978) Total Design Method. At no point did the survey mention that the results would be used to establish the correct level for policy. It was made apparent that this was simply part of my Master's thesis research in the faculty of graduate studies and part of an ongoing research by Forestry Canada and the Forest Economics and Policy Analysis Research Unit (FEPA).

Furthermore, it was hoped that strategic bias would be minimized since respondents were informed that the results were simply for research for a thesis and not necessarily for use in public policy making. In spite of the attempts to minimize these biases, it must be noted that those who replied to the survey may have had strong and biased views (i.e., environmentalists or those in the logging based industries). Many of the returned surveys had comments made by people who opposed preservation of more forestland and accused the survey of being biased in favour of the environmentalists. Conversely, there were letters returned implying that the survey was aimed towards the forest industry. Nonethelesss, many of these respondents filled in the questionnaire and it was obvious that they may have overstated or understated (depending on their standpoint) their true

WTP. However, it is difficult to identify all those that may have overstated or understated their WTP outside of protest bidding or endowment bidding. It is unlikely that these people made up a large percent of the respondents.

The problem of "yea" or "nay" saying did not seem to be of too much concern in these surveys as: (1) the survey was a mailout not an in-person survey--people did not feel compelled to please the interviewer; and (2), since there were two versions of the questionnaire and the version which began with the highest offer amount yielded the highest WTP amounts, one can reject the possibility of either "yea" or "nay" saying. Since the classroom survey only offered one amount, there does not seem to be a problem.

7.7 Model Specification: Functional Form

To estimate the sensitivity of the results to the functional form, regressions were performed using several common functional forms--linear, share and logarithmic forms. Recent research on the impact of functional form on WTP estimates obtained from dichotomous choice question formats has shown that, depending on the model specification, estimates may vary between models (Bowker and Stoll 1988; Ozuna, Jang and Stoll 1993; and Desvousges *et al.* 1992). Table 7.6 presents the results of the regressions using the various functional forms.

The results show that the estimates obtained from the different functional forms varied little between models. The logarithmic form (the only model which is not

consistent with Hanemann's utility theory) gives a slightly higher estimate of mean WTP ($559) and has a higher overall goodness of fit.

Table 7.6: Logit Regressions Using Various Functional Forms

	Functional Form		
	Linear	Logarithmic	Share
Mean WTP	$558	$559	$558
Maddala R^2	0.18	0.19	0.16
Correct Predictions	69%	70%	66%

The number of correct predictions is 70% for the log-log specification, compared with 66% and 69% for the share and linear specifications. Similarly, the Maddala R^2, McFadden R^2, and the pseudo R^2 are also higher than for the other two models. The share model exhibited the lowest overall goodness of fit measurements.

The variable representing income is expected to cause some imprecise estimates since students could not possibly predict the *actual* amount of income they will be earning in the next few years, but rather their expected income. The linear specification was the model chosen as the correct model for this survey since it conforms to Hanemann's (1984) utility theory and it has a reasonable goodness of fit.

Dropping the socioeconomic variable from the regression equations did not have any affect on the final estimated willingness-to-pay. In all scenarios, the E(WTP) was

$559. Possibly, the upper tail is so "fat" tail.

7.8 Welfare Estimates

Due to the concern that the results of dichotomous choice questionaires are sensitive to the functional form used (Desvousges et al. 1992; Bowker and Stoll 1988; and Boyle 1990), several different functional forms were used to test the reliability of the results found in this paper.

The results suggested that the functional form did not affect the estimated mean WTP when using the standard parametric approach of numerically estimating the area under the estimated c.d.f. However, when using the censored logistic regression approach (Cameron 1988), the difference in E(WTP) between the log-linear form and the linear form is more apparent (discussed below in Section 7.8.2).

7.8.1 Integrating Under The C.D.F. And Other Approaches

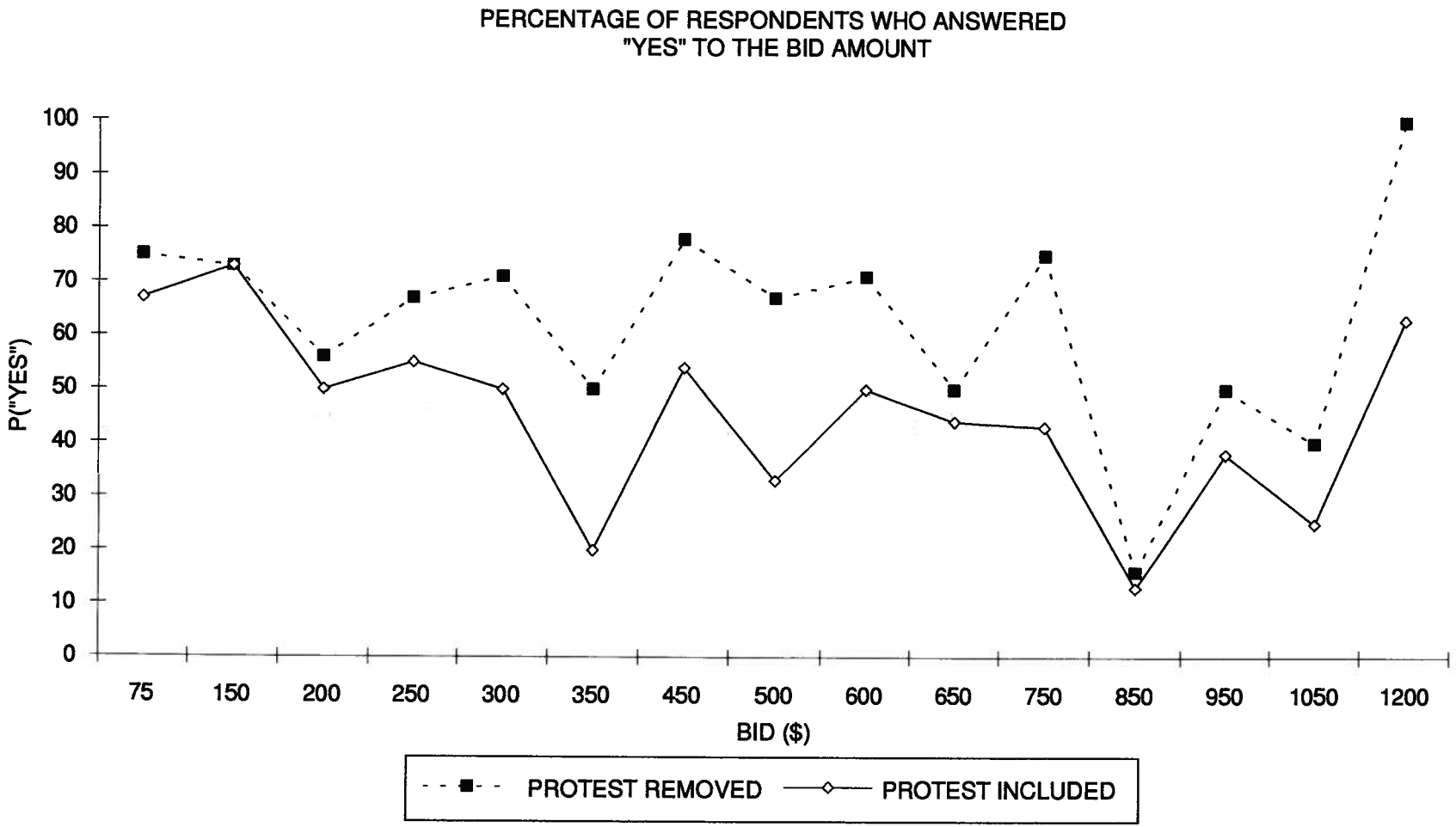
By numerically integrating the area under each estimated willingness-to-pay function over the range of bid amounts at the mean values of the independent variables (equation 6.3), an annual estimated WTP per person was obtained. The average estimated WTP from this survey is approximately $558/yr. This amount is considerably higher than that obtained other surveys (Vold *et al.* 1994). However, comparing the results from this survey with the results of the first survey, one can see that there is only a difference of $185. One possible reason for such a high value is that the bid amounts varied from $75

