FOREST VALUES IN NORTHERN ONTARIO: PUBLIC TRADEOFFS AND SUSTAINABILITY

by

Jeff Moore

H.B.O.R., Lakehead University, 1995

B.A., Lakehead University, 1995

B.Sc., Lakehead University, 1996

RESEARCH PROJECT SUBMITTED IN PARTIAL FULFILMENT
OF THE REQUIREMENTS FOR THE DEGREE OF
MASTER OF RESOURCE MANAGEMENT

in the

School of Resource and Environmental Management

Report No. 305

SIMON FRASER UNIVERSITY

August 2002

APPROVAL

NAME: Jeff Moore

DEGREE: Master of Resource Management

PROJECT TITLE: Forest Values in Northern Ontario: Public Tradeoffs and Sustainability

REPORT NO.: 305

SUPERVISORY COMMITTEE:

____

Senior Supervisor: Dr. Wolfgang Haider
Assistant Professor
School of Resource and Environmental Management
Simon Fraser University

____

Committee Member: Dr. Duncan Knowler
Assistant Professor
School of Resource and Environmental Management
Simon Fraser University

Date Approved: August 2, 2002

ABSTRACT

Ecosystem management, which is premised on the goal of sustainability, has become a widely accepted paradigm for resource management in Canada and around the world. To ensure sustainability for the forests of northern Ontario, critical minimum levels of natural, social, and economic capital must all be maintained. After these minimum standards have been achieved in each area, an understanding of the tradeoffs which people are willing to make among the various types of capital will aid in selecting resource management strategies which maximise the benefits to society.

This project uses a discrete choice experiment to examine the tradeoffs people are willing to make among environmental, social, and economic forest values. The values were specified in a manner similar to the indicators in a criteria and indicator framework. Surveys were mailed to a random sample of 2784 residents of northern Ontario in which respondents were asked to repeatedly select their more preferred forest management Outcome for their respective community. A multinomial logit model was used to estimate part worth utilities for 18 environmental, social, economic, landuse, and access attributes. Based on this model, a computerised decision support system was developed to examine the tradeoffs respondents were willing to make among the various attributes. A collapsed model form was also analysed to examine the more general tradeoffs that respondents are willing to make among environmental, social, and economic values.

In general, respondents are opposed to any decline in any Ecological Services below the ‘natural’ level but are neutral or opposed to any increase beyond what is ‘natural.’ At the same time, respondents would strongly favour improvements to the social conditions, while they were less consistent in their evaluation of changes to the economic situation in their community. This information, along with the computerised decision tool, can be used by managers and participatory public processes alike.

On a more conceptual level, this project successfully examined the tradeoff behaviour of the public among environmental, social, and economic dimensions of sustainability, which constitutes a significant contribution to the sustainability debate.

ACKNOWLEDGEMENTS

First, I would like to give thanks to the Earth for giving me life and for sustaining the forests upon which this project is based. I would also like to acknowledge the Coast Salish people, within whose territory I have had the honour to live while working on this research project.

This project would not have been possible without the support of many people. The ideas of all the members of the Resource Services Valuation Project research team were invaluable for initiating and conceptualising the study on which this research project is based. Thanks to Don Anderson for the statistical design, and for all the helpful comments, suggestions, and statistical wizardry. Thank you Len Hunt for the direction you gave this project, for all the computer help and codes, and for always having the answers. Thanks also to Jim Duncan and Brian Hutchinson for their help with conceptualising and developing the survey instrument. I would also like to acknowledge the Ontario Ministry of Natural Resources and Parks Canada for providing the funding for the Resource Services Valuation Project.

The support of my supervisors and all the staff in the School of Resource of Environmental management was also essential to the success of this project. Wolfgang, you have been a mentor to me for a few years now. Thank you for providing me with opportunities to learn and develop my research skills. Thank you for your continual guidance on this project, and for always keeping the big picture in mind. Duncan, thank you for bringing your perspective to this paper, and for helping me to get a better sense of how to apply the results from a choice experiment. Thanks to Rhonda, Bev, Mary Ann and Julie for always being able to solve any problem I brought to you. Thank you to Laurence for always making the computers work properly.

Finally, I would like to thank my family and friends who have supported me throughout this project. Thank you Tina for being there along the way, for all your encouragement, your love, and your friendship. Thanks also to Erin, Veronica, Jimmy, and Kim for your friendship and support, and for helping me through the tough times.

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

LIST OF ABBREVIATIONS

CCFM	Canadian Council of Forest Ministers
C&I	Criteria and Indicators
CVM	Contingent Valuation Method
DCE	Discrete Choice Experiment
DSS	Decision Support System
FMU	Forest Management Unit
LFL	Lands for Life
MNL	Multinomial Logit
MLE	Maximum Likelihood Estimation
NOAA	National Oceanic and Atmospheric Administration
OMNR	Ontario Ministry of Natural Resources
PWU	Part Worth Utility
ROS	Recreation Opportunity Spectrum
RP	Revealed Preference
RSVP	Resource Services Valuation Project
SP	Stated Preference
TCM	Travel Cost Method
WTA	Willingness to Accept (Compensation)
WTP	Willingness to Pay

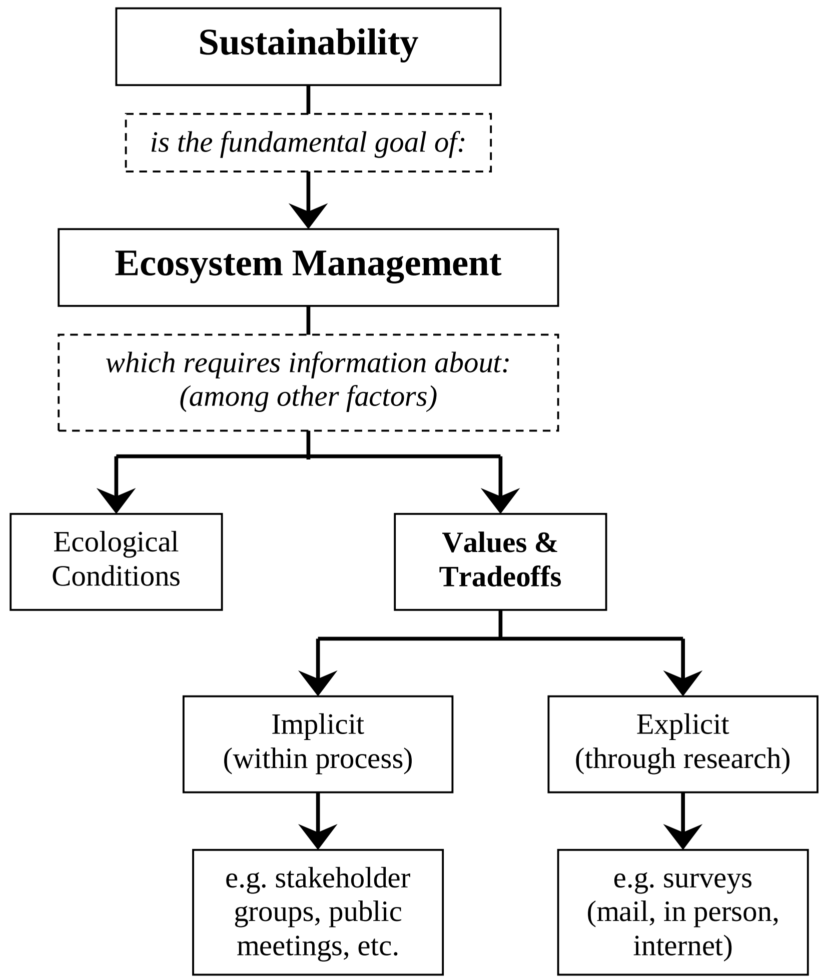
CHAPTER ONE: INTRODUCTION

The survival of human beings is, and always has been, dependent on the resources provided by the Earth. For millennia, the human population was small enough that stocks of natural resources seemed, for all intents and purposes, inexhaustible. Over the past few centuries, however, exponential population growth coupled with increasing industrialisation on a global scale has led to an ever-increasing demand for natural resources. Examples such as the recent collapse of fisheries on both coasts of Canada make it abundantly clear that the Earth's resources are not inexhaustible. Since our very survival depends on the continued presence of natural resources, it is obvious that resources must be managed in a sustainable manner to ensure that there will be enough resources available to meet the needs of future generations. Since the World Commission on Environment and Development brought the concept of sustainable development to the forefront, many countries around the world have embraced sustainability as a worthy objective.

Despite the widespread acceptance of the concept of sustainability, there is still a great deal of debate over exactly what is meant by sustainability and how it may best be achieved. Sustainability is particularly relevant in the context of resource management. Ecosystem management is an emerging paradigm in resource management, which accepts the concept of sustainability as its fundamental goal. What makes sustainability particularly challenging is the recognition that, in addition to environmental components, social and economic components must also be taken into consideration. In order to establish some sort of balance among these 'pillars' of sustainability, information is needed about people's values and preferences for the environmental, social, and economic benefits provided by the Earth's ecosystems.

Over the past few decades in Canada, the public has increasingly demanded a voice in resource management decisions. This demand has been met in part through public meetings, information sessions, and–to varying degrees—public input or membership in different types of round tables, planning teams, and community advisory councils. While these types of forums certainly provide essential information to resource managers, the input is usually limited to a tiny fraction of the people who will be affected by such decisions. In order to accurately determine the values held by the general population, other techniques, such as surveys, may be appropriate. Properly designed surveys can also provide more quantitative information about values, which would complement the qualitative information more commonly obtained through public participation in planning processes. Figure 1.1 illustrates the role that information about values and tradeoffs plays in ecosystem management.

Figure 1.1 The role of values and tradeoffs in ecosystem management



This research project is based on the Resource Services Valuation Project (RSVP), a joint project of the Ontario Ministry of Natural Resources (OMNR) and Parks Canada, which explored peoples' values and preferences surrounding forest management in northern Ontario. While the objectives of RSVP were specific to the context of forest management in northern Ontario, the results of the RSVP study may provide valuable insights into the potential of stated preference[1] (SP) survey techniques for examining the tradeoffs people are willing to make among environmental, social, and economic values.

1.1 RESEARCH GOAL

The goals of this project are to investigate the multitude of forest values held by residents of resource-dependent communities in northern Ontario and to position the investigation within the context of

---

[1] Stated preference methods are used to gather information about people's preferences and are particularly useful in situations where this information cannot be gained through observations of people's behaviour.

sustainable forest management. As a starting point, this study assumes that resource managers are attempting to manage resources sustainably, as evidenced by the emerging paradigm of ecosystem management. The relevant literature suggests that, in addition to ecological sustainability, both economic and social sustainability also need to be considered; consequently, balancing between these "pillars" of sustainability becomes the main management challenge. Recognising that there are critical minimum levels to natural, social, and economic capital, an understanding of the tradeoffs which people are willing to make among the various types of capital will aid in selecting resource management strategies which maximise the benefits to society, while striving toward environmental, social, and economic sustainability. While the theoretical literature on this topic is increasing rapidly, few attempts have yet been made to conduct an empirical investigation into the tradeoffs people are willing to make among the environmental, social, and economic concerns.

1.2 RESEARCH OBJECTIVES

This conceptualisation leads to the following research objectives:

- to operationalise environmental, social, and economic values in a manner that is both consistent with the Criteria & Indicator (C&I) framework and at the same time meaningful to members of the public;
- to require respondents to make tradeoffs among specific environmental, social, and economic values;
- to create a decision support tool that can be used in participatory decision-making processes and which provides information about public support for different management outcomes; and
- to examine whether a general model can be developed to measure more fundamental tradeoffs among environmental, social, and economic aspects of sustainability.

1.3 RESEARCH QUESTIONS

Based upon the research conducted through the Resource Services Valuation Project, this research project addresses two main questions:

1. How can survey techniques be used to inform resource management decision-makers about the environmental, social, and economic values held by the general public?
2. Can stated preference techniques be used to assess the tradeoffs people are willing to make among environmental, social, and environmental values in northern Ontario?

1.4 OUTLINE OF PROJECT METHODS

The method selected to address these questions was a discrete choice experiment in which respondents repeatedly selected between pairs of hypothetical forest management outcomes. Each outcome consisted of environmental, social, and economic indicators describing the respondents' community and surrounding forests. These indicators translate physical values into measures that the general public can evaluate. Additional context was provided in each outcome through the inclusion of general descriptions of management strategies relative to land use and access. By analysing the choices respondents made between various hypothetical outcomes, utility functions were developed for each environmental, social, and economic indicator. These part worth utilities (PWUs) are not "values" in the traditional sense; instead they are preference measures which represent utility associated with each level of each attribute.

1.5 REPORT ORGANISATION

This document is divided into six chapters. Chapter One has presented the rationale for the project, the purpose of the study, research questions and a brief description of the research methods used in the RSVP. Chapter Two provides a review of relevant literature, including discussions of sustainability, ecosystem management, and environmental valuation. The third chapter describes the methodology of Discrete Choice Experiments in general, followed by an overview of the development and implementation of the survey instrument. Chapter Four presents some results of the RSVP study. The implications of these results to forest management in northern Ontario are discussed in Chapter Five. Chapter Six extends the model to consider more general tradeoffs among environmental, social, and economic components of sustainability. Finally, Chapter Seven presents conclusions and recommendations for further research in this field.

CHAPTER TWO: LITERATURE REVIEW

This chapter provides a review of the literature related to the topics addressed in this project. It begins with an overview of the concept of ecosystem management, followed by a discussion of the term sustainability as it pertains to ecosystem management. Next is a description of environmental values and the techniques that can be used to estimate them. The strengths and weaknesses of several methods are discussed. Finally, the current state of research into the use of discrete choice experiments for environmental valuation is presented.