to $1200. Most other studies do not go as high. The few studies that did employ higher bids also exhibited higher WTP values than the norm. As mentioned earlier, the problem of "yea" saying is quite common in dichotomous choice questionnaires, and even more so in a controversial situation such as that considered here. However, as noted previously, "yea"-saying is much more prevalent in surveys where an interviewer is present.

Similarly, due to difficulties in the truncation procedure for the parametric approaches, several alternative welfare measures were implemented. The nonparametric (Kristrom 1990), parametric (Bishop and Heberlain 1979, Sellar *et al.* 1986) and the censored logistic regression (Cameron 1988) were all implemented using the data obtained from the classroom surveys. The nonparametric approach (described in Section 6.6) became difficult because the sequence of proportion of "yes" responses to the bid amounts did not form a monotone nonincreasing sequence of proportions. This was due to the fact that once the protest bids were removed from the data set, 100 percent of the remaining respondents receiving the offer of the highest bid ($1200) agreed to the amount (see Figure 7.3). Even through modification using the correction factor suggested by Ayer *et al.* (1955), the results were not considered to be a good estimate of E(WTP) and, therefore, this approach was dismissed.

The parametric approach also had its problems since the mean is influenced by the upper tail of the distribution. Due to the problem of a "fat" tail of the estimated c.d.f. (i.e., the probability of accepting the offer was considerably greater than zero at very high bids), integrating to infinity would lead to excessively high WTP values. Consequently,

Figure 7.3


PERCENTAGE OF RESPONDENTS WHO ANSWERED
"YES" TO THE BID AMOUNT
P("YES")
100
90
80
70
60
50
40
30
20
10
0
75
150
200
250
300
350
450
500
600
650
750
850
950
1050
1200
BID ($)
PROTEST REMOVED
PROTEST INCLUDED

the range of integration was truncated at a much lower amount (the maximum bid in the questionnaire). However, as Boyle *et al.* (1988) point out, this is not statistically correct. Therefore, to correct this problem a normalization procedure outlined by Boyle *et al.* as well as Duffield and Patterson's (1991) recommendation to truncate the model at a point T and replace all WTP values greater than T with T) were used. Both procedures resulted in large variations in results depending on the point of truncation. The values varied from $558 when the maximum bid ($1200) was chosen as the truncation point to $409 when $850 was chosen as the truncation point. The reason this value was chosen as a truncation point was due to the fact that a majority of the respondents whose WTP were greater than this amount were considered to be endowment bidders (i.e., proportioning more than 5% of their expected annual income).

However, truncating at any point where the probability of anyone accepting a bid higher than this value is anything but close to zero, can lead to underestimates of E(WTP). The argument for this is that you would be ignoring those who are actually willing to pay greater amounts. This can be minimized by choosing a truncation point and then setting a maximum bid. Furthermore, pretesting with open-ended questionnaires and using the guidelines suggested by Boyle *et al.* (1988) are extremely beneficial in avoiding the problems of "fat" tails.

The use of the median as a welfare measure was not really considered in this paper. Although the use of the median ignores outliers in the data, it also tends to neglect all those who are truly willing to pay the higher offers. Since the results indicate a large

percentage of respondents who are willing to pay the maximum bid, it would be inappropriate to disregard any of those respondents.

7.8.2 Censored Logistic Regression Approach

The results of the censored logistic regression indicate that the linear functional form yields an overall higher E(WTP) than the log-linear form ($408 versus $326.35). Similarly, when the offer amount was the only independent variable used in the regression, the E(WTP) for the linear model was $360.61, while the E(WTP) for the log-linear model was only $308.96. When income was dropped from the linear model, the mean WTP dropped by $5.56 to $402.44. The justification for dropping the variable was due to the fact that they were expected annual earnings and thus could not be considered an ideal indicator of income.[11]

A regression using just the offer amount and preservation amount was run and the results are shown in Table 7.7. As can be seen, the regression is very sensitive to the addition of socioeconomic variables (i.e., WTP varied from $360- $408). As in the first survey, the opinion questions were dropped due to some unforeseen problem linking the variables together. Although the pseudo R^2 value and number of right predictions increased considerably, most of the opinion questions were either insignificant or of the wrong sign (which in itself is considered an indication of multicollinearity).

---

[11]Student's expected earnings varied considerably, but for no apparent reasons other than the student's area of study and marks.

It is clear from Table 7.7 that the results obtained through numerical integration (see Table 7.6) differ significantly from those obtained through Cameron's (1988) censored logistic regression approach. This is unusual, as both approaches should yield identical results. One possible explanation is that the upper end of the tail of the c.d.f. is so fat that the numerical integration technique is just too obscure to make any relevant judgements.

Table 7.7: Estimated Mean Willingness-to-Pay Using Cameron's Censored Logistic Regression Approach

Functional Form	Variables Included In Regression	Estimated Mean WTP
Linear	amt	$360.61
Linear	amt, pre	$391
Linear	amt, pre, gen, cl, co, me	$402.44
Linear	amt, pre, in, gen, cl, me	$408
Log-linear	lnamt	$308.96
Log-linear	lnamt, lnpre	$319.26
Log-linear	lnamt, lnpre, lnin, gen, cl, me	$326.35

The estimated regression equations using both the linear and log-linear specifications are as follows:

(7.1a) ln[Pi/(1-Pi)] = 2.814 - 0.491lnamt
(1.99) (-2.10)

(7.1b) ln[Pi/(1-Pi)] = -3.230 - 0.635lnamt + 2.987lnpre
(-1.51) (-2.49) (3.80)

(7.1c) ln[Pi/(1-Pi)] = -16.324 - 0.837lnamt + 3.486lnpre + 1.301lnin -
(-2.11) (-3.00) (4.09) (1.86)

0.487cl - 0.854gen + 0.784me
(-1.26) (-2.10) (1.18)