2.1 INTRODUCTION

Ross (1995) describes the evolution of forest policy in Canada and identifies several distinct periods of forest management. Early loggers described Canada's Red and White Pine forests as inexhaustible and focused solely on producing as much lumber as possible. Gradually, people began to realise that the forests were finite and some efforts were made to prevent damage to the existing resource base. In the 1940s and 1950s, the concept of sustained-yield management came to prominence, with an emphasis on ensuring that there would always be a constant supply of trees available to be logged. In the 1960s, there was a growing recognition that forests are a source of many different types of values, in addition to the widely recognised timber values. The concept of multiple use of forests has guided many forest management decisions in the latter part of the twentieth century. While forests were managed to allow multiple uses, the emphasis was still on maintaining a sustained yield of timber (Ross, 1995). Finally, the 1990s have seen the rise of ecosystem management, in which the emphasis is on maintaining long term ecological integrity of the forest ecosystem.

2.2 ECOSYSTEM MANAGEMENT

Ecosystem management, like 'sustainability' and other buzzwords, means different things to different people. Grumbine (1994) outlines the development of what has become known as ecosystem management, from initial realisations that protection of species of concern required protection of entire ecosystems to the principles of today's ecosystem management. According to Grumbine (1994), several trends have led to the current popularity of ecosystem management. Advances in forestry, conservation biology, and other fields have emphasised the interconnectedness of all parts of an ecosystem, leading to the realisation that one particular species or part of an ecosystem cannot be preserved in isolation from the rest. At the same time, there has been growing public opposition to traditional forestry practices that aim solely to maximise timber production, coupled with a demand for greater public involvement in land-use planning processes.

Grumbine (1994) reviewed a number of articles on ecosystem management, in an attempt to develop a commonly accepted definition for ecosystem management. Grumbine's (1994) working definition states that "ecosystem management integrates scientific knowledge of ecological relationships within a complex sociopolitical and values framework toward the general goal of protecting native ecosystem integrity over the long term" (p. 31). The importance of protecting ecosystem integrity cannot be overemphasised. Ecosystem management does not simply include the protection of ecosystem integrity as a factor to be balanced with the traditional goals of maximising resource production. Rather, ecosystem management "considers all resource use as a managerial artifact that may flow sustainably from natural systems only if basic ecosystem patterns and processes are maintained" (Grumbine, 1994, p. 32).

The Ecological Society of America established a committee to report on the scientific basis for ecosystem management (Christensen et al., 1996). This committee identified eight key elements of ecosystem management:

1. long-term sustainability as fundamental value;
2. clear, operational goals;
3. sound ecological models and understanding;
4. understanding complexity and interconnectedness;
5. recognition of the dynamic character of ecosystems;
6. attention to context and scale;
7. acknowledgement of humans as ecosystem components; and
8. commitment to adaptability and accountability. (Christensen et al., 1996, p. 669)

For the purposes of this paper, elements one and seven are particularly relevant. The concept of sustainability as the fundamental goal of ecosystem management has been discussed above. The other important element is the recognition that not only are humans part of the ecosystem, but that their values and preferences need to be included in guiding decision-making.

The role of the public in providing input to resource management decisions has been growing in recent years. It has grown, in large part, because of legislative requirements in many jurisdictions that require some sort of public consultation. While there is growing recognition of the importance of incorporating public preferences into forest policies, the question of how best to actually determine and measure these preferences is still being resolved. Currently in Canada, much public involvement takes the form of simply inviting public comments on proposed management plans. In other cases, stakeholders and/or members of the public may be invited to sit at some sort of round table or planning committee, theoretically ensuring that non-timber values are incorporated into the plan. There is no guarantee, however, that the values of the people who participate in these planning processes will accurately represent the values of the general public. Adamowicz and Veeman (1998) suggest that public participation in forest policy decision-making should take two forms. Public membership on planning committees and in other processes is appropriate for resolving specific, local issues, but the larger question of measuring values requires some sort of more structured method of determining public opinion, such as a survey. Bengston (1994) identifies a number of benefits resulting from a better understanding of forest values. One of these benefits is that information about the relative importance of various forest values can help resource managers determine what the level of public support will be for various forest management practices.

2.3 SUSTAINABILTY

There appears to be a general consensus in society that sustainability is a desirable characteristic of most systems, especially those systems upon which human life depends. Almost all definitions of ecosystem management include sustainability as a fundamental goal. Costanza (1996) goes so far as to suggest that "we should institute a consistent goal of sustainability in all institutions at all levels from local to global" (p. 161). Given the importance of sustainability, it is necessary to explain what exactly is meant by the term.

2.3.1 DEFINING SUSTAINABILITY

> Sustainable development is development that meets the needs of the present without compromising the ability of future generations to meet their own needs.
> (World Commission on Environment and Development, 1987, p. 43)

The above definition has become one of the mostly widely accepted definitions of what is meant by sustainable development and it provides a useful introduction to the concept of sustainability[2]. In addition to this definition, Hediger (2000) emphasises that sustainable development includes sustaining the natural systems that support life on Earth.

Costanza and Patten (1995), tackle the problem of defining sustainability, and identify three important characteristics of sustainable development:

1. a sustainable *scale* of the economy relative to its ecological life-support system;
2. an equitable *distribution* of resources and opportunities between present and future generations; and
3. an efficient *allocation* of resources that adequately accounts for natural capital (p. 194).

Costanza and Patten (1995) point out that most definitions of sustainability are too vague, in that they do not specify which system (be it ecological, economic, et cetera) is to be sustained, nor for how long the system should be sustained. These questions cannot be answered simply by studying the ecological components and processes that make up an ecosystem, unless the answer is that all systems should be sustained forever. Since no system lasts forever, some sort of value judgements must be a part of any discussion of sustainability. As Dodds (1997) points out, "in a world where trade-offs must occur, difficult decisions must be made regarding which environmental and other assets should be passed on, and in what form" (p. 96).

2.3.2 SUSTAINABILITY AS A FUNCTION OF CAPITAL

A useful way of looking at sustainability involves the concept of capital. In the simplest economic terms, capital is defined as "a stock that yields a flow of valuable goods or services into the future" (Costanza & Daly, 1992, p. 38). This flow of goods and services can be considered sustainable, as long as the stock of capital is not depleted. If the capital is depleted, then the flow of goods and services may be impaired or interrupted altogether.

Traditionally, economics has only considered manufactured capital and relevant input materials (e.g. infrastructure, machinery, natural resources). Gradually, however, there has been a recognition of many other types of capital, which have been variously referred to as natural capital, ecological capital, social capital, human capital, and even moral capital (e.g. Costanza & Daly, 1992; Goodland, 1995; Hediger, 2000). There are a number of different ways of conceptualising and differentiating among these various types of capital. For the purposes of this paper, I will broadly divide capital into three categories: natural, social, and economic (see Table 2.1). There is some overlap among these categories; for example, natural resources may be part of economic capital (in that they are used to produce goods and services for human consumption) and also part of natural capital (in that they are required to maintain properly functioning ecosystems). The point of distinguishing among these three types of capital is not to establish mutually exclusive categorisations, but rather to relate the different types of capital to different conceptualisations or gradations of sustainability.

Within the field of ecological economics, several types of sustainability have been identified, from 'weak' to 'strong' sustainability. Various authors have described finer gradations of sustainability, such as 'very weak', 'very strong', 'absurdly strong', and 'superstrong' sustainability (e.g. Goodland, 1995;

---

[2] Jamieson (1998) suggests that the term 'sustainability' has come to replace the term 'sustainable development.' These terms will be used interchangeably in this paper.

Hediger, 2000). Regardless of the terminology employed in any one of these conceptualisations of sustainability, the various grades of sustainability are defined according to the extent to which various types of capital may be substituted for one another.

Table 2.1 Types of capital

Type of Capital	Description
Economic	• an economy's generalised productive capacity • machines, buildings, knowledge, social organisation, institutions, renewable and non-renewable resources, land • does not include ecological assets that are not directly used
Natural	• the natural resource base of an area • renewable and non-renewable resource stocks, natural and semi-natural land areas, ecological factors, and ecosystem resilience
Social	• society's capacity to deal with environmental, social, and economic problems • socio-cultural values and norms, learned preferences, human capital and labour force, local knowledge of the environment, social competence and institutions, human health and life expectancy, cultural and social integrity, social cohesion
Total	• an aggregate of parts of economic, natural, and social capital • human-made capital, non-renewable resources, ecological capital, immaterial aspects of social capital

(adapted from Hediger, 2000)

In general terms, weak sustainability assumes that all the various types of capital are perfectly substitutable for one another; as long as the aggregate value of the various types of capital is sustained, then a system is weak sustainable (Munda, 1997). Under a weak sustainability framework, natural capital could be completely eliminated, as long as it was replaced by an equal or greater amount of some other type of capital. The concept of strong sustainability developed out of a recognition that for at least some types of natural capital, there are no substitutes. Certain aspects of natural capital, (for example clean air and water) are essential to human survival, and no amount of money or other type of capital can replace this essential natural capital. Taken to the extreme, strong sustainability assumes that the various types of capital are perfectly complementary, meaning that no substitutions can be made amongst the different forms of capital (Costanza, 1996). Neither of the extreme conceptualisations of sustainability is particularly useful, as neither seems to be an accurate reflection of reality. Hediger (2000) describes three types of sustainability (see Table 2.2), and suggests that a blend of weak and strong sustainability based on the concept of total capital (defined in Table 2.1) may be appropriate for the study of sustainability. Hediger (2000) refers to this blend of weak and strong sustainability as 'weak sustainability' while Goodland (1995) develops a virtually identical concept but calls it 'strong sustainability.' To avoid confusion, I will use the term 'moderate' sustainability. Under such a moderate sustainability framework, some substitution among the various types of capital can occur, subject to certain limits.

The idea that an ecological system has certain limits (i.e. a minimum level of ecological capital or threshold of ecosystem resilience) beyond which irreversible change may occur is widely accepted within the field of ecology (e.g. Daly, 1987; Pearce, Atkinson, & Dubourg, 1994). Analogous to this concept, Hediger (2000) proposes that there should also be critical minimum levels of social and economic capital[3]. These limits can be used to define the boundaries of an 'opportunity space' for sustainable development. Essentially, ecological, social, and economic capital can be traded off with each other, as long as all the types of capital stay within the boundaries of the opportunity space (i.e. critical natural capital is maintained. For economists, this means that these limits must be taken into account when determining the optimum levels of production of various goods and services.

Table 2.2 Types of sustainability

Type of Sustainability	Objective	Type of Capital Considered
weak	maintain income per capita constant over time	economic
moderate	maintain the level of social welfare	total
strong	maintain ecological capital at the initial level	natural[4]

(adapted from Hediger, 2000)

The critical minimum levels of each type of capital may very well be impossible to identify until management decisions have surpassed them. As Costanza and Patten (1995) point out, a true determination of whether or not a system is sustainable can only be made after the fact (i.e. only after a system has ceased to exist can one truly judge that a system was sustainable for X years). Any attempt to define a currently existing system as 'sustainable' inevitably amounts to a prediction, rather than a true description of the system (Costanza & Patten, 1995). In many natural systems, there may be limits as to the amount of stress that can be placed on a system before the system collapses. Unfortunately, these limits may only become apparent after the system has already collapsed. This has lead to concepts such as safe minimum standards, which set limits by erring on the side of caution. Determining how much reduction in the various types of capital is acceptable is far beyond the purview of this paper and would likely be next to impossible to estimate for most complex ecosystems. In any case, any such

---

[3] Hediger splits the economic component of sustainability into two parts: the minimum income required to meet basic human needs; and, macroeconomic stability (measured by unemployment and inflation).
[4] Hediger actually defines 'strong' sustainability with reference to 'ecological' capital, which he defines as "the part of natural capital which determines the overall quality of the ecosystem" (p. 483). Ecological capital does not include non-renewable resources

limits should be established with the greatest degree of caution, as the consequences of an error could both catastrophic and irreversible.

Given that certain minimum levels of natural, social, and economic capital must be maintained, there are still a great many tradeoffs that may be examined, both within and among each component of sustainability. Assuming that the underlying goal of sustainability can be met, one could argue that the next purpose of ecosystem management is to maximise the benefits that accrue to society from forest lands. In fact, one definition of sustainable development elucidates this goal as follows:

> *to maximise simultaneously* the biological system goals (genetic diversity, resilience, biological productivity), economic system goals (satisfaction of basic needs, enhancement of equity, increasing useful goods and services), and social system goals (cultural diversity, institutional sustainability, social justice, participation). (Barbier, 1987, p. 103)

With reference to the above definition, Munda (1997) argues that "it is impossible to maximise different objectives at the same time" (p. 215). I would argue that such a blanket statement is nonsensical, and in fact there may very well be situations in which more than one (although likely not all) objective can in fact be maximised simultaneously. Regardless, sustainability does not necessarily require that environmental, social, and economic goals all be maximised; rather, well-being (as an aggregate of these three goals) should be maximised. This requires an understanding of the different values associated with forests and of the tradeoffs that people are willing to make amongst these values.

2.4 MEASURING ENVIRONMENTAL VALUES

Virtually all resource management decisions involve some sort of tradeoff between or among various environmental values. To ensure that these tradeoffs result in the maximum benefit to society, it is necessary to measure as many of the various environmental values as possible. The starting point of any valuation exercise is to define the values that are being measured as precisely as possible. Once the values have been defined, appropriate measures can be selected.

Since most values are partially a function of personal preferences, there has been a great deal of debate about what values should be considered and how they should be classified to aid in their measurement. Stankey and Clark (1992) explain the difficulties of valuing even one type of environment: "Like all resources, forests are a function of socio-cultural appraisal. Their utility is what society perceives them to be; hence, the meaning and value of forests change over time and space" (p. 9).

Table 2.3 Description of forest values

Value	Description
Timber Products	The wood harvested from a forest, and all the products which can be made from that wood
Non-timber Products	Include products such as mushrooms, craft supplies, and medicinal plants which can be harvested from the forest and sold to provide direct economic benefits (Balick & Mendelsohn, 1992; Godoy, Lubowski, & Markandya, 1993)
Other Commodities	The value of minerals underneath forests, or the value of forest land for livestock grazing (Stankey & Clark, 1992)
Subsistence	In many rural areas in North America, both natives and non-natives obtain a significant portion of their food, building materials, and other products from forests (Muth & Glass, 1989)
Recreation / Tourism	Many different forms of outdoor recreation require forests. Both active and contemplative recreation can occur in forests (e.g. Manning, 1989; Rolston, 1985, 1988)
Aesthetic	The scenic beauty of forests (e.g. Ribe, 1989)
Existence	The knowledge that natural forest ecosystems exist, even if they will never personally visit these areas (Walsh & Loomis, 1989)
Ecosystem Services	Also called life support values. The value of forests for preserving the ecological process necessary for life on Earth (Daily, 1997; Scott, Bilyard, Link, Ulibarri, & Westerdahl, 1998)
Scientific / Research	Research on large, undisturbed ecosystems provides important baseline data for other research. Old-growth or wilderness-dependent species can only be studied in undisturbed areas. Forest can also be an important venue for social research (Manning, 1989)
Wildlife	Many wildlife species require large and/or undisturbed forests for survival (Rolston, 1985, 1988)
Biotic / Genetic Diversity	Forests represent and important reservoir for preserving both biotic and genetic diversity (Rolston, 1985, 1988)
Natural / Cultural History	Forests represent a museum of natural history where people can observe the functioning of the natural world (Rolston, 1985, 1988). Much of North American culture was also shaped by the presence of wild areas (Manning, 1989)
Spiritual	Many people gain spiritual or even religious benefits from spending time in forest ecosystems (McDonald, Guldin, & Wetherhill, 1989)
Character-building	Programs such as Outward Bound use forests to improve people's concepts of self-worth (Rolston, 1985, 1988)
Therapeutic	Both physical and mental health can be improved by forest recreation (Levitt, 1989)
Cultural Symbolisation	Many aspects of forests, including species such as salmon or bald eagles, are important symbols of various cultures (Rolston, 1985, 1988)
Intrinsic	People believe that forests have an inherent value in addition to all the instrumental values above (Leopold, 1949; Rolston, 1985, 1988)[5]

[5] The intrinsic value of a forest is the value of the forest in and of itself, without providing any utility to humans (Rolston, 1985). Intrinsic values are outside the scope of any valuation exercise, but are still considered by many people to exist

There are many different environmental values, some of which are common to many ecosystems and some of which are specific to forest ecosystems. For this paper, the focus will be on values associated with forests. The wide range of forest values discussed in the literature is summarised in Table 2.3. Since these descriptions of values come from a number of different sources, there may be some overlap among different conceptualisations of values, but most of the values in Table 2.3 are unique. Many of the values described in Table 2.3 are also present in other types of ecosystems.

A common starting point in classifying environmental values is to distinguish between market and non-market goods and services. Some goods and services produced by forests (e.g. timber) are traded in the marketplace. The value of these goods and services can be measured with traditional economic techniques. For many services, however, no market exists, so one must turn to other techniques to attempt to estimate the value of these non-market goods and services.

Forest based goods and services can be further divided into use and non-use values. Use values are those values which accrue to people through the use of the forest, such as for recreation. The economic value of these use values can be estimated through revealed preference (RP) methods (e.g. the Travel Cost Method (TCM)) in which the value of a good or service is inferred from peoples' transactions in a related market. Use values can be further divided into direct and indirect use values (see Knowler & Lovett, 1996). A number of indirect use values can be estimated using techniques such as changes in production functions, avoided costs, preventive expenditures, relocation costs, and replacement costs (Knowler & Lovett, 1996).

The value of many of the goods and services produced by forests, however, cannot be measured by, or inferred from any existing market. These values are referred to as non-use, or passive use values. Non-use values rely simply on the existence of the resource, and do not require the use of the resource (Knowler & Lovett, 1996). A number of authors also use the term passive use values (e.g. Carson, 1998; Hanley, Wright, & Adamowicz, 1998b), which can include both non-use values and some indirect use values.

Passive use values are particularly difficult to measure. Adamowicz and Veeman (1998) refer to this difficulty in their definition of passive use values as "those that individuals have for elements of the forest environment that are not reflected in any observable behaviour" (Adamowicz & Veeman, 1998, p.

S53)[6]. The difficulties associated with measuring passive use values led to many of these values simply being ignored in resource management planning. Over the past few decades however, there has been a growing realisation of the importance of passive use values to society. This has led to the development of techniques that attempt to measure and compare some of these difficult-to-measure values.

2.4.1 The Criteria and Indicators Framework

The Canadian Council of Forest Ministers (CCFM, 2000) has adopted the criteria and indicators (C&I) framework to examine the state of Canada's forests with respect to sustainability. This framework includes six criteria that "define a set of values Canadians want to enhance and sustain" and 83 indicators that "identify scientific factors to assess the state of the forests and measure progress over time" (CCFM, 2000, p. III-IV). In Ontario, among other provinces, work is being done to measure the current levels of many of these indicators in order to gain a better understanding of the sustainability of current forest management practices. One difficulty with using these indicators in a public survey is that the indictors may not be meaningful to the average person. While the indicators might provide useful information to a resource manager, they may need to be converted into simpler terms that can be evaluated more meaningfully by survey respondents.

2.4.2 Stated Preference Techniques

When passive use values are to be considered, stated preference (SP) techniques can be used to create a hypothetical market in which non-market goods and services can be valued (Adamowicz, Boxall, Williams, & Louviere, 1998b). Stated preference techniques may also be used to measure use values, especially in situations where RP techniques fail to capture all of the value associated with a particular use of a resource.

2.4.3 Contingent Valuation

The most common method for measuring passive use values is the Contingent Valuation Method (CVM). The CVM creates a hypothetical market for a non-market good or service (i.e. a benefit associated with a natural area, or a specific environmental improvement) by asking people how much money they would be willing to pay for that particular benefit (Mitchell & Carson, 1989). In a simple CVM study, people are asked how much they would be willing to pay for a change from the current situation to a hypothetical future situation. These Willingness to Pay (WTP) responses are then used to

[6] Interestingly, Adamowicz and Veeman note that in certain cases, passive-use values can translate into marketplace actions such as choosing to boycott a particular logging company because of the impact of that company's practices on passive-use values. While the economic impact of consumer boycotts can be measured, I

calculate the economic value of a particular change in one or more environmental attributes. In theory, these environmental values can then be compared to other values calculated through more traditional economic techniques.

The CVM technique has been used extensively in environmental valuation since the 1970s and a number of significant design improvements have been suggested to make these studies more accurate and reliable. In 1993, the National Oceanic and Atmospheric Administration (NOAA) convened a panel of experts to debate the usefulness of CVM. This "Blue Ribbon Panel" issued a number of guidelines to follow when conducting CVM studies. The panel suggests that the best design for a CVM is to use a dichotomous choice referendum-style CVM, in which respondents are asked whether or not they would pay a tax of $X for a clearly-defined environmental improvement (Arrow, Solow, Portney, Leamer, Rader, & Schuman, 1993). Double-bounded CVM studies then ask a follow-up question which, depending on the response to the first question, asks respondents if they would be willing to pay a greater amount (in the event of an initial yes response) or a lower amount. The value of X is varied among respondents, and the mean Willingness to Pay (WTP) can then be calculated. These guidelines have resulted in significantly improved CVM studies over the last few years, but there are still some unresolved issues.

2.4.3.1 Drawbacks of Contingent Valuation

One of the major concerns with CVM is the embedding effect. This is the phenomenon whereby respondents provide almost the same WTP for an entire bundle of goods as they do for one of the goods in the bundle (Kahneman & Knetsch, 1992; Loomis, Lockwood, & DeLacy, 1993). It appears that respondents are willing to pay for a positive environmental change, but they are unable to make distinctions about how much change they are really willing to pay for. CVM can show support for a change, but the embedding effect raises questions about the validity of comparing WTP estimates with other economic values. Carson (1998) suggests, however, that even the embedding effect can be reduced or eliminated through careful wording of the CVM survey.

A similar concern with CVM is what is known as 'yea-saying'. This is the tendency of respondents to say yes to a referendum CVM question regardless of the actual WTP amount, simply because they want to indicate support for a positive environmental policy. The result of this tendency is that CVM studies

---

am not aware of these impacts being included in any calculations of passive-use values. In any case, such measures would not likely be an accurate reflection of the passive-use values held by society as a whole.

can overestimate the actual WTP, and hence overestimate the value of a particular environmental benefit.

There are a number of more philosophical objections to CVM. An interesting case arises when the environmental resources being valued consist of public lands. A number of researchers have questioned the validity of asking people to state their WTP for benefits provided by public forest lands (e.g. Jakobsson & Dragun, 1996; Rolston, 1985). Since the public theoretically already owns these lands, it does not seem justified to ask people to pay to keep these forests in their existing natural condition. As an alternative to WTP, some researchers have suggested asking people for their “willingness to accept compensation” (WTA) for the loss of the values provided by the natural environment. Knetsch (1994) points out that since gains are measured by WTP for the gain, then losses should be measured in terms of WTA compensation for the loss. WTA has rarely been used successfully, but results tend to show a mean WTA that is 3-20 times higher than the mean WTP for the same values (Jakobsson & Dragun, 1996). Studies have found that commonly up to 50% of people surveyed refuse to provide any WTA amount, instead stating that the environment is not for sale (Jakobsson & Dragun, 1996). Even when WTA amounts are provided, they are often so large (e.g. infinity or billions of dollars) that researchers simply discard them as outliers. This forces the researcher to make some arbitrary cutoff value for reasonableness, which introduces a bias into the results because the researcher is making judgements based on his or her own values. Because of the difficulty of getting usable WTA responses, most researchers rely on WTP instead, even though the WTP may not be the most appropriate measure for these values.

In addition to the WTA/WTP debate, there is also the question of whether or not many of the benefits of environmental resources can or should be measured in monetary terms. Many people would argue that it is impossible to put a price on the natural world, regardless of what technique is used to obtain the price. Both WTP and WTA CVM studies are vulnerable to protest responses in which respondents refuse to answer the question because of objections to different aspects of the valuation process. Some respondents, for example, attach a value to the environment, but yet are unwilling to pay anything for it (Jorgensen, Syme, Bishop, & Nancarrow, 1999). These protest bids usually have to be excluded from the evaluation but doing so reduces the accuracy of the study. Follow-up questions to determine whether zero WTP responses are valid or protest bids have been used with some degree of success (Yoo, Kwak, & Kim, 2001).

A CVM study is usually limited to measuring the value of only one specific environmental change. One could determine the value of improving a number of different environmental, social, and economic attributes, but it would not be possible to determine how much of the overall value is attributable to each attribute. Since the research objectives in RSVP required that values be obtained for each different attribute, a CVM study would not have met the objectives. A more flexible research approach, discrete choice experiments (DCE), avoid some of the problems associated with CVM and have recently been applied to the field of environmental valuation and the evaluation of management alternatives.

2.4.4 DISCRETE CHOICE EXPERIMENTS

The DCE is a stated preference technique that has been applied extensively in the fields of transportation demand and market research (Adamowicz et al., 1998b). A DCE is more flexible than CVM in that the model can simultaneously incorporate multiple changes to the description of a scenario. The model structure used in DCE is the same structure used in Dichotomous Choice (referendum) CVM studies, as well as in discrete choice travel cost models (Boxall, Adamowicz, Swait, Williams, & Louviere, 1996). The format of a DCE can appear so similar to a referendum CVM that some researchers (e.g. Adamowicz et al., 1998b) refer to DCE as a variant or extension of CVM. This similarity should ease the acceptance of DCE as an environmental valuation tool, since the theory behind CVM is already widely accepted

There are two major steps to a DCE study. The development of a DCE survey is outlined in this section, while the methods of analysing the data from a DCE are explained in Chapter Three. The data for a DCE is collected using surveys, conducted either through mailouts or through in-person interviews. In a typical choice experiment, a respondent is presented with a series of 6-16 choice tasks. In each choice task, the respondent is presented with a choice set consisting of two or more alternative scenarios, and is required to choose which alternative he/she would prefer assuming these are the only two alternatives available. A base alternative of choosing the status quo is often also available in each choice task. Each alternative is described in terms of a fixed number of attributes. Each attribute is described in terms of several (usually two to eight) levels, which are varied in each choice set according to an orthogonal[7] statistical design. By aggregating the responses from all respondents, it is possible to derive part worth utilities (PWUs) for each attribute. These PWUs demonstrate the importance of various attribute levels to the choice selection of an individual.

A DCE may be either generic or alternative specific. An alternative specific design may be selected if labelling each alternative of a choice set would make the response task more realistic. In some situations, for example when one alternative, such as constructing a dam, is particularly controversial,

[7] In an orthogonal design, the attribute levels are uncorrelated with any other attributes, thus ensuring that the part worth utilities measure only the intended attribute and are not confounded with other attributes.

the use of labels may detract from the DCE by causing the respondent to base her/his decision more on their general opinion of dams, rather than on the attributes of each scenario (Blamey, Bennett, Louviere, Morrison, & Rolfe, 2000). This kind of situation may call for a generic DCE. The use of labels for alternatives may also substantially reduce the importance of each attribute, resulting in much lower WTP values for each attribute (Blamey et al., 2000).