(7.1d) ln[Pi/(1-Pi)] = 0.325 - 0.0009amt
(1.02) (-1.69)

(7.1e) ln[Pi/(1-Pi)] = -2.55 - 0.0012amt + 0.291pre
(-3.12) (-2.08) (3.80)

(7.1f) ln[Pi/(1-Pi)] = -2.062 - 0.0015amt + 0.324pre - 0.404cl - 0.748gen -
(-2.32) (-2.40) (3.97) (-1.07) (-1.89)

0.141co + 0.688me
(-0.22) (0.95)

(7.1g) ln[Pi/(1-Pi)] = -2.875 - 0.0016amt + 0.332pre + 0.224in - 0.847gen +
(-2.74) (-2.57) (4.08) (1.56) (-2.10)

0.682me - 0.541cl
(1.04) (-1.38)

The corresponding censored logistic regressions for the above equations are:

(7.2a) E(WTP) = 308.96
(1.56)

(7.2b) E(WTP) = -5.084 + 4.70lnpre
(-1.46) (3.76)

(7.2c) E(WTP) = -19.51 + 4.17lnpre + 1.55lnin - 0.58cl - 1.02gen + 0.94me
(-2.06) (3.96) (1.85) (-1.25) (-2.05) (1.15)

(7.2d) E(WTP) = 360.61
(1.01)

(7.2e) E(WTP) = -2124.0 + 242.68pre
(-3.03) (3.80)

(7.2f) E(WTP) = -1382.44 + 216.97pre - 271.19cl - 501.27gen - 94.62co +
(-2.19) (3.79) (-1.02) (-1.72) (-0.23)

461.75me
(0.82)

(7.2g) E(WTP) = -1756.24 + 203.06pre + 136.7in - 577.31gen - 330.75cl +
(-2.03) (4.03) (1.45) (-1.98) (-1.31)

416.59me
(0.99)

7.8.2.1 Removal of Bids

The sensitivity of the model to the removal of bids can be seen when the linear model in equation (2f) is re-run with the three highest bids removed (see Table 7.8). The rationale for removing the three highest bids is that the majority of respondents whose WTP is greater than $850 had allocated a large percentage of their expected earnings.

Table 7.8: Results of Removing The Three Highest Bids

Estimation Procedure	All Bids Included (Mean WTP)	Highest Three Bids Removed (Mean WTP)
Numerical Integration	$559	$404
Censored Logistical Regression	$408	$367

From the table one can see that the removal of the highest three bids yields a much lower mean WTP. However, there is a difference of $155 when the estimation procedure of numerical integration is used, and only a $41 difference with the censored logistic regression approach. Thus, the procedure for integration is much more sensitive to truncation procedures than the alternative method. Similar results have been found by Cooper and Loomis (1992) and Desvousges *et al.* (1992).

7.9 Breakdown of WTP Based on Desired Level of B.C.'s Wilderness Areas

The mean WTP per respondent that has been broken down based on the level of desired wilderness protection can be found in Tables 7.9 and 7.10. For each level of protection (6% - 15%), Table 7.9 shows the number of respondents who desired each amount and the corresponding average WTP for that level. As can be seen from the table, the majority of respondents indicated that 10% was the ideal amount of wilderness protection. Also shown in Table 7.9 is that the average WTP for protection of 7 percent to 9 percent of the land base was greater than the average WTP for 10 through 12 percent of the land base (i.e., $667-$431 versus $399-$397).

The estimated mean WTP from running separate regressions on the different levels of preservation can be found in Table 7.10. The estimated WTP were calculated using the censored regression approach. One can see from Table 7.10 that as the level of protection increases the mean WTP almost doubles in comparison.

Table 7.9: Average WTP ($) For Each Level of Protection

LEVEL OF PROTECTION	NUMBER OF RESPONDENTS (WTP > 0)	AVERAGE WTP
6%	12 (3)	$150
7%	9 (3)	$667
8%	14 (1)	$500
9%	9 (9)	$431
10%	54 (25)	$399
11%	4 (2)	$325
12%	14 (8)	$397
13%	10 (7)	$636
14%	5 (4)	$688
15%	16 (11)	$566

Table 7.10: Mean ($) WTP Based on Level of Protection

LEVEL OF PROTECTION	WTP
6 - 9%	$286
10 - 12%	$446
13 - 15%	$964

7.10 Aggregate Willingness-To-Pay

With approximately 1.3 million households in the province (Census Canada 1992), and benefits of $373.15 per household per year, the total annual benefits to British

Columbians is roughly $484 million for increased wilderness protection in B.C.

Using the estimated WTP from the classroom survey of $326 per respondent per year, the estimated annual benefits for wilderness protection in B.C. is $716 million based on a total adult population of 2,196,300 in B.C. This value is based on an average of 10.75% of the province's land base being protected. An important point to make is that since the classroom surveys were administered to students in both forestry economics and land use economics the value is not considered to be good representation of the adult population in B.C. as a whole.

CHAPTER 8

SUMMARY AND CONCLUSIONS

8.1 Summary

This research on the benefits of increased wilderness preservation entailed development of contingent valuation surveys to elicit residents' WTP for the province of British Columbia. The study came about after the Protected Areas Strategy (PAS) proposed an additional 6% of B.C.'s land base be set aside for protection. Two surveys were used: one survey was distributed province-wide, while the other was issued to third and fourth year university students in both land use and forestry economics.

An open-ended format was chosen for the mailout survey, while a dichotomous choice format was chosen in the survey of students. A logistic model was used to calculate the probability of a person agreeing to pay to a pre-determined offer amount.

The results of the province-wide survey indicated that respondents valued additional wilderness protection in British Columbia at $371.34 per household per year. Aggregating this amount to include all B.C. households yielded a value of $484 million per year. The results of the classroom survey showed that the respondents' WTP was $326 per person per year for a total of $716 million when aggregated for the whole adult population in B.C. Similarly, the province-wide survey included individuals of all educational backgrounds while the classroom survey included only individuals with post secondary education.

8.2 Conclusions

Problems with the model included outliers in the set of observations from both the provincial survey and the classroom survey. In the classroom survey, once protest responses were removed, all responded who were asked to pay $1200 to increase the level of protection by X% agreed to do so. This does not meet *a priori* expectations. Logically, the higher the offer, the greater the probability of a "no" response. However, in the classroom case the findings showed an increase in the probability of a "yes" as the offer increased in amount. This result made it very difficult to calculate a correct value of WTP. As a consequence, the tail of the distribution function did not converge. Using the median instead of the mean would have helped minimize the problem of outliers in the data. However, since the results from this survey could not be aggregated over the population, the median was not used. Furthermore, the use of the median would have eliminated those who were genuinely willing to pay the maximum bid.

The results also showed that there were significant differences between the final WTP estimates depending on the choice of welfare measure employed. The censored logistic regression approach seemed to give the best results for this study, while the other approaches were heavily influenced by the "fat" tail of the c.d.f. Carefully selecting the range of the offer amounts may reduce the occurence of this problem in future studies.