2.4.4.1 Design of Discrete Choice Experiments

To calculate efficient PWUs, the DCE must be carefully designed. Usually this requires orthogonality of attribute levels both within and between alternatives. Each attribute level should appear in the design the same number of times and, ideally, each combination of attribute levels should also appear the same number of times. A full factorial design, where all main effects and interactions are orthogonal, represents one extreme for a design plan that a researcher could employ for a DCE. However, full factorial design plans require an unrealistic number of choice sets, even when the total number of attributes is small.

In order to make a DCE feasible, a design plan is usually selected in which only a subset of all the possible choice sets are actually evaluated. For that purpose, fractional factorial designs can be selected in such a way that all of the main effects of each attribute to be calculated but usually very few, if any, interactions (among attributes within an alternative) or cross effects (between one alternative and another) can be calculated (Raktoe, Hedayat, & Federer, 1981). These interactions and cross effects should be explored in focus groups prior to the final design of the DCE, and the design can be adjusted so that any significant interactions and/or cross effects can be included.

The design of the survey instrument is the most crucial part of a DCE study. It is essential that most of the relevant attributes of a particular situation be included in the experiment. The first stage in the design of a DCE is to gather a group of experts (researchers and managers) who are familiar with various aspects of the situation to be studied. In the case of this study, this included biologists or ecologists to provide information about the environmental attributes, and economists and social scientists to provide information about the human dimensions of the situation. The research group must determine what values should be measured and what are appropriate indicators or attributes of these values. In some cases, photographs can convey useful information to respondents, but they must be used with care to ensure that they convey the intended meanings. Once the attributes have been established, appropriate levels (measures) for each attribute must also be determined. The levels should represent realistic states of nature, both in the current situation, and in any possible future situations. By including levels both below and above the current situation, the values of both increases and decreases can be estimated. The development of a DCE should be an iterative process, involving extensive use of focus groups and pretesting to make sure that the attributes chosen are useful to managers, and at the same time meaningful to the respondents, and that no significant attributes are missing. Once the DCE has been designed and refined, the analysis of the data collected is relatively straightforward. The analysis of the results of a DCE is explained in Chapter Three of this paper.

2.4.4.2 Benefits of Discrete Choice Experiments over Contingent Valuation

A number of authors suggest that DCE may offer significant improvements over CVM as an environmental valuation tool. A major drawback of CVM is that a CVM study will only provide information about one specific environmental change. DCE, on the other hand, allows researchers to learn about the values associated with a wide range of possible situations, bounded by the attribute levels used in the experiment. Welfare effects can also be estimated for a change in any attribute or for combinations of changes in several attributes.

One of the most serious problems with CVM is the problem of “yea-saying”. This problem is lessened in a DCE because respondents have multiple opportunities to express their desire for an environmental change. With a CVM, respondents only have one (or in the case of double-bounded CVMs, two) chance(s) to indicate whether or not they support a particular policy. If a respondent supports a policy, she/he may agree to a WTP amount that is actually higher than his/her actual WTP, either as a vote in favour of the policy or simply to avoid looking bad by refusing to support an environmental policy. In DCE, the incentive for “yea-saying” is reduced, and respondents can concentrate instead on making meaningful decisions about whether or not the environmental benefits in each choice set are worth the costs.

Given the limited budgets commonly available for environmental valuation studies, researchers are often forced to rely on benefits transfer as a crude method of environmental valuation. Hanley and others (1998a) note that the results of CVM studies are rarely useful in a benefits transfer exercise, meaning that another full CVM would have to be carried out in each area where valuation is required. This limitation of CVM is a result of the very specific nature of a CVM question. A transfer of CVM-based results would only be possible if the situation in question was nearly identical to the original CVM situation. Since DCE allows values to be estimated for each attribute of an environmental resource, it may be possible for these values, or their value functions, to be transferred to other similar, but not necessarily identical, sites (Hanley et al., 1998a).

A DCE may reduce the embedding effect common in CVM studies. In a DCE, a respondent will be required to value a number of different environmental changes, with different prices or price substitutes for each alternative. This should force the respondent to make a more meaningful consideration of exactly what he/she is valuing. By trading off, for example, different levels of wilderness preservation against different tax increases, it is hoped that respondents will not simply place the same value on the differing levels of preservation.

As mentioned earlier in this paper, there has been a great deal of debate about the appropriateness of WTP rather than WTA as a measure of environmental valuation. By carefully designing a DCE so that each attribute has levels both above and below the current situation, it is possible for the same study to measure both WTP and WTA. The difference between WTP and WTA is partially attributed to the endowment effect and this effect has been demonstrated using a DCE. Adamowicz and others (1998b) found the marginal utility of caribou losses (-0.004) to be twice the marginal utility of caribou gains (0.002) (p. 73). The same study found an even stronger endowment effect for wilderness area with the marginal utility of wilderness loss being –0.1319 per unit, and a marginal utility of wilderness gain of only 0.028 per unit (Adamowicz et al., 1998b, p. 73-74). The capability of DCE to measure both WTP and WTA means that the debate over which measure is most appropriate can be avoided. Losses can be measured using WTA and, at the same time, gains can be measured using WTP.

One of the greatest benefits of DCE is its ability to provide the researcher with a much more comprehensive set of useful information about the resource management decision. While CVM can only give the researcher information about a change from the current situation to one future scenario, DCE allows researchers to estimate the values associated with a wide range of possible future scenarios. If new information is discovered, for example if biologists discover that a proposed management scheme will have a much greater impact on an endangered species than was previously thought, the information collected from a CVM study would be of little help in the new situation. With a DCE approach, however, as long as the respective change has already been specified within the attribute levels of the study, the values associated with the new situation have already been evaluated. Similarly, the nature of a DCE approach includes a built-in sensitivity analysis. The level of any attribute in a DCE can be systematically varied to examine the sensitivity of the model to changes in that particular attribute.

One of the reasons why CVM studies are sometimes thought to overvalue an environmental improvement is the tendency of respondents to ignore possible substitutes. Boxall and others (1996) examine this issue by conducting parallel CVM and DCE studies on the effects of forest management practices on recreational moose hunting. In this study, the WTP for increasing the moose population in one of 15 Wildlife Management Units (WMUs) was found to be $85.59 / trip using CVM and only $3.46 / trip using DCE (Boxall et al., 1996, p. 250-251). This huge difference in WTP estimates is explained by the fact that in the CVM, hunters tended to ignore the possibility of hunting in one of the other 14 WMUs and instead based their WTP decision solely on whether they could hunt in the study WMU or not. In the DCE, on the other hand, hunters had to make repeated choices about which of two hypothetical WMUs they would prefer to hunt it, and as such, tradeoffs between different WMUs were explicitly built into the study design. In their study, they actually were able to test this hypothesis by constraining the DCE to only consider the study WMU; in that situation, the resulting WTP was found to be $56.69, which is much closer to the WTP obtained from the CVM study (Boxall et al., 1996, p. 251). These results suggest that because of the possibility of respondents ignoring substitution possibilities in CVM studies, the associated welfare estimates may overestimate the true value of the resource in question. DCE may provide a more accurate measure of WTP, and also provide the flexibility to perform internal tests to see the effects of ignoring possible substitutes.

2.4.5 Applications of Discrete Choice Experiments in Measuring Environmental Values

Over the past decade, a number of researchers have used DCE for estimating a variety of use and passive or non-use environmental values. Table 2.4 summarises many of the recent applications of DCE to environmental valuation. Obviously, the DCE approach has been applied to a wide range of different environmental valuation problems. DCEs have been used to value a variety of both use and passive use values associated with both land and water-based resources. If a payment vehicle is included as an attribute in the DCE, it is possible to calculate the economic value of changes to any individual attribute in any of the studies listed in Table 2.4. If on particular environmental good or service is evaluated in a number of different situations, it might be possible to compare the different values for that attribute from different studies; one could then gain a general understanding about the consistency of people’s values for that particular environmental good or service. This concept of preference regularity is explored by Louviere, Hensher, and Swait (2000) who also outline a procedure for testing for preference regularity.

Many of the studies described in Table 2.4 have also been used to experiment with different design elements of DCE. Researchers have examined the role of objective versus subjective rating of attributes (Adamowicz et al., 1997), the use of photographs to describe attributes (Haider et al., 1998; Hanley et al., 1998a, 1998b), and the use of labels for different alternatives (Blamey et al., 2000). Each new study generates new insights about applying the DCE to environmental valuation.

Table 2.4 Summary of environmental valuation discrete choice experiments

Authors	Subject of study	Attributes
Adamowicz, Louviere, & Williams (1994)	Water-based recreation site choices	Water feature Terrain Driving distance Fish species Fish size Fishing success Camping facilities Water quality Boating Swimming Beach Entry Fee
Boxall, Adamowicz, Swait, Williams, & Louviere (1996); Adamowicz, Swait, Boxall, Louviere, & Williams (1997)	Effects of forest management on moose hunting	Moose population Hunter congestion Hunter access Forestry activity Road quality Distance to site
Xu (1997)	Environmental and social values for forest management alternatives	Management strategies Biodiversity Visual appearance Costs to your household Impact on rural jobs
Adamowicz, Boxall, Williams, & Louviere (1998b)	Passive use values of caribou preservation	Caribou population Wilderness area Recreation restrictions Forest industry employment Changes to provincial income tax
Haider, Anderson, Daniel, Louviere, Orland, & Williams (1998)	Remote tourism in northern Ontario	Accommodation Setting Crowding Fish species / quality Bag limits Expected catch Noise Driving time Fly-in time Oblique aerial image[a] Distant Image Shoreline image
Hanley, MacMillan, Wright, Bullock, Simpson, Parsisson, & Crabtree (1998)	Benefits of Environmentally Sensitive Areas (ESAs)	Biodiversity Presence of indicator species Relative rarity Bird numbers / species Archaeological features Tax
Hanley, Wright, & Adamowicz (1998)	External benefits of public forest management	Forest shape (straight vs. organic edges Felling scheme (large vs. small clearcuts) Species mix

Table 2.4 continued

Authors	Subject of study	Attributes
Blamey, Gordon, & Chapman (1999)	Environmental values of water supply options	Reduction in household water use Use of recycled water Increase in water charges Improvement in river flows Number of species with habitat loss Colour of grass in urban areas
Morrison, Bennett, & Blamey (1999)	Value of improved wetland quality	Water rates Irrigation related employment Wetlands area Waterbirds breeding Endangered and protected species present
Blamey, Bennett, Louviere, Morrison, & Rolfe (2000)	Values of remnant vegetation in desert uplands	Levy on income tax Income lost to region Jobs lost in region Endangered species lost to region Reduction in population size of non-threatened species
Mallawaarachchi, Blamey, Morrison, Johnson, & Bennett (2001)	Protection of natural vegetation in a sugar-cane growing region	Annual levy on land rates Income in region in 2005 Teatree woodlands in 2005 Vegetation along rivers and in wetlands in 2005

a: These images represented eight timber management attributes: buffer, residuals, access road, forest type, size of cut, shape, blocks, and age.

The study which most closely resembles RSVP is by Xu (1997). Xu uses a DCE to measure environmental and social values for forest management alternatives in Washington state. Xu (1997) used a mailout survey to measure five attributes related to the function and formation of ecosystem management. These attributes represented a number of different forest values, including ecological (biodiversity), recreational (visual appearance), economic (household cost), and social (jobs lost) values. The final attribute in Xu's study was the emphasis of the management strategy. Xu included a payment vehicle in the study, so an emphasis was on welfare estimation for various management alternatives. Xu's study provides a useful example for the RSVP survey, as it is a complex survey instrument attempting to measure environmental, social, and economic values. The RSVP survey is more complex than Xu's survey, but will also provide information about a more comprehensive suite of values.

2.4.5.1 Economic Valuation with DCE

As described in Chapter Three of this paper, conditional multinomial logit regression analysis produces PWUs for each attribute of an environmental resource. In many DCEs, one of the attributes is a payment vehicle. The inclusion of a payment vehicle allows the marginal value of changes in any of the other attributes to be estimated in monetary terms. While these dollar values can be useful, there are also drawbacks to the inclusion of a payment vehicle.

A major reason for not including a payment vehicle might be associated with the difficulty of defining an appropriate payment vehicle. Most valuation studies have used some form of a tax as a payment vehicle, but caution that this may lead to protest responses from respondents who are opposed to any new form of tax. One proposed solution to this problem is to make the payment vehicle a mandatory payment to a trust fund that is earmarked specifically for the environmental improvement under consideration. This solution, which has been used with some success in the United States, (e.g. Johnston, Swallow, & Weaver, 1999) avoids some of the problems of a simple tax, but it is also an unfamiliar concept in Northern Ontario, which is the focus of this study. The situation in Ontario is complicated further, as some forest management costs are currently paid by the forest industry, while others are covered by the OMNR, and are therefore paid for by taxpayers through general taxation. So, although taxpayers are already paying for forest management, any payment vehicle that makes these costs more explicit may have been met with considerable resistance and would likely have affected the survey responses.

There are also concerns about the notion of using actual money to measure the attributes used in the DCE. Dollars are a convenient metric with which to compare the value of attributes but they may not necessarily be the most appropriate scale. Some people feel that while many ecological services have a value, these values are not necessarily ones that can or should be expressed in dollars.

Any resource management decision involves making tradeoffs among various environmental, social, and economic interests with the goal of providing the maximum benefits to society. Through the careful design of a DCE, most of these interests can be represented by various attributes in a choice task. The PWUs estimated for each attribute can be directly compared, thus allowing different types of values (e.g. environmental, social, economic) to be measured relative to each other, rather than on a potentially inappropriate monetary scale.

2.4.6 DISCRETE CHOICE EXPERIMENTS AS A DECISION TOOL

In addition to serving as a method for valuation, DCEs may also be used as a decision support tool. Criticism of CVM also focused on the argument that it might be inappropriate to value environmental goods and services in monetary terms, regardless of the method used to obtain the monetary values. Nevertheless, it would still be essential to consider these environmental values when making resource management decisions, especially for the purpose of evaluating alternatives in a comparative manner. The huge field of decision analysis has evolved around this concern. Methods such as multiattribute utility theory (Keeney, 1992) have developed many evaluative tools, such as pairwise comparisons and the Analytic Hierarchy Process, for the purpose of weighting decision attributes subjectively, so that ultimately alternatives can be evaluated. The DCE may be useful as an alternative decision support tool, as the PWUs serve as weights and the multinomial logit regression as a format to compare alternatives (see equation 4 in Chapter 3).

2.4.7 Outstanding Issues / Challenges with Discrete Choice Experiments

Adamowicz and others (1998b) found evidence of a strong status quo bias. Respondents appear to have a strong preference for maintaining the status quo. Although all the environmental improvement attributes in their study had positive marginal utilities, these were offset by a strong negative marginal utility for moving away from the status quo (Adamowicz et al., 1998b). In addition to a possible status quo bias, the authors suggest some other possible reasons for this result, including a mistrust of government, an overly complex choice task, or a form of protest response. They mention that the status quo bias could have been avoided by changing the design of the DCE (Adamowicz et al., 1998b). Instead of choosing between the current situation and two possible future scenarios, as was done in Adamowicz and others' (1998b) study, the emphasis on status quo could have been reduced significantly by designing each choice set as a choice between two or three hypothetical future scenarios, and simply including the current situation as another scenario within the entire design. Adamowicz and others (1998b) discuss this possibility but discard it because of the importance of including a status quo alternative for welfare estimation. Clearly status quo bias may be a concern, especially if the current situation is explicitly labelled as such and if it appears in each choice set. However, if obtaining a welfare estimate is not a required part of the DCE study, a simple redesigning of the DCE to include the current situation as part of the overall factorial design could reduce or eliminate the status quo bias.

A DCE may still be vulnerable to the protest responses common to CVM, especially if a payment vehicle such as a tax is included in study. As with CVM, some kind of follow-up question may allow the identification of protest responses. However, so far no published studies have specifically examined the issue of protest responses in DCE.

Another issue that needs more research is the area of respondents' fatigue. Blamey and others (1999) noted that some respondents found the tradeoffs involved in the choice tasks to be too difficult and would have preferred a different type of survey. In the same study, other respondents complained that some of the combinations of attributes were infeasible (Blamey et al., 1999). Possible solutions to this problem are to restrict certain combinations of attributes, or to provide supplementary information to the respondents indicating how such scenarios might realistically occur. It is interesting to note that in the earlier DCE studies, each respondent was required to complete 16 choice tasks, whereas in later studies, the number of choice tasks presented to each respondent was generally reduced to 6 to 10. This trend may be a result of respondents complaining of fatigue or boredom from the repetitive nature of the choice task.

Perhaps the most serious challenge to overcome with DCE is the difficult, lengthy, and expensive process of attribute specification. As mentioned earlier in this paper, the proper specification of attributes is essential to the success of a DCE. In some cases, necessary information about current or future attribute levels may be unavailable, making DCE difficult or impossible in some situations. One should note, however, that the ability to predict future conditions is even more of a concern in CVM than in DCE.

CHAPTER THREE: METHODS

This chapter describes the methods used for this research project. It begins with an explanation of the analysis of discrete choice experiments. This is followed by a description of the development of the Resource Services Valuation Project (RSVP) survey instrument. The methods of conducting the survey and analysing the data are explained, and the chapter concludes with a discussion of a computerised decision support system.

3.1 DISCRETE CHOICE EXPERIMENTS

The theoretical basis for the DCE lies in random utility theory (Ben Akiva & Lerman, 1985; McFadden, 1974) in which a person's utility from a particular site or experience is described by the following utility function (sometimes referred to as a conditional indirect utility function):

$$U_{in} = V_{in} + \varepsilon_{in} \tag{1}$$

The utility gained by person *n* from alternative *i* is made up of an objective or deterministic and observable component (*V*) and a random, unobservable component (ε) (Adamowicz et al., 1994; Adamowicz et al., 1998b). The unobservable component, often referred to as a random error component, is commonly assumed to be type I or Gumbel distributed (McFadden, 1974). In the case of a DCE, the error terms associated with each choice set are also assumed to be independently and identically distributed (Hanley et al., 1998b). A result of this assumption is that a DCE study must be consistent with the assumption of the independence of irrelevant alternatives (IIA), meaning that "the ratio of choice probability for any two alternatives is unaffected by addition or deletion of alternatives" (Carson et al., 1994, p. 354). In simpler terms, the IIA requires that alternatives are independent of one another.

Some authors expand equation 1 to show that each component depends both on the attributes (*Z*) of the alternative and on the socio-economic characteristics (*S*) of person *n* (Hanley et al., 1998b). This results in the following equation:

$$U_{in} = V(Z_{in}, S_n) + \varepsilon(Z_{in}, S_n) \tag{2}$$

The inclusion of socio-economic characteristics tends to be more common when the end result of the DCE is to provide welfare estimates for one or more attributes. While some socio-economic data was collected in the RSVP survey, this information was used to test for differences among various segments of the sample rather than being directly included in the utility estimates (as in Equation 2).
An individual *n* will choose alternative *i* over alternative *j* if and only if $U_{in} > U_{jn}$. Thus, the probability that person *n* will choose alternative *i* over alternative *j* is given by the equation:

$$\text{Prob}(i|C) = \text{Prob}\{V_{in} + \varepsilon_{in} > V_{jn} + \varepsilon_{jn}; \forall j \in C\} \tag{3}$$

Where *C* is the complete set of all possible alternatives from which the individual can choose. Since the ε term is assumed to be Gumbel-distributed, the probability of choosing alternative *i* can be calculated by the multinomial logit model (MNL) (McFadden, 1974):

$$\text{Prob}(i) = \frac{\exp^{\mu v_i}}{\sum_{j \in C} \exp^{\mu v_j}} \tag{4}$$

The observable component of utility (*V*) can be expanded to a linear-in-parameters utility function as follows:

$$V_{in} = \text{ASC}_i + \beta_1 X_1 + \beta_2 X_2 + ... + \beta_k X_k \tag{5}$$

where ASC_i (also referred to as an intercept) is an alternative-specific constant which represents the "mean effect of the unobserved factors in the error terms for each alternative" (Blamey et al., 1999, p. 341). β_1 is the coefficient for the first attribute, X_1 is the level for the first attribute, and there are a total of *k* attributes.

If the socio-economic variables are included (as in Equation 2), then Equation 5 expands to:

$$V_{in} = \text{ASC}_i + \beta_1 X_1 + \beta_2 X_2 + ... + \beta_k X_k + \gamma_1 (S_1 \times \text{ASC}_i) + ... + \gamma_p (S_p \times \text{ASC}_i) \tag{6}$$

where γ_1 is the coefficient for the first socio-economic variable (S_1), and there are *p* socio-economic variables. In Equation 6, the socio-economic characteristics are multiplied by the alternative specific constants, but they could also be included by multiplying the characteristics by each attribute (Blamey et al., 1999).

The coefficients of each attribute (i.e. β_1 in Equation 5) may be estimated using several methods (i.e. MNL, multinomial probit, etc.). For MNL models, the most common estimation technique is maximum likelihood estimation (MLE) (Ben Akiva & Lerman, 1985; Louviere et al., 2000). Essentially this technique involves determining the value of β_1 which maximises the probability that the sampled respondents would choose the alternatives that they actually chose (Train, 1986). The MNL model is usually estimated with an econometric software package such as Limdep 7.0 (Greene, 1998).

Limdep produces a number of results for a DCE. Of primary importance are the actual parameter estimates. These estimates represent the weight of each attribute in the utility function of a particular alternative (i.e. β_1 represents the weight of the first attribute in Equation 5). Each parameter estimate is multiplied by the level of the corresponding attribute (i.e. X_1 from Equation 5) to produce a *part worth utility* (PWU) which is defined as "the total utility associated with a given level of an attribute" (Adamowicz et al., 1998b, p. 34). Equation 4 specifies the multinomial logit model, in which these PWUs are combined to determine the utility for a particular alternative.

During the design stage, the attributes in a DCE are discrete by definition. However, in the analysis, an attribute may be coded in a number of different ways depending on the specification of each attribute (i.e. categorical or numeric). For categorical attributes, dummy coding or effects coding are commonly used to estimate a coefficient for each attribute level[8]. The PWU for a continuous variable may be estimated in different functional forms, including linear, quadratic, cubic, or some combination of the above. In some situations the most appropriate functional form may be known a priori. In other instances, a number of different functional forms may be tested in order to see which form produces the most efficient model (Louviere et al., 2000).

In addition to the parameter estimates for each attribute, Limdep also provides a test of the significance of each estimate in the form of an asymptotic *t*-statistic. A *t*-value of 1.96 or above (or –1.96 or below) indicates that the parameter estimate is significant at $p<0.05$ (Louviere et al., 2000).

---

[8] In dummy coding, all but one of the levels of an attribute are coded as 1 if that level is present in a particular alternative or 0 if it is not. Since not all levels of an attribute can be estimated, the remaining level is coded as 0. In effects coding, the remaining estimate is coded as –1 (Louviere et al., 2000).

Limdep also provides some measures that can be used to estimate the overall goodness-of-fit of a model. The rho-squared statistic is a likelihood-ratio index that measures the goodness-of-fit of a MNL model. An adjusted rho-squared, which takes into account the degrees of freedom of the model, is the preferred measure of the goodness-of-fit of the model. A rho-squared (or adjusted rho-squared) value of 0.2 or above indicates a good fit of the model (Louviere et al., 2000).

3.2 SURVEY DEVELOPMENT

The goal of RSVP was to measure the values people place on the Ecological, Social, and Economic benefits they receive from forests. In order to measure these values for the general population, it is necessary to take all these benefits into consideration jointly, and to force respondents to make tradeoffs among these Ecological, Social, and Economic benefits. This was accomplished through the use of a discrete choice experiment.

The RSVP survey instrument consisted of six parts. Central to the instrument was the DCE in which respondents were asked to repeatedly choose which of two hypothetical forest management Outcomes they would prefer. Other sections collected basic socio-demographic information about the respondents, their outdoor recreation behaviour over the previous year, their attitudes towards the ecological, social and economic benefits accruing from the northern forests, and their attitudes towards some prevailing management issues such as types of land uses and road access. Several of these sections actually served the dual purpose of collecting information as well as informing the respondents about some more complex concepts that they needed to understand for the DCE. Presenting this information in question format, rather than lengthy instructions and information was crucial to the success of the survey. The sections below provide a detailed description of the various elements of the survey instrument. The DCE is presented first, followed by the remaining sections of the questionnaire.

3.2.1 FOREST MANAGEMENT OUTCOMES—A DISCRETE CHOICE EXPERIMENT

During the conceptual design of the research instrument, several options for selecting and operationalising variables were considered. Usually, one desires (1) to position a DCE around an actual decision context that is relevant to respondents, and (2) to select attributes and levels that are relevant to the decision process, that can be influenced by managers, and that are at the same time comprehensible to respondents. In northern Ontario two relevant decision processes come to mind: one focusing on Crown land landuse in general, and another that is more specific to forest management.

For a DCE with the purpose of valuing a larger suite of forest values, a landuse planning process would be quite appropriate. The OMNR recently undertook an extensive landuse planning process called Lands for Life (LFL)[9], which dealt with landuse issues on Crown lands covering approximately 45% of the province (OMNR, 1999). However, by the time RSVP was ready for implementation, the crucial decisions in the LFL process had already been made (Ontario Ministry of Natural Resources [OMNR], 1999), and building a study around LFL would have amounted to a rather artificial exercise from the outset.

Forest management plans are developed for each forest management unit (FMU) every five years; a complex regulatory process defines basic requirements and there is also room for public participation (OMNR, 1996). In these plans, forest values are defined from the technical perspective of resource managers (see Section 2.4). These values are numerous and many of them would not necessarily be comprehensible by the public. Therefore it became apparent, that in order to translate such values into concepts that are also meaningful in a public survey, one would need to summarise the multitude of values for a planning unit in some sort of summary table (see Figure 3.1). When we attempted to select a planning unit for implementing the study, it turned out that planning units typically do not have sufficiently detailed information from which to develop such aspatial summary tables. Another difficulty for undertaking such a study of values is that the population of each FMU in northern Ontario is typically too small to provide an adequate sample.

Two other aspects also became obvious: (1) while the spatial boundaries of a FMU are important to resource managers, they are rather irrelevant for local residents with respect to their recreational behaviour; people simply hunt, fish, and pursue other recreational activities in whatever they consider the most attractive places, regardless of FMU boundaries. (2) The FMU and the associated planning process certainly determine the flow of wood to the mills. Typically several communities are associated with one FMU. However, since often only one of the affected communities has a mill, each community may benefit quite differently from these decisions. If these differences were designed into an FMU-based DCE, the study would inevitably shift its focus away from the main concerns of RSVP. The solutions that eventually emerged to these two dilemmas affected the research design fundamentally, hopefully for the better.