There did not seem to be any variability in WTP values across different functional forms. Several of the most commonly applied functional forms for discrete response data were examined in this study, but there did not seem to be any notable disparities in WTP

values between model specifications.

The results of the classroom survey can only be taken in a broad sense. Since the amount a person is willing to pay for increased protection of an environmental good is subject to his/her budget constraint, it is important to know the level of income the respondent earns. In the classroom surveys the best the respondent could give was his/her expected earnings five years after completion of his post-secondary education.

It is impossible to know how accurate the student was in estimating their future earnings as estimates varied between students from $20,000-$25,000 to $80,000 and over. Generally, however, university students tend to belong to higher income classes and have potentially higher earnings than the average population.

The timing of the survey is expected to have had some impact on the results of this research. As mentioned, the province-wide survey was distributed during the controversial Clayoquot Sound conflict. Due to the nature of the survey, it is expected that many of the respondents were biased in one manner or another. Many of these respondents bid a large proportion of their annual earnings and were, therefore, eliminated from the data, while others were not as easy to identify. The application of Heckman's (1979) procedure is expected to have eliminated the possibility of sample selectivity bias.

The results of this paper indicate that an average of 10 percent was the ideal level of protection desired by respondents from both the provincial survey and the classroom survey. In both surveys respondents were willing to pay large amounts of money to protect B.C.'s wilderness areas. Thus, the governments' decision to double the amount of

wilderness protection was on average comparable to the desired level illustrated in this paper.

8.3 Future Recommendations

This paper has examined the use of contingent valuation in determining the value of wilderness in B.C. Although there have been many improvements in the use of discrete choice questionnaires, the use of either the double bounded (systematically giving the respondent a second offer, higher or lower than the initial bid depending on the response to the first one) or even the triple bounded models would allow the researcher to obtain a more accurate estimate of WTP as there is much more information with these advanced approaches with respect to the range of the respondent's WTP.

The surveys used in this paper could have been improved upon in many ways. For example, the range of offers seemed to cause problems in the final estimation of mean WTP. Thus, the approach suggested by Boyle *et al.* (1988) in the determination of offer amounts (i.e., pretest, bid range, etc.) would have enhanced the findings of this paper.

It is highly recommended that, in the future, unless under a tight budget constraint, pre-letters and follow-up phone calls be implemented in order to increase the response rate. If the sample size is not too large, telephone surveys may be an alternative to those under a strict budget However, one should be cautious of the biases that may result from personal interviews.

It is expected that respondents were knowledgeable in the conflict between

preservationists and timber companies. However, it is not certain as to the familiarity of the participants with the benefits (attributes) of old-growth forests (e.g., biodiversity). Nor do we have any means of determining which attributes, if any, people value most in regards to old growth. An alternative measure would be to test whether or not people can judge the difference between an old-growth and second-growth forest based on their composition. Establishing which attributes (ecological and non-ecological) are most important to people, then determining which attributes are solely dependent on old-growth forests and those which can be found in second-growth forests may help the researcher immensely in analyzing the respondent's preferences concerning old-growth forests.

The use of conjoint analysis could be used to infer preferences for multi-attribute amenities such as old-growth forests. Conjoint analysis can also be used to:

1) Determine the utility value of each attribute;

2) Determine the importance of old growth as a collection of these attributes;

3) Determine the trade-offs between attributes;

4) Estimate the effects of a loss in any one of the attributes; and

Furthermore, a respondent's knowledge and familiarity of the subject can be enhanced with the use of photographs and a system of computer simulations developed by the geographic information system (GIS).

References

Ayer, Miriam, H.D. Brunk, G.M Ewing, and Edward Silverman, 1955. "An Empirical Distribution Function for Sampling with Incomplete Information." *Annuals of Mathematical Statistics*, 26(Mar.):641-47.

B.C. Ministry of Forests, 1991. *Outdoor Recreation Survey 1989/90. How British Columbians Use and Value their Public Forest Lands for Recreation.* Recreation Branch Technical Report 1991-1. Victoria: Queen's Printer for British Columbia.

B.C. Ministry of Forests, 1992. *Old Growth Strategy for British Columbia.* Victoria: Queen's Printer for British Columbia.

B.C. Ministry of Forests, 1992. *An Inventory of Undeveloped Watersheds in British Columbia.* Victoria: Queen's Printer for British Columbia.

Bishop, R.C., and T.A. Heberlein, 1979. "Measuring Values of Extra-Market Goods: Are Indirect Measures Biased?" *American Journal of Agricultural Economics,* 61(Dec.):926-30.

Bishop, R.C., Richard Ready, 1991. "Endangered Species and the Safe Minimum Standard", *American Journal of Agricultural Economics*, 73(2May): 309-312.

Bowker, J.M., and J.R. Stoll, 1988. "Use of Dichotomous Nonmarket Methods to Value the Whooping Crane Resource." *American Journal of Agricultural Economics,* 70(May):372-81.

Boyle, K.J., M.P. Welsh, and R.C. Bishop, 1988. "Validity of Empirical Measures of Welfare Change: Comment" *Land Economics*, 64(Feb.)94-98.

Brown, T.C, and T. Daniel, 1984. *Modelling Forest Scenic Beauty: Concepts and Application to Ponderosa Pine*, United States Dept. of Agriculture, Research paper RM-256.

Brown, T.C., M. Richards, T. Daniel, D. King, 1990. "Scenic Beauty and Recreation Value: Assessing the Relationship, *Social Science and Natural Resource Recreation Management*, p.330.

Brunson, M., B. Shelby, 1992. "Assessing Recreational and Scenic Quality", *Journal of Forestry*, 90(7Jul): 37-41.

Bunnell, F.L., D.K. Daust, W. Klenner, L.L. Kremsater and R.K. McCann, 1991. *Managing for Biodiversity in Forested Ecosystems.* Victoria: Report to the Forest Sector of the Old-Growth Strategy, mimeograph, July 25.

Cameron, T.A., 1988. "A New Paradigm for Valuing Non-Market Goods Using Referendum Data: Maximum Likelihood Estimation by Censored Logistic Regression." *Journal of Environmental Economics and Management,* 15(Sept.):355-79.

Cooper, J., and J. Loomis, 1992. "Sensitivity of Willingness-to-Pay Estimates to Bid Design in Dichotomous Choice Contingent Valuation Models." *Land Economics,* 68(2)(May):211-224.

Cummings, Ronald G., David S. Brookshire and William D. Schuzle (editors), 1986. *Valuing Environmental Goods: An Assessment of the Contingent Valuation Method.* Totowa, H.J.: Rowman and Allanheld.

Daly, Herman E. John B. Cobb Jr., 1989. *For the Common Good.* Boston: Beacon Press

Desvousges, W.H., F.R. Johnson, R.W. Dunford, K.J. Boyle, S.P. Hudson, and K.N. Wilson, 1992. "Measuring Natural Resource Damages With Contingent Valuation: Tests of Validity and Reliability." In *Contingent Valuation: A Critical Assessment.* Cambridge Economics, Inc. Washington, D.C., April 2-3, 1992.

Dillman, D.A., 1978. *Mail and Telephone Surveys: The Total Design Method.* New York: John Wiley and Sons, Inc.

Duffield, J.W., and D.A. Patterson, 1991. "Inference and Optimal Design for a Welfare Measure in Dichotomous Choice Contingent Valuation". *Land Economics,* 62(May):225-39.

Edwards, S.F., and G.D. Anderson, 1987. "Overlooked Biases in Contingent Valuation Surveys: Some Considerations." *Land Economics,* 63(May):168-78.

Ehrenfeld, David, 1988. "Why Put a Value On Biodiversity". In *Biodiversity,* edited by E.O. Wilson. Washington, D.C.: National Academy Press. pp. 212-216.

Ehrenfeld, David, 1970. *Biological Conservation.* New York: Holt, Rinehart and Winston, Inc.

Focus on Resources and Our Environment: A Report on Recent Initiatives of the British Columbia Government. Government of British Columbia Legislative Buildings: Victoria, B.C.. March 1992.

Gov. of British Columbia, 1992. "Protected Areas Strategy". News Release 1992:EL068. N. Vancouver: Ministry of Environment, Land & Parks and Ministry of Forests, May 6.

Gov. of British Columbia, 1992. "Khutzeymateen Valley to be Protected Area For Grizzly Bears." News Release 1992:049. Ministry of Environment, Land & Parks and Ministry of Forests, June 4.

Gov. of British Columbia, 1992. "Undeveloped Watershed Inventory Completed". News Release 1992:104. Ministry of Forests, October 4.

Green, P.E., V. Rao, 1971. "Conjoint Measurement for Quantifying Judgmental Data", *Journal of Marketing Research,* 8(Aug): 355-63/

Green, P.E., F. Carmone, and Y. Wind, 1972. "Subjective Evaluation Models and Conjoint Measurement", *Behavioral Science*, Vol. 17:288-299.

Hagen, D.A., J.W. Vincent, and P.G. Welle, 1992. "Benefits of Preserving Old-Growth Forests and the Spotted Owl." *Contemporary Policy Issues*, vol.X(Apr.):13-26.

Hanemann, M.W., 1988. "Economics and the Preservation of Biodiversity". In *Biodiversity*, edited by E.O.Wilson with F.M. Peter. Washington, D.C.: National Academy Press. pp. 193-199.

Hanemann, M.W., 1984. "Welfare Evaluations in Contingent Valuations Experiments with Discrete Responses." *American Journal of Agricultural Economics*, 66(Aug.):332-41.

Hanley, N., Robin Ruffell, 1992. *The Valuation of Forest Characteristics*. Queen's Discussion Paper #849, Institute for Economic Research.

Hanley, N., Alistair Munro, 1992. *The Effects of Information in Contingent Markets for Environmental Goods: A Survey and Some New Evidence*. Queen's Discussion Paper #848, Institute for Economic Research.

Heckman, J.J., 1979. "Sample Selection Bias as a Specification Error." *Econometrica*, 47:153-61.

Johnson, R.L., N. Stewart Bregenzer, and Bo Shelby, 1990. "Contingent Valuation Question Formats: Dichotomous Choice Versus Open-Ended Responses." In *Economic Valuation of Natural Resources: Issues, Theory, and Applications,* edited by Rebecca L Johnson and Gary V. Johnson, Social Behaviour and Natural Resources Series. Boulder, CO: Westview Press.

Kahneman, D., Jack L. Knetsch, 1992. "Valuing Public Goods: The Purchase of Moral Satisfaction, *Journal of Environmental Economics and Management,* 22(1Jan): 57-70.

Kahneman, D., Jack L. Knetsch, 1992. "Contingent Valuation and The Value of Public Goods: Reply", *Journal of Environmental Economics and Management,* 22(1Jan): 90-94.

Kealy, M.J., J.F. Dovidio, and M.L. Rockel, 1988. "Accuracy in Valuation is a Matter of Degree." *Land Economics,* 64(May):158-70.

Kealy, M.J., J.F. Dovidio, and M. Montgomery, 1990. "Reliability and Predictive Validity of Contingent Values:Does the Nature of the Good Matter?" *Journal of Environmental Economics and Management,*(Nov.):244-263.

Kenton, R. Miller, 1991. *Biodiversity and the Forest Profession.* H.R. MacMillan, Forestry Lecture Series, UBC. November 7.

Kristrom, Bengt, 1990. "A Non-Parametric Approach to the Estimation of Welfare Measures in Discrete Response Valuation Studies." *Land Economics,* 66(May):136-39.

Leduc, George, Robert Goodland, 1988. *Wildlands: Their Protection and Management in Economic Development.* Washington: World Bank.

Leefers, Larry A. (1992). *Analyzing Old-Growth Designation Using Ecological and Analytical Hierarchies.* Paper presented at the Workshop on Hierarchical Approaches to Forest Management in Public and Private Organizations held in Toronto, ON, May 25-29.

Ludwig, D., John Conrad, 1991. *Opportunity Cost of Preservation of Old Growth and the Present Value of Silviculture,* FEPA Research Unit Working Paper No. 165, University of B.C., August.

Malcolm L. Hunter, Jr., 1988. *Wildlife, Forests, and Forestry*. Englewood Cliffs, N.J.: Prentice Hall.

McKillop, W., 1992. "Use of Contingent Valuation in Northern Spotted Owl Studies: A Critique", *Journal of Forestry*, 90(8Aug): 36-37.

McDaniels, T., 1992. *A Prescriptive Decision Framework for Preservation of Biodiversity*, Westwater Research Center and School of Community and Regional Planning.

Milon, J.W., 1989. "Contingent Valuation Experiments for Strategic Behavior." *Journal of Environmental Economics and Management*, 17. pp.293-308.

Milon, J.W., Roger Clemmons, 1991. "Hunters' Demand for Species Variety", *Land Economics*, 67(4Nov): 401-412.

Munasinghe, M., 1992. *Environmental Economics and Valuation in Development Decisionmaking*, ENV Working Paper No. 51, World Bank, Washington, D.C., February 1992.

Norgaard, R.B., 1988. "The Rise of the Global Exchange Economy and the Loss of Biological Diversity". In *Biodiversity*, edited by E.O. Wilson with F.M. Peter. Washington, D.C.: National Academy Press. pp. 206-211.

Norton, Bryan, 1988. "Commodity, Amenity, and Morality: The Limits of Quantification in Valuing Biodiversity". In *Biodiversity*, edited by E.O. Wilson with F.M Peter. Washington, D.C.: National Academy Press. pp. 200-205.