1) Rather than focusing the study on one single FMU or on a generic FMU, the unit for scoping this study was defined as each respondent’s community and surrounding forest. This decision enabled

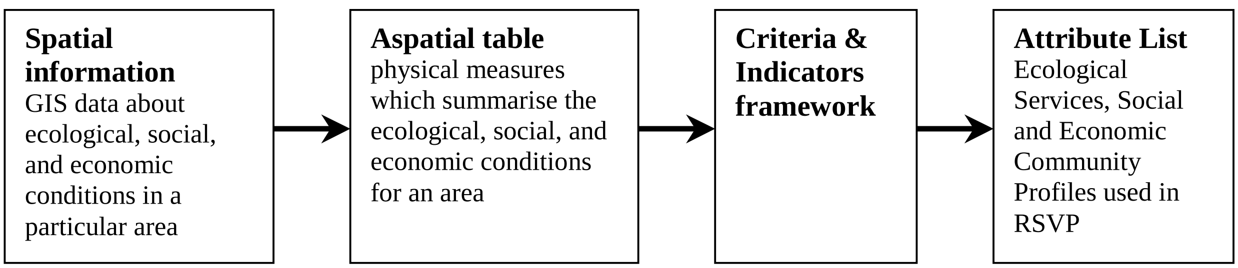
[9] The Lands for Life process led to the landuse strategy entitled Ontario’s Living Legacy (OMNR, 1999).

us to define a context for the study that subsequent focus groups identified as being meaningful. The generic nature of the study also allowed us to draw a sample from across northern Ontario.

2) In search for more general and more comprehensible measures of values we eventually decided to emulate the system of C&I as much as possible. The concept of C&I has become an important management framework in sustainable forestry and ecosystem based management, and we decided to select a set of indicators for the main sustainability concepts (CCFM, 2000).

Figure 3.1 shows how different measures of ecological, social, and economic conditions are related to one another. The actual spatial biophysical conditions of an area can be summarised in an aspatial table. These aspatial measures can then be used to determine the current state of various indicators from the C&I framework. Finally, these indicators can be described in terms of the Ecological Services and Social and Economic attributes used in RSVP (see Table 3.1).

Figure 3.1 The relationships among measures of ecological, social, and economic conditions



Based on these conceptualisations, the discrete choice experiment for RSVP consisted of a series of eight choice tasks in which respondents were required to select their preferred Outcome for the forest around their community in 30 years time. Each Outcome consisted of Ecological, Social, and Economic attributes, along with Landuse and Access attributes. For a complete list of attributes and their levels, refer to Table 3.1. Example choice sets are presented in the sample survey in Appendix A. The attributes and levels listed in Table 3.1 are the result of extensive consultations among the research team, OMNR representatives, and Parks Canada managers, as well as survey pre-tests with various groups as described elsewhere in this report.

The first part of each Outcome profile consisted of Ecological, Social, and Economic attributes, which described the benefits to each community from their surrounding forests. The pre-tests suggested that simply presenting respondents with such a suite of benefits resulted in too hypothetical a choice task. The Ecological, Social, and Economic attributes alone do not provide respondents with enough information about what each Outcome actually means to the respondents and their use of the land around their communities. Therefore, several additional attributes were added to each Outcome. These attributes described the use of land around the community, and types of permitted access. The attributes are described in more detail in the following sections.

Table 3.1 Attributes used in the discrete choice experiment and their levels

Attribute	Levels
Ecological Services	all ecological attributes share the following levels:
Fish Habitat	• significantly impaired
Wildlife Habitat	• moderately impaired
Rare & Endangered Species Habitat	• slightly impaired
Biodiversity	• at the natural level
Nutrient Cycles	• at the maximum possible
Carbon Storage	
Community Profile—Social	all social attributes share the following levels:
Population	• - 20%
Crime Rate	• - 10%
Quality of Medical Care	• no change
Quality of Education	• + 10%
	• + 20%
Community Profile—Economic	all economic attributes share the following levels:
Unemployment Rate	• - 20%
Average Household Income	• - 10%
Employment in Forestry	• no change
Employment in Tourism / Recreation	• + 10%
	• + 20%
Landuse Allocation	• Timber Harvest
	• Preservation
	• Integration of Uses
	• Separation of Uses
Park Classes	• few wilderness parks
	• mostly wilderness parks
Access & Recreation	• Low Access
	• Moderately Low Access
	• Moderately High Access
	• High Access
Access Restrictions	• no restrictions on access
	• no hunting in recent clearcuts
	• no access to certain remote lakes

3.2.1.1 Ecological Services

Forests provide a tremendous range of Ecological Services that benefit human beings and other species in a myriad of direct and indirect ways (see Table 2.3). One of the most challenging aspects of designing the RSVP survey was to select which of these Ecological Services should be included in the

DCE. As discussed in Chapter Two, there is a great deal of literature that describes and classifies many different benefits of forests, including everything from physical benefits such as clean air and water, to less tangible benefits like spiritual growth, and the existence value of knowing that natural areas exist. Many of these benefits are described in general terms, and are difficult to measure, especially in a way that would be meaningful to resource managers. In the quest of operationalising sustainable forest management, several agencies have adopted a C&I framework to measure the health of an ecosystem. These indicators, in contrast to the very general benefits described above, tend to be very specific, and are often measured in terms that are meaningless to potential survey respondents.

The following six Ecological Services were selected because they are: important and/or meaningful to many people; relatively easy to understand; and directly affected by forest management activities. In particular, Fish Habitat and Wildlife Habitat were included because of the importance of fishing and hunting to the lifestyle of many northern Ontario residents. Rare and Endangered Species Habitat was also included because it adds a non-use dimension to the idea of habitat.

Biodiversity was one of the most difficult attributes to define. Some aspects of biodiversity overlap or are related to many of the other Ecological Services, especially endangered species, fish and wildlife habitats. Part of the problem is that biodiversity occurs on many different scales (e.g. genetic, species, ecosystem), and supports many varied use and non-use values. The term ‘biodiversity’ is very commonly used in academia, resource management, and in the media. Many people may be familiar with the term, but unsure as to its exact meaning, making it important for the term to be defined as accurately as possible to make sure respondents know what they are valuing. Conservation of biodiversity is also a forest management objective for the OMNR, which was another argument in favour of its inclusion as an Ecological Service.

Nutrient Cycles and Carbon Storage were included as attributes in order to include a more global perspective on ecological services. Since many ecological services provide benefits at many different spatial and temporal scales, these attributes attempt to value the importance of ecological services that provide benefits that are less obvious at a local, short-term scale.

Earlier versions of the instrument included Air Quality and Water Quality as Ecological Services. Air Quality was discarded because on a local scale, Air Quality is largely insensitive to forest management activities. Water Quality was also discarded because it partially overlaps with the Fish Habitat attribute.

Specifying measures for the various Ecological Services also presented a number of challenges. Pre-testing indicated that a measure that might be meaningful to a wildlife biologist, such as the density of a moose population, might not mean anything to the average hunter who simply wants to know his/her chances of getting a moose next hunting season. Other measures, such as the mass of carbon absorbed per hectare of forests would be equally meaningless to most respondents. Also, six different measures for each one of the Ecological Services would make the response task rather complex.

To simplify things, one common scale was developed for measuring all of the Ecological Services. The basic notion for this scale was modelled after a production function approach, in which the amount or level of each Ecological Service was considered a function of both the underlying natural conditions of the forest (e.g. ecological productivity) and the management applied to that area. It is assumed that in the absence of any human interference, each Ecological Service would be produced at the natural level. This level would vary from site to site, depending on the particular characteristics of each site. Obviously, since human activities have global impacts, there are no longer any areas on Earth that are truly free from human impact. Additionally, many ecosystems are dynamic, and change over time even in the absence of human influences (Christensen et al., 1996). Despite the practical impossibilities of determining exactly what is 'natural,' the ecological condition of many parts of northern Ontario may still be considered close to 'natural'. Management activities in an area will change the level at which each Ecological Service is produced. Some activities may increase the production of one or more Ecological Services beyond the 'natural' level up to a theoretical maximum based on the underlying productivity of the site. Similarly, management activities may also decrease or impair the production of other Ecological Services. Many management activities will increase some Ecological Services, while decreasing others. This approach results in a scale made up of the five levels listed in Table 3.1. As mentioned above, this scale represents a compromise, simplifying the task for respondents as much as possible, while at the same time provide a meaningful basis from which to evaluate each benefit.

3.2.1.2 COMMUNITY PROFILE—SOCIAL

Especially in single industry communities of the Canadian periphery, community stability and social concerns in general are very important. Social and economic community profiles actually are an important piece of information in the forest management planning process, and the Criteria and Indicators framework also includes some social and economic measures. All the Social attributes were described in terms of the percentage change from the current community situation. It was felt that these relative measures would provide more useful information to respondents than the absolute numbers (e.g. # of crimes / population) would provide. One reason for using relative numbers is that many people may not be aware of the exact statistics for their own community. In these cases, individuals are likely to still have a general impression about the acceptability of the current levels of attributes such as crime and medical care, and the types of changes they desire or find acceptable for these attributes.

Undoubtedly, forest management alone does not determine the future levels of these social and economic attributes. However, these attributes were included to try to provide a more complete picture of the different benefits that come from forests, and to determine the tradeoffs that people are willing to make among Ecological, Social, and Economic benefits.

3.2.1.3 Community Profile—Economic

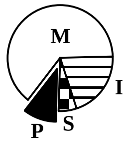
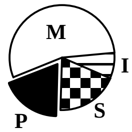
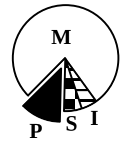
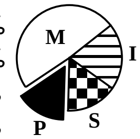
As with the Social attributes, all of the Economic attributes were described as a percentage change from the current situation in the community. A particular emphasis of this section was to measure the benefits provided by forest dependent jobs that arise from resource use and/or resource preservation. These attributes were also an attempt to determine the importance of the economic diversity within a community, which is often measured as the percentage of the workforce employed in major industries. The study did not identify the percentage of the workforce employed in mining. In mining-dependent communities, there may be low percentages of the population employed in both forestry and tourism, indicating a diverse economy, when in fact, most of the employment is concentrated in mining, meaning that the economy is actually less diverse than shown in the profiles of this DCE.

During the survey design stages it became obvious that in addition to the Ecological, Social, and Economic attributes, a reference to landuse and access regulations might significantly influence respondents' evaluations of Outcome scenarios. These additional attributes were included in the manner described below.

3.2.1.4 Landuse Allocation

The difficulty when describing landuses in simple terms for the DCE survey was that one needed to describe several types of landuses and also specify the amount or proportion land under any one of the management regimes. Therefore, an early survey question was used to develop the relevant concepts. In that question, respondents were familiarised with four general landuse types: multiple use; intensive forestry; special management; parks & protected areas, which actually overlapped broadly with the main categories in the LFL process (see section 3.2.4). These four landuse types could be combined to form any number of possible patterns of landuse. To simplify the choice task for respondents, we included only four landuse patterns in the DCE. Each pattern was given a descriptive name; the early survey question presented the pattern in a pie chart (Figure 3.2), and repeated on a removable glossary sheet (an insert) in the questionnaire, but only the name appeared in each Outcome.

Figure 3.2 Landuse patterns

Pattern 1: Timber Harvest	Pattern 2: Preservation	Pattern 3: Integration of Uses	Pattern 4: Separation of Uses
M 65% I 20% S 5% P 10% 	M 56% I 8% S 18% P 18% 	M 78% I 5% S 5% P 12% 	M 50% I 20% S 15% P 15% 

M = Multiple Use
I = Intensive Forestry
S = Special Management
P = Parks & Protected Areas

3.2.1.5 Access & Recreation

In RSVP, access was used as a means of describing the types of recreation opportunities available around respondents' communities. This concept is drawn from the Recreation Opportunity Spectrum (ROS) (Clark & Stankey, 1978), in which potential recreation sites are classified along the following continuum:

1. wilderness
2. semi-primitive non-motorized
3. semi-primitive motorized
4. roaded natural
5. rural, and
6. urban

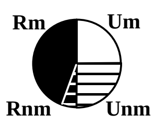
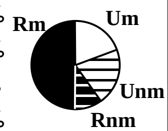
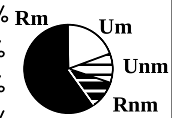
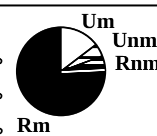
These ROS classes are based on the distance of a potential recreation site from a road, as well as on the types of activities permitted and the degree of development of trails and other facilities.

For RSVP, the ROS framework was adapted by describing the lands around the respondents' communities with two parameters: presence or absence or roads; and, whether or not motorised use is permitted. This emphasis on access is warranted because of the role that intensity and type of access plays on the availability and final characteristics of various recreation opportunities.

Roads provide easy access for many kinds of recreation, and as such can enhance the recreation opportunities available in an area. Roads can also have a negative impact on some types of outdoor recreation, particularly on activities such as canoeing and backpacking in which the remote and wilderness characteristics of an area can be an important part of the recreation experience. Similarly, motorised vehicles such as cars and trucks, snowmobiles, and all terrain vehicles can provide quick and easy access both on and off roads to remote areas (Hunt, Twynam, Haider, & Robinson, 2000). Implicitly, a respondent decided from the mixture of areas that are road accessible and/or motorised, whether the landscape was suitable for his/her preferred types of recreation. Pretests showed that respondents had no difficulty with this task.

The Access & Recreation section of the DCE followed the same format as the Landuse Allocation section. Four types of access (Unroaded Motorised, Unroaded Non-motorised, Roaded Non-motorised, Roaded Motorised) were presented to respondents in an earlier question about Access (see Section 3.2.5). These four access types were combined to form the four access patterns included in the DCE. These access patterns were labelled along a continuum from Low Access to High Access, and one of these labels appeared in each Outcome. As with the Landuse Patterns, the Access Patterns were included on the removable glossary sheet in each questionnaire (see Figure 3.3).