Old-Growth Definition Task Force, 1986. *Interim definitions for old-growth Douglas-fir and mixed confier forests in the Pacific Northwest and California.* USDA Forest Service, Pacific Northwest Research Station Research Note PNW-447, Portland, Oregon. 7pp

Patrick, G.F., E. Loehman, A. Fernandez, 1983. *Measuring Trade-Offs: An Application of Conjoint Analysis.* American Agricultural Economics Association Meetings, Purdue Univ., July 31-Aug. 3.

Patterson, D.A. and J.W. Duffield, 1991. "Comment on Cameron's Censored Logistic Regression Model for Referendum Data." *Journal of Environmental Economics and Management*, (May):275-283.

Pope III, C.A., and J.W. Jones, 1990. "Value of Wilderness Designation in Utah." *Journal of Environmental Economics and Management*, 30:157-174.

Randall, Alan, 1988. "What Mainstream Economists Have to Say About the Value of Biodiversity". In *Biodiversity*, edited by E.O. Wilson with F.M. Peter. Washington, D.C.: National Academy Press. pp. 217-223.

Randall, Alan, 1991. *Thinking About the Value of Biodiversity*. Columbus, Ohio: Dept. of Agric. Econ. and Rural Sociology, Ohio State Univ., mimeograph.

Rockel, M.L., and M.J. Kealy, 1991. "The Value of Nonconsumptive Wildlife Recreation in the United States." *Land Economics,* 67(Nov.):422-34.

Roloff, G., J. Haufler (1991). *Incorporating Wildlife Objectives into Forest Planning*. Department of Fisheries and Wildlife, Michigan State University.

Rubin, J., G. Helfand, J. Loomis, 1991. "A Benefit-Cost Analysis of the Northern Spotted Owl", *Journal of Forestry*, 89(12Dec): 25-30.

Schreier, H., W.A. Thompson, G.C. van Kooten , I. Vertinsky, 1992. *A Decomposed Hierarchical System for Forest Land Use Allocation Decisions With Public Participation*, Forest Economics and Policy Analysis Research Unit, Univ. of B.C.

Sellar, C., J.R. Stoll, and J.P. Chavas, 1986. "Specification of The Logit Model: The Case of Valuation of Nonmarket Goods." *Journal of Environmental Economics and Management*, 13(Dec.):382-90.

Sellar, C., J.R. Stoll, and J.P. Chavas, 1985. "Validation of Empirical Measures of Welfare Change: A Comparison of Nonmarket Techniques." *Land Economics*, 61(May):156-75.

Shoup, David W. (1981). *Using Conjoint Analysis to Forecast Saleable Machine Features*. Paper No. 81-1518 presented at the American Society of Agricultural Engineers winters meetings, Chicago.

Sinden, J.A. and A.C. Warrell, 1979. *Unpriced Values: Decisions Without Market Prices*. New York: Wiley.

Smith, K.V., 1992. "Arbitrary Values, Good Causes, and Premature Verdicts", *Journal of Environmental Economics and Management,* 22(1Jan): 71-89.

Stevens, T.H., Jaime Echeverria, Ronald J. Glass, Tim Hager, Thomas A. More, 1991. "Measuring the Existence Value of Wildlife: What Do CVM Estimates Really Show?", *Land Economics*, 67(4Nov): pp. 390-400.

Old Growth Strategy Project. Towards an Old Growth Strategy: Public Review Draft, Ministry of Forests, Jan. 1992.

Tyrrell, L.E., 1991. *Old-Growth Forests on National Park Service Lands: NPS Views and Information.* Great Lakes Cooperative Park Studies Unit #91-1, Univ. of Wisconsin-Madison.

van Kooten, G.C., 1991. *Land Resource Economics and Sustainable Development: An Introduction to the Resolution of Land Use Conflicts.* Vancouver, B.C.: Dept. of Agric. Econ. and Forest Resources Management, University of British Columbia.

van Kooten, G.C., R. Schoney, K. Hayward (1986). "An Alternative Approach to the Evaluation of Goal Hierarchies among Farmers." *Western Journal of Agricultural Economics*, 11(1July):40-48.

Walsh, R.G., R.D. Bjonback, R.A. Aiken, and D.H. Rosenthal, 1990. "Estimating the Public Benefits of Protecting Forest Quality." *Journal of Environmental Economics and Management*, 30:175-189.

Wilson, E.O., 1989. "Threats to Biodiversity", *Scientific American* (September): 108-114.

APPENDIX 1A - PROVINCIAL SURVEY

SURVEY

PROTECTING B.C.'S FORESTLANDS: DECISIONS FOR THE FUTURE

Background

Protection of old-growth forests in British Columbia is a controversial issue: at one extreme is the view that all old-growth forests should be available for logging; on the other, that all old growth must be preserved. Old growth differs between the Coast and Interior regions of the Province. On the Coast, old growth refers to areas where trees are 200 years or older; the forest is undisturbed (no harvesting of timber has occurred); there is a variety of large living trees, standing dead trees (snags), and fallen trees and debris; and the canopy gives an umbrella-like effect. Interior forests are frequently disturbed by fire, so trees tend to be less magnificent and it is more difficult to distinguish between areas that have never been harvested and those that were harvested quite some time ago. Yet Interior old growth provides some unique features that are not available in stands that have been harvested. The distinction is a direct result of the inevitable disturbance (e.g., road building) that results from forestry operations. The economic value from harvesting old growth in the Interior is much smaller than on the Coast because trees do not, in general, attain the size they do on the Coast.

Since citizens of B.C. are the owners of about 95 per cent of the forest resources of the province, changes in harvest and other uses affect them financially. This survey seeks to determine how you value the preservation of forest resources. The survey consists of four sections, followed by a page providing additional information about B.C. forest lands. The information page is located on the back of this panel.

This panel can be removed if desired.

ANSWERS PROVIDED WILL BE KEPT IN STRICT CONFIDENCE

Section 1: Opinion Questions

How important **to you** are the following benefits from British Columbia's forest resources. (Please circle the number that best represents your response to the statement indicated).

	Extremely Important		Neutral		Not Important At All
Provide an environment for recreational activities (such as hiking, canoeing, wildlife viewing, *etc.*)	5	4	3	2	1
Provide timber and manufactured forest products	5	4	3	2	1
Provide information on medical compounds	5	4	3	2	1
Provide tourism incentives	5	4	3	2	1
Provide scientific research and education (i.e. how ecosystems work)	5	4	3	2	1
Provide opportunities for hunting, trapping and fishing	5	4	3	2	1
Provide a large variety of habitats for a large diversity of species	5	4	3	2	1
Provide general ecosystem benefits, such as regulation of waterflow and absorption of carbon dioxide from the air	5	4	3	2	1
Provide goods and services that you or others may want to use in the future	5	4	3	2	1
Provide spiritual and aesthetic values (scenic beauty)	5	4	3	2	1
Provide wilderness value (access to an area not disturbed for commercial purposes)	5	4	3	2	1
Provide wilderness areas, even if these areas are never used	5	4	3	2	1
Provide value knowing that this resource will be available to future generations	5	4	3	2	1
Provide you opportunities for gathering plant products for culinary and/or decorative purposes	5	4	3	2	1

Section 2: Protecting Old-Growth Forests from Timber Harvest

About 6.5% or 6 million ha of B.C.'s total land base is currently protected in a variety of ways (national and provincial parks, wildlife refuges, recreation areas, *etc.*). The amount of land to be protected is going to be increased from about 6 million ha to some greater amount. For each level of protection, the average person will be required to pay through taxes the amount indicated *in perpetuity*. This represents our best available, but still rough, estimate of the average cost to a B.C. household for increasing levels of preservation, but it does not include costs to the environment or costs of developing the area for other uses (e.g., developing access roads or campsites).