Figure 3.3 Access patterns

Pattern 1: Low Access	**Pattern 2: Moderately Low Access**	**Pattern 3: Moderately High Access**	**Pattern 4: High Access**
Um 25% **Unm** 25% **Rnm** 5% **Rm** 45% 	**Um** 20% **Unm** 20% **Rnm** 10% **Rm** 50% 	**Um** 20% **Unm** 10% **Rnm** 10% **Rm** 60% 	**Um** 15% **Unm** 5% **Rnm** 5% **Rm** 75% 

Um = Unroaded Motorised
Unm = Unroaded Non-motorised
Rnm = Roaded Non-motorised
Rm = Roaded Motorised

3.2.1.6 Payment Vehicle

Although many choice experiments contain some sort of a payment vehicle, it was eventually decided that the RSVP instrument would work best without a payment vehicle. An argument in favour of including a payment vehicle is that it makes the costs to the respondents more explicit, thus creating a more realistic choice scenario; a payment vehicle would also allow Willingness to Pay (WTP) estimates to be calculated for each attribute, and for different outcomes. Resource management decision-makers can make use of such economic valuation information when making policy decisions. The payment vehicles used in choice experiments and other environmental valuation studies (e.g. CVM) usually consist of some type of tax, which may be specifically earmarked to pay for the proposed environmental improvement (see Section 2.4.5.1). Other problems were that including a cost variable would have increased the complexity of the response task significantly, and during pre-tests it became apparent that that no realistic payment vehicle could be specified for the design that emerged. Finally, the analyses can effectively proceed without monetaried estimates of attribute level importance. In fact, the PWUs represent generic preference measures that are scalars of monetary values (Louviere et al., 2000).

3.2.1.7 Outcomes, Choice Sets, & the Partial Design

The attributes described above were presented to respondents in profiles of forest management Outcomes. The full design of the DCE included six Ecological Services and four each of the Social and Economic attributes. However, since the pre-tests suggested that the resulting Outcomes were too complex for respondents to be able to make meaningful tradeoffs, a partial design was adopted for the DCE. In the partial design, each Outcome contained only three Ecological, two Social, and two Economic attributes, along with the Landuse and Access attributes. Each choice set consisted of two of these Outcomes, and each respondent evaluated eight choice sets. Since the fractional factorial design required a total of 64 choice sets for estimating all main effects, eight different versions of the DCE needed to be developed. Examples of the choice sets can be found in Appendix A. Each version of eight choice sets also included two common choice sets, which were identical across all versions of the questionnaire. The Outcomes in these two common sets contained all six Ecological Services, and all four of both the Social and Economic attributes. They were presented as the last two choice sets; it was felt that after having completed eight partial choices, the respondents would be able to easily respond to the full profiles.

3.2.2 Outdoor Recreation Participation

This first section of the survey instrument consisted of a list of common outdoor recreation activities. For each activity, respondents were asked to indicate the number of days they had participated in that activity during the previous year, as well as the usual distance travelled to participate in each activity.

This section was relatively simple and straightforward, and was partially intended to initiate respondents into the survey with a question on a topic that is usually enjoyable to most people. In hindsight, a different first question should have been used since the activity question seemed to cause a number of potential respondents to disqualify themselves from the survey. Several respondents commented that they were too old or inactive to participate in outdoor recreation activities, and therefore the survey did not apply to them (37.8% of the 82 non-respondents who gave a reason for not-responding cited being too old or inactive as their reason for not responding). A more appropriate first question might have been one more closely related to the overall purpose of the study, namely measuring forest values.

3.2.3 Ecological Services

In this section of the questionnaire, respondents were familiarised with the same six Ecological Services that were later used in the DCE. Each Ecological Service was defined in detail, and the respondent was then asked to rate the importance of the service on a scale of one (i.e., not at all important) to five (i.e., extremely important). The main purpose of this question was not to obtain detailed ratings but rather to familiarise the respondents with the various concepts and to describe the Ecological Services. Therefore, respondents should have been better able to make tradeoffs among the services in the DCE that followed.

During pre-testing, several respondents were concerned about the length of the Ecological Services definitions. Therefore, two different versions of the Ecological Services definitions were used in the study. Half the sample received short definitions of Ecological Services in which the services were simply defined. The other half of the sample received longer definitions in which the importance of each Ecological Service was also described. This enabled testing for an "information effect" in which the type of information provided to the respondent actually influences the value they place on the ecological services (Arrow et al., 1993).

3.2.4 LANDUSE

In the Landuse section of the survey, four types of landuse were defined (see description above). The respondent was provided with the current pattern of these landuses in northern Ontario, and was then asked to provide his/her ideal pattern of landuses both around her/his community and throughout northern Ontario. As with the Ecological Services section of the survey, an important purpose of the Landuse section was to familiarise respondents with the various possible landuse types that were used in the DCE.

3.2.5 ACCESS AND RECREATION

The Access and Recreation section of the survey was structured in the same way as the Landuse section. Four types of access were described, and the respondent was asked to indicate the ideal patterns of access both around his/her community and throughout northern Ontario.

3.2.6 SOCIODEMOGRAPHICS

The final section of the questionnaire asked respondents a series of sociodemographic questions. These questions were intended to allow comparisons between various segments of the survey population and to compare the sample to the population. The last page of the survey instrument provided space for respondents to add any comments they might have about forest management in northern Ontario or about the questionnaire.

3.3 CONDUCTING THE SURVEY

The population for the RSVP survey was defined as all residents of northern Ontario, which was defined as the area north of the French River (south of Sudbury). The sample for the survey was obtained by purchasing a mailing list of randomly selected residents of northern Ontario. The sample was stratified into residence segments (*Rural* and *Urban*) according to Forward Sortation Area (FSA—the first 3 digits of the postal code). The *Urban* segment consisted of residents of Thunder Bay, Sault Ste. Marie, Sudbury, Timmins, and North Bay. All other addresses were considered part of the *Rural* segment (see Table 3.2). The initial sample size was 2784 households.

Table 3.2 Residence segments

Segment	Forward Sortation Areas	Description
Rural	P0H, P0J, P0K, P0L, P0M, P0N, P0R, P0S, P0T, P0V, P0W, P0X, P2N, P3L, P3N, P3P, P3Y, P5A, P5E, P5N, P8N, P8T, P9A, P9N	All communities in Northern Ontario (excluding urban centres listed below) located North of the French River.
Urban	P1A, P1B, P1C, P3A, P3B, P3C, P3E, P3G, P4N, P4P, P4R, P6A, P6B, P6C, P7A, P7B, P7C, P7E, P7G, P7J, P7K	North Bay (including Sturgeon Falls), Sault Ste. Marie, Sudbury (including Estaire), Thunder Bay (including Cloud Bay), Timmins

The survey was conducted using a modified version of the Tailored Design Method (Dillman, 2000). The methodology involved three stages: initial mailing; reminder postcard; replacement survey.

1. Initial mailing: The initial mailing consisted of a cover letter introducing the project and the questionnaire, the survey instrument, and a business reply envelope for returning the questionnaire. A one-dollar coin was attached to each cover letter as an incentive to encourage people to complete the questionnaire.
2. Reminder postcard: Approximately one week after the initial mailing, a postcard was sent to every person on the mailing list to remind people to complete the survey. The timing of this postcard was such that most people would still have the initial survey instrument on hand, but they might not have completed it yet.
3. Replacement survey: Four weeks after the initial mailing, a package containing a replacement survey, a cover letter, and a business reply envelope was sent to all people who had not yet responded to the initial mailing.

3.4 DATA ANALYSIS

Most of the analysis was performed in SPSS. Limdep 7.0 (Greene, 1998) was used to estimate the various DCE models upon which much of the discussion in this paper is based. Based on the PWU estimates from the DCE, a computerised decision support system (DSS) was designed in Microsoft Excel. This DSS was then used to predict the level of public support for various management outcomes, as well as to predict the changes in public support that would result for changes in the various attributes.

3.4.1 PART WORTH UTILITY ESTIMATES

As discussed in Section 3.1, the PWU estimates can be obtained using a variety of different coding schemes. In RSVP, the four Landuse and Access attributes are categorical variables and were estimated using effects coding. The Social and Economic attributes are treated as continuous variables in the analysis. The Ecological Services attributes were defined on a graphic scale, and therefore may also be treated as continuous for the purpose of this analysis.

The PWU for a continuous variable may take a number of different functional forms, including linear, quadratic, cubic, or some combination of the above. In order to determine the most appropriate functional form for each attribute, models were estimated using single linear, double linear, and linear-quadratic functional forms[10]. For the Ecological Services, a combined linear-quadratic model form best represented the utility functions of each attribute. For the Social attributes, a single linear form was the most appropriate. The Economic attributes did not fit one standard model form as well as either of the first two sets of attributes, but the linear-quadratic form appeared to be best suited for them.

3.4.2 SEGMENTATIONS

To better understand the differences in response behaviour among various segments of the population, the sample was segmented in several ways and separate models were estimated for each segment. These models were then compared using a t-statistic to test for significant differences in parameter estimates between segments. The t-statistic is calculated according to the following equation:

---

[10] The single linear model contained only one linear estimate for each attribute. The double linear model contained two separate linear estimates for each attribute. For the Ecological Services, the first linear estimate represented the PWU from ‘significantly impaired’ to ‘at the natural level’, while the second estimate represented the PWU from ‘at the natural level’ to ‘at the maximum possible.’ For the Social and Economic attributes, the first linear estimate represented the PWU from ‘–20%’ to ‘no change’, while the second estimates referred to the PWU from ‘no change’ to ‘+20%’. Finally, the linear-quadratic model combines both a linear and quadratic estimate for each attribute.

$$t = \frac{\beta_1 - \beta_2}{\sqrt{(SE_1)^2 + (SE_2)^2}} \qquad (7)$$

where β_1 and β_2 are the parameter estimates for the same attribute for two different segments of the sample and SE_1 and SE_2 are the standard error terms associated with the respective parameter estimates. A t-statistic of 1.96 or greater indicates that the parameter estimates for the two segments are significantly different at $p<0.05$.

Two a priori segmentations were built into the survey design (by residence and by survey version). Further segmentations were undertaken during analysis based on the responses to various survey questions. The various segmentations are described below:

1. Segmentation by Preferred Outcome: *Economic* vs. *Environmental*. This segmentation divides respondents according to which Outcome they selected in Choice Set 10. This choice set was common to all versions of the survey instrument, and essentially forced respondents to choose between an Outcome in which the Social and Economic attributes were at high levels and the Ecological Services attributes were at low levels (Outcome A), and an Outcome in which the Ecological Services attributes were high while the Social and Economic attributes were less favourable (Outcome B). It will become apparent during the following analysis that this segmentation in effect differentiates between respondents who place more importance on social and economic factors (the "*Economic*" segment), and those who place more importance on environmental factors (the "*Environmental*" segment).
2. Segmentation by Land Allocation: *Less* vs. *More* Parks. This segmentation divides the sample according to the amount of land respondents would ideally like to see designated as parks and protected areas. The "*More Parks*" segment consists of people who indicated that they would like to see more than the current 12% of the land protected, both around their communities and throughout Northern Ontario. The "*Less Parks*" segment consists of those respondents who would prefer the amount of protected areas to be 12% or less.
3. Segmentation by Recreation Participation: *Consumptive* vs. *Non-consumptive*. Many of the recreation activities listed in the first question of the questionnaire can be classified into consumptive (i.e. a resource is consumed by the activity) or non-consumptive. Previous research has shown that a useful segmentation is to combine motorised and consumptive recreation into one segment, and to make non-consumptive recreation the other segment (Hunt et al., 2000). Respondents were divided into segments depending on whether they participated more often in

consumptive and motorised activities or in non-consumptive activities. The recreation activities were categorised as follows:

Consumptive and Motorised
- motor boating (without fishing)
- fishing from boat (for pickerel, pike, bass)
- fishing from boat (for laketrout)
- fishing from shore
- fishing on ice
- big game hunting (moose/deer/bear)
- small game hunting (grouse/ducks/rabbits)
- snowmobiling
- driving all terrain vehicles (ATVs)

Non-consumptive
- day hiking and nature walking
- backpacking (multi-day)
- canoeing / kayaking
- wildlife viewing or study
- landscape photography or art
- bird watching
- cross-country skiing
- mountain biking

The remaining recreation activities were not classified as either consumptive or non-consumptive. The determination of which category each respondent fell into was made using the following method. First, for each recreation activity, the responses were standardised to z-scores[11]. Next, these z-scores for each respondent were summed separately for each of the two categories. These sums were then divided by the number of activities in each segment, resulting in participation scores for each of the two categories. Finally, each respondent was placed into the segment corresponding to the category of recreation activities for which she/he had the higher participation score.

4. Segmentation by Residence: *Rural* vs. *Urban* residents (see Table 3.2).
5. Segmentation by Survey Version: *Long* vs. *Short* ecological services definitions. As discussed in Section 3.2.3, the half the sample received surveys with long definitions for each ecological service, while the other half received short definitions.