Please **circle** one entry **in each row** indicating whether or not you would be willing through taxes for provincial land to be protected.

An answer is needed in each row.

Land base that is to be protected increases from 6.0 mil.ha to:	Actual Cost to you:	Would you pay?
14.0 mil.ha.(14.8% of provincial land base)	$1,200/year	YES NO
13.0 mil. ha. (13.7% of provincial land base)	$1,050/year	YES NO
12.0 mil. ha. (12.6% of provincial land base)	$ 900/year	YES NO
11.0 mil. ha. (11.6% of provincial land base)	$ 725/year	YES NO
10.0 mil. ha (10.5% of provincial land base)	$ 575/year	YES NO
9.0 mil. ha (9.5% of provincial land base)	$ 400/year	YES NO
8.0 mil. ha (8.4% of provincial land base)	$ 250/year	YES NO
7.0 mil. ha (7.4% of provincial land base)	$ 75/year	YES NO
Current level of protection is adequate		YES NO

Section 3: Allocating a Government Budget

The government has a limited budget for forest protection. You will have in mind some specific benefits that you value more than others and would like to see these emphasized by the public forest manager. If you were asked to allocate the provincial government's forest protection budget, how would you allocate it among the items listed.

The total should sum to 100 %.

BENEFITS:	%
Preserve species and their habitats	_____
Protect forests for scientific research and education purposes	_____

Reserve forests for the following alternative uses:

Wilderness recreation	_____
Hunting	_____
Fishing and gathering	_____
Other recreation	_____

Other reasons (Please specify):

_____	_____
_____	_____
TOTAL	100 %

Section 4: Personal Information

1. a) What is your age? (Please check one)

___ 25 or under ___ 26-35 ___ 36-45

___ 46-55 ___ 56-65 ___ over 65

b) Are you: ___ Male ___ Female

2. Including yourself, how many individuals are there in your household? ___

3. What is your level of education? (Please circle)

Secondary (Grade): 8 9 10 11 12

Post Secondary (Trade School, University, etc.)

Years: 1 2 3 4 5 6 7 or more

4. What was the approximate gross (before tax) income of **your household** in 1992? (Check one)

___ less than $20,000

___ $20,000 to less than $30,000

___ $30,000 to less than $40,000

___ $40,000 to less than $50,000

___ $50,000 to less than $60,000

___ $50,000 to less than $70,000

___ $70,000 to less than $80,000

___ $80,000 and over

5. a) Do you regularly contribute to any environmental organizations, such as the World Wildlife Fund? (Please circle)

YES NO

b) Are you a member of any environmental organizations? (Please circle)

YES NO

THANK YOU FOR TAKING THE TIME TO COMPLETE THIS QUESTIONNAIRE

Information Page
Protection of Forestlands in British Columbia

How much is protected?

Canada's total land area is 997 million hectares (ha). Of this area, 45% (453 million ha) is designated forest land, with 244 million ha considered productive forest. About 4% of the productive forest land base or 10 million ha is reserved in national and provincial parks. Large areas of forested land are also excluded from commercial harvesting simply because it is not economically feasible to harvest trees in these areas.

B.C. is Canada's leading lumber producer and exporter. Total provincial land area is 94.8 million ha, of which 54% (51.2 million ha) is designated productive forestland (96% is publicly owned, the remainder privately held). The *net operable land base* that is suitable and designated for timber harvest is about half the productive forest area; the Coast accounts for 3.7 million ha of operable forest, and the Interior 21.5 million ha. Some 6.5% of the total land base or 6.3 million ha is currently reserved in national and provincial parks, regional parks, recreation areas, private conservation areas, wildlife and migratory bird sanctuaries, *et cetera.* Current government policy is to increase the amount of provincial land protected in parks and ecological reserves to about 12.5 million ha, or about 12% of the land base. Some of this increase will come from the net operable land base that is currently scheduled for timber harvest.

What is the cost of protection?

A ban on logging has economic costs that will be borne by B.C. residents.

(1) An important cost is the net value of the lost timber which, if harvested, would contribute to your overall financial wealth. This loss shows up as lower government revenues, lower levels of investment and employment in forest product industries, and likely higher prices to consumers for forest products.

(2) There will be costs to governments due to lost jobs, community instability, and so on. These costs are hard to quantify but include such things as unemployment compensation, welfare payments, retraining allowances, higher government administration costs, and so on.

(3) Finally, decreased timber output in B.C. may have national and global environmental effects as a result of using non-wood substitutes or increasing harvests in areas (such as the tropics) with more fragile ecosystems.

What are some benefits of protection?

British Columbia has the greatest number and most diversity of species of any province (e.g., 55% of Canada's birds breed only in B.C.). Some 80 wildlife species strongly depend on old-growth forests. By harvesting all old growth, some known species could become extinct, as may species that have not yet been discovered. Uncertainty as to the possible use of these species (e.g. medical compounds, scientific research) is of concern to everyone. It is clear that B.C.'s forest lands are important for maintaining biodiversity, although appropriate management of timber harvests and forests can prevent extinction of most (but likely not all) species. Protection of forests also provides benefits from recreational opportunities, hunting, fishing, hiking, viewing, and simply knowing that old-growth forests and wilderness areas exist in B.C. Development of forest policies that take into account biodiversity, recreation, timber and other values will be important for future management of B.C.'s forest lands.

APPENDIX 1B - CLASSROOM SURVEY

SURVEY

PROTECTING B.C.'S WILDERNESS AREAS: DECISIONS FOR THE FUTURE

Background

Canada's total land area is 997 million hectares (ha). Of this area, 45% (453 million ha) is designated forestland, with 244 million ha (just over 1/2) considered productive forest. About 4% of the productive forestland base (but a much higher proportion of the total land area) is reserved in national and provincial parks. Large areas of forested land are also excluded from commercial harvesting simply because it is not economically feasible to harvest trees in these areas.

British Columbia is Canada's leading lumber producer and exporter. Total provincial land area is 94.8 million ha, of which 54% (51.2 million ha) is designated productive forestland (96% is publicly owned, the remainder privately held). The *net operable land base* that is suitable and designated for timber harvest is about half the productive forest area; the Coast accounts for 3.7 million ha of operable forest, and the Interior 21.5 million ha. Some 6.5% of the total land base or 6.3 million ha is currently reserved in national and provincial parks, regional parks, recreation areas, private conservation areas, wildlife and migratory bird sanctuaries, *et cetera.* Current government policy is to increase the amount of provincial land protected in parks and ecological reserves to about 12 million ha, or about 12% of the land base. Some of this increase will come from the net operable land base that is currently scheduled for timber harvest.

One reason for increasing wilderness preservation is to protect old-growth forests. This is a controversial issue: on one side, the view is that all old growth should be available for logging; on the other, that all old growth must be preserved. Old growth differs between the Coast and Interior regions of the Province. On the Coast, old growth refers to areas where trees are 200 years or older; the forest is undisturbed (no harvesting of timber has occurred); there is a variety of large living trees, standing dead trees (snags), and fallen trees and debris; and, the canopy gives an umbrella-like effect. Interior forests are frequently disturbed by fire, so trees tend to be less magnificent and it is more difficult to distinguish between areas that have never been harvested and those that were harvested quite some time ago. Yet Interior old growth provides some unique features that are not available in stands that have been harvested. The distinction is a direct result of the inevitable disturbance (e.g., road building) that results from forestry operations.

The economic value from harvesting old growth in the Interior is much smaller than on the Coast because trees do not, in general, attain the size they do on the Coast. Therefore, the financial cost to you from preserving old growth in the Interior is substantially lower than on the Coast.

Protection of old-growth forests cannot be separated from the larger issue of wilderness protection. Old growth can only be protected in contiguous areas that constitute financially valuable old-growth timber, other financially valuable trees that are not considered old growth, timber than is uneconomic to harvest, and areas that are barren (e.g., glaciers and mountain tops). Old growth often constitutes 4-12% of the area that would be protected under the province's Protected Areas Strategy (PAS).

What is the cost of protection?

A ban on logging has economic costs that will be borne by B.C. residents.

(1) An important cost is the net value of the lost timber which, if harvested, would contribute to your overall financial wealth. This loss shows up as lower government revenues, lower levels of investment and employment in forest product industries, and likely higher prices to consumers for forest products.

(2) There will be costs to governments due to lost jobs, community instability, and so on. These costs are hard to quantify but include such things as unemployment compensation, welfare payments, retraining allowances, higher government administration costs, and so on. Given government debt and recurring budget deficits, a reduction in timber harvest will increase the budgetary problems of government, leading to a reduction in other services or the need to cut down trees in protected areas at some future date.

(3) Finally, decreased timber output in B.C. may have national and global environmental effects as a result of using nonwood substitutes or increasing harvests in areas (such as the tropics) with more fragile ecosystems.

What are some benefits of protection?

British Columbia has the greatest number and most diversity of species of any province (e.g., 55% of Canada's birds breed only in B.C.). Some 80 wildlife species strongly depend on old-growth forests. By harvesting all old growth, some known species could become extinct, as may species that have not yet been discovered. Uncertainty as to the possible use of these species (e.g. medical compounds, scientific research) is of concern to everyone. It is clear that B.C.'s forest lands are important for maintaining biodiversity, although appropriate management of timber harvests and forests can prevent extinction of most (but likely not all) species. Protection of forests also provides benefits from recreational opportunities, hunting, fishing, hiking, viewing, and simply knowing that old-growth forests and wilderness areas exist in B.C. Development of forest policies that take into account biodiversity, recreation, timber and other values will be important for future management of B.C.'s forest lands.

ANSWERS PROVIDED WILL BE KEPT IN STRICT CONFIDENCE

Section 1: Opinion Questions

How important to you are the following benefits from British Columbia's forest resources. (Please circle the number that best represents your response to the statement indicated.)

	Extremely Important				Not Important At All
			Neutral		
Provide an environment for recreational activities (such as hiking, canoeing, wildlife viewing, *etc.*).	1	2	3	4	5
Provide timber and manufactured forest products	1	2	3	4	5
Provide information on medical compounds	1	2	3	4	5
Provide tourism incentives	1	2	3	4	5
Provide scientific research and education (i.e., how ecosystems work)	1	2	3	4	5
Provide opportunities for hunting, trapping and fishing	1	2	3	4	5
Provide a large variety of habitats for a large diversity of species	1	2	3	4	5
Provide general ecosystem benefits, such as regulation of waterflow and absorption of carbon dioxide from the air	1	2	3	4	5
Provide goods and services that you or others may want to use in the future	1	2	3	4	5
Provide spiritual and aesthetic values (scenic beauty)	1	2	3	4	5
Provide wilderness value (access to an area not disturbed for commercial purposes)	1	2	3	4	5
I am happy just to know these areas exist, even if they are never used	1	2	3	4	5
Provide value knowing that this resource will be available to future generations	1	2	3	4	5
Provide you opportunities for gathering plant products for culinary and/or decorative purposes	1	2	3	4	5

Section 2: Protecting Old-Growth Forests from Timber Harvest

Some 6.5% of B.C.'s total land base is currently protected in a variety of ways (national and provincial parks, wildlife refuges, recreation areas, *etc*. The amount of land to be protected is going to be increased from about 6 million ha to some greater amount. How much of B.C.'s total land base do you think ought to be placed in a permanent reserve, so that no harvesting of trees will be permitted? **Please circle the amount you would wish to preserve.**

6% 7% 8% 9% 10%

11% 12% 13% 14% 15%

For the level of protection that you indicated above, would you be willing to pay the amount indicated below as an annual surtax on your income *in perpetuity*. If you currently do not have a source of income, the accrued annual amounts (annual amount indicated below) plus accumulated interest will be charged at the time that you begin earning an income; since you will be paying this amount annually once you graduate, the accrued amount will not be due at one time, but will be spread over the number of years you have spent in post-secondary education.

Would you be willing to pay $1,200 per year for the level of wilderness protection indicated above? **(Circle one)**

YES **NO**

If NO, would you be willing to pay the amount indicated for a higher level of wilderness protection? **(Circle)**

YES NO If YES, for a level of _____% of the land base.

If YES, what is the minimum level of wilderness protection that you would be willing to accept for the dollar amount that you indicated you would be willing to pay?

_____ % of the land base.

Section 3: Personal Information

1. a) What is your age? (Please check one.)

____ under 25 ____ 26-35 ____ 36-45

____ 46-55 ____ 56-65 ____ over 65

b) Are you: ____ Male ____ Female

2. **Realistically**, what do you expect to be earning upon completion of ALL your post secondary education? Please check your approximate, expected gross (before tax) income in 1993 dollars.

____ less than $20,000

____ $20,000 to less than $30,000

____ $30,000 to less than $40,000

____ $40,000 to less than $50,000

____ $50,000 to less than $60,000

____ $60,000 to less than $70,000

____ $70,000 to less than $80,000

____ $80,000 and over

5. a) Do you regularly contribute to any environmental organizations, such as the World Wildlife Fund? (Please circle)

YES NO

b) Are you a member of any environmental organizations? (Please circle)

YES NO

THANK YOU FOR YOUR COOPERATION