For the purposes of this research project, I will focus mainly on the segmentation by Preferred Outcome, though other segmentations will be mentioned whenever they provide useful insights into the values and

[11] A z-score is "a score that represents the deviation of a specific score from the mean and is expressed in standard deviation units" (Runyon & Haber, 1991, p. 168).

preferences of northern Ontario residents. The segmentation by Survey Version did not reveal a clear information effect, so no results will be discussed for this segmentation.[12]

3.5 COMPUTERISED DECISION SUPPORT SYSTEM

The PWU estimates from the DCE were used to create a computerised DSS in Microsoft Excel. The user interface of this DSS is similar in appearance to the holdout sets from the DCE (i.e. it lists all attributes rather then a selected subset, as was the case in the partial design). The DSS consists of two Outcomes, each made up of all the attributes used in the DCE. The user can set the levels of the various attributes for each Outcome. For each attribute, the DSS multiplies the level of the attribute by the appropriate parameter estimate (from Limdep) to obtain the PWU for that attribute. The PWUs for each attribute are summed to calculate the utility for each Outcome. The DSS then uses the MNL model (see Equation 4 in Section 3.1) to predict the probability that each Outcome will be selected. These probabilities represent the 'market share' or 'percent of public support' that each Outcome would receive. This DSS is intended as a tool for resource managers which would enable them to predict the level of public support for proposed management plans or activities. The DSS can also be used to determine the change in public support that would result from a change in any one attribute. Examples of the application of the DSS are explained in Chapter Five.

In this Chapter, the methodology of DCEs has been explained along with details of how the methods have been applied to the RSVP project. Physical measures of ecosystem and community conditions were converted into ecological, social, and economic attributes which were evaluated by respondents in the DCE.

---

[12] The segmentation by Survey Version was intended to reveal whether or not there was an "information effect", whereby different definitions for each ecological service would influence the way in which people responded to some or all of the other questions in the survey. The most obvious question where an information effect would be apparent is Question 3, where the respondents provided importance ratings for each ecological service. An information effect would likely be revealed by differences in the ratings provided by individuals receiving each of the two types of definitions. The results are inconclusive but suggest that there may be some kind of information effect occurring. The *Short* segment rated the first three ecological services as more important than did the *Long* segment. For the remaining three ecological services, the reverse is true. One explanation for these results could be that in general, people are more familiar with the concept of habitat for various species, but are less familiar with the other ecological services. Those people who received the short definitions then placed more importance on the services with which they were familiar, and less importance on the other services. By providing the other segment with longer definitions, these respondents may have become more familiar with the other ecological services, and thus rated them more highly. The other section where an information effect may have been present was in the DCE. Since one of the purposes of defining the ecological services in Question 3 was to familiarise the respondents with these definitions in order to help them for the DCE, an information effect resulting from the different definitions should carry over into the DCE, particularly in the PWU functions for Ecological Services. There were no significant differences between the Survey Version segments in any of the Ecological Services estimates, suggesting that no information effect was present in the DCE.

CHAPTER FOUR: RESULTS

Overall, the results of the RSVP survey show that forest management is an issue that concerns many residents of northern Ontario. The DCE revealed that most respondents placed a lot of importance on ensuring that all the various Ecological Services are maintained at close to the natural level, even if this means trading off some Social and Economic benefits. Results from other sections of the survey reveal that despite some differences between various segments of the population, residents of northern Ontario desire to have more protected areas, to have a stable level of employment from both forestry and tourism, and to ensure that local residents have the right to access forested land.

In this Chapter, the results of the RSVP survey are presented in detail. The Chapter begins with a summary of the sociodemographic results of the sample, followed by an overview of the results of the various preliminary sections of the RSVP survey. The results of the DCE are presented next. As described in Chapter Three, the DCE consisted of Ecological, Social, and Economic attributes, along with Landuse and Access attributes. The results for each of these types of attributes will be discussed in the order in which they appeared in the DCE. In each section, the results of the entire sample are presented first, followed by the results of one or more relevant segmentations.

4.1 SOCIODEMOGRAPHIC CHARACTERISTICS

Many sociodemographic characteristics of the respondents were obtained in the final section of the questionnaire. In Table 4.1, the sociodemographic results of the sample are compared with selected sociodemographic statistics for Ontario as a whole[13]. The initial sample was split evenly between rural and urban residents and this split carried through into the surveys that were returned. Rural residents accounted for 50.3% of respondents, while 49.6% were urban residents. One respondent obscured the identification number on the return envelope, and thus could not be classified as either rural or urban.

The respondents were not gender balanced, with 71.6% of the respondents being males. The population of Ontario is only 48.9% males. A likely reason for this pattern is that the names on the mailing list reflected the names of people registered for telephones, which apparently are dominated by males. While the mailing list only provided initials for many of the people in the sample, for entrees with full first names, the dominance of male names was apparent.

---

[13] The results from RSVP are compared to Ontario as a whole, since detailed sociodemographic information is not available specific to northern Ontario. The data in Table 4.1 comes from Statistics Canada and is based on the 1996 and 2001 Census data. This data is available at www12.statcan.ca/english/census01/release/index.cfm.

Table 4.1 Sociodemographic characteristics of the sample and for the population of Ontario

Sociodemographic Characteristic	sample (%)	Ontario (%)	Sociodemographic Characteristic	sample (%)	Ontario (%)
Rural or Urban (N=915)			**Employment status (N=845)**		
Rural	50.3	50.1	Unemployed	2.2	4.2
Urban	49.6	49.9	Retired	31.1	-
Unknown	0.1	-	Homemaker	3.4	-
			Student	2.5	-
			Total not in labour force	37.0	32.7
Gender (N=877)					
male	71.6	48.9	Full-time employment	50.7	-
female	28.4	51.1	Part-time employment	7.0	-
			Seasonal employment	3.1	-
Age Category (N=882)			Total employed	60.8	63.1
18-29	7.9	20.1			
30-39	17.2	20.9	**Employment sector (N=531)**		
40-49	24.9	21.0	Agriculture	1.5	
50-59	20.2	15.6	Forestry / forest industry	15.1	
60-69	17.1	10.5	Mining and prospecting	7.5	
70 or over	12.6	12.0	Other industries	7.7	
			Public sector	31.1	
Highest level of education (N=870)			Tourism or recreation	2.3	
Completed elementary	6.8	-	Other service industries	16.0	
Some high school	13.1	-	Professional	4.1	
Total less than high school	19.9	35.0	Other	14.7	
Completed high school	20.8	23.8			
Technical / college	30.0	24.3	**Household income in 2000 (N=799)**		
Some university	9.3	-	Under $30 000	22.3	
Completed university	13.7	11.5	$30 000 - $49 999	26.4	
Postgraduate study	6.3	5.4	$50 000 - $69 999	24.9	
			$70 000 - $89 999	13.9	
			$90 000 or over	12.5	

Source: Statistics Canada 1996 and 2001 Census data. Available at: www12.statcan.ca/english/census01/release/index.cfm

The age of respondents to this survey appears to be higher than would be representative of the general population in northern Ontario. Almost 30% of respondents were over age 60; in Ontario as a whole, 22.5% of the population is over age 65. Similarly, less than 8% of respondents were under age 30, while over 20% of the population of Ontario is between 18 and 29 years of age. It is impossible to determine if this bias relates to a coverage error in the mailing list or a response bias to the survey. However, it is likely that part of the reason for the high percentage of older respondents was due to the complexity of the survey instrument. Since some respondents commented that the questionnaire took between 45 and 60 minutes to complete, it could have been that older respondents may have had more free time, and thus were more likely to complete the survey. This aspect is further supported by the finding that 31.1% of respondents were retired (and thus would also likely have had more free time than employed people). Another possible, but unlikely, explanation is that older respondents are more interested in forest management.

In terms of education, 40.7% of respondents had no post-secondary education, 30.0% had college or technical training, and 29.3% had some university education. It is interesting that although many respondents indicated that the questionnaire was quite complex, many respondents with relatively low levels of formal education were able to complete the survey. On the whole, the sample seems to be slightly biased towards more highly educated people.

The most common employment sector for the respondents was the public sector (31.1%), followed by service industries (16.0%) and the forest industry (15.1%). Only 2.3% of respondents indicated employment in tourism or recreation, which was too small of a sample size to allow comparisons between specific employment sectors such as tourism versus forestry workers, for example.

Respondents were also asked to provide their household income for the year 2000. While a number of respondents refused to provide this information (12,7%), this was the only sociodemographic variable that did not produce significant differences between segments in any of the segmentations. The average household income for the sample was estimated to be $52 576 for the year 2000. This is relatively close to the average household income for Ontario for 2001 of $54 291.

4.1.1 Differences in Sociodemographic Characteristics Between Segments

Table 4.2 shows those segmentations for which there are significant differences between segments for the various sociodemographic characteristics. There were significant differences in the level of education and the employment status between the *Economic* and *Environmental* segments. More respondents in the *Environmental* segment had at least some university education (35.8%) than did respondents in the *Economic* segment (24.8%). *Economic* segment respondents, on the other hand, were more likely to have a technical or college education (34.0%), than were respondents from the *Environmental* segment (27.8%). This suggests that more highly educated people tended to place a greater importance on environmental benefits instead of on social and economic benefits. The *Environmental* segment had more retired (31.1%) and student (3.9%) respondents than did the *Economic* segment (25.1% retired, 1.4% students). Similarly, the *Economic* segment had more respondents in full-time employment (57.5%) than did the *Environmental* segment (48.8%). This suggests that people in the workforce were more likely to select an Outcome that provided greater social and economic benefits over an Outcome that provided mainly environmental benefits.

The Segmentation by Land Allocation reveals a different pattern of sociodemographic characteristics than the previous segmentation. The *More Parks* segment consisted of more urban residents and more females than the *Less Parks* segment. Although these trends were present in the Segmentation by

Preferred Outcome, the differences were not significant. In the Segmentation by Land Allocation, the employment status was not significantly different between segments, yet the employment sector was significantly different. The most striking difference between segments was in the percent of respondents employed in the forest industry (*Less Parks*=23.8%; *More Parks*=9.8%). This suggests that many people in the forest industry view parks and protected areas as a threat to their livelihood, since logging is generally not permitted in parks or protected areas.

Table 4.2 Significant differences in sociodemographic characteristics between segments

Sociodemographic Characteristic	Preferred Outcome	Land Allocation	Recreation Participation	Residence
Residence		X	X	N/A
Gender	(X)	X	X	
Age Category				X
Highest Level of Education	X		X	X
Employment Status	X		X	X
Employment Sector		X	X	X
Household income in 2000				(X)

*An X indicates variables for which there was a significant ($p<0.05$) chi-squared difference between segments. An X in parentheses indicates a difference that was significant only at $p<0.10$.

The Segmentation by Recreation Participation reveals the greatest number of significant differences in sociodemographic variables between segments. The *Consumptive* segment consisted of significantly more rural residents, more males, more lower-educated people, more employed people, and more people employed in resource sectors of the economy than did the *Non-consumptive* segment.

The Segmentation by Residence showed significant differences in only two sociodemographic variables, the level of education and the employment sector. In general, *Rural* residents had lower levels of formal education than did *Urban* residents. *Rural* residents were more likely to be employed in resource-based industries such as forestry and mining. More *Urban* residents were employed in other industries, and in the service industry. This finding is consistent with general employment trends in northern Ontario, where most small communities are resource-dependent. Urban centres are also resource-dependent, but generally have more diversified economies than most small communities.

<u>4.2 RECREATION</u>

Almost all respondents (92%) indicated that they participated in at least some form of outdoor recreation for at least one day during the year 2000. The mean recreation participation was quite high at 76.7 days, while the median was 60.5 days. When interpreting these levels of participation, it is important to keep several factors in mind: some sample members who did not participate in any recreation activities chose not to complete the survey; additionally, some respondents may have participated in more than one activity on a particular day (e.g. hunting, ATV-driving, and camping on crown land). Thus, the actual number of days of recreation participation in the study population may be somewhat lower than the above figures suggest.

Table 4.3 Recreation participation and mean days of participation during 2000

Recreation Activity	N	% of respondents who participated	Mean days of participation
Consumptive or Motorised			
Motor boating (without fishing)	900	46.4	9.8
Fishing from boat (for pickerel, pike, bass)	900	58.4	12.9
Fishing from boat (for laketrout)	902	29.3	8.5
Fishing from shore	902	38.0	8.4
Fishing on ice	899	34.7	9.5
Big game hunting (moose/deer/bear)	900	23.6	12.5
Small game hunting (grouse/ducks/rabbits)	901	32.4	11.9
Snowmobiling	899	32.9	13.7
Driving all terrain vehicles (ATVs)	903	25.7	13.5
Non-consumptive			
Day hiking and nature walking	902	64.6	12.6
Backpacking (multi-day)	900	10.9	6.2
Canoeing / kayaking	903	29.9	7.9
Wildlife viewing or study	901	37.7	10.7
Landscape photography or art	902	21.4	8.1
Bird watching	903	32.2	14.0
Cross-country skiing	901	20.0	10.5
Mountain biking	901	19.5	12.8
Not Classified			
Gathering (berries / mushrooms etc.)	899	56.5	6.2
Cutting fuelwood / firewood	901	37.4	9.3
Camping on private land (campground)	903	28.0	11.6
Camping in parks	902	28.4	8.1
Camping on crown land	902	24.9	9.6

The mean days of participation were calculated using the midpoint of each category as the number of days (i.e. 1-4 days scored as 2.5 days, 5-9 days as 7 days, 10-24 days as 17 days, and >25 days as 27 days).

In terms of the percent of respondents participating, the most popular recreation activities were day hiking / nature walking, fishing for pickerel, pike and bass from a boat, and gathering berries. The least popular activities were backpacking, mountain biking, and cross country skiing. Another way of looking at recreation participation is to look at the frequency of participation. For those respondents who participated in a particular activity, the average days of participation during 2000 were calculated. The most popular activities in terms of mean days of participation were birdwatching, snowmobiling, ATV-driving, and fishing for pickerel, pike and bass from a boat. The least popular activities were gathering berries, backpacking, and canoeing / kayaking. The percent of respondents participating and the mean days of participation in 2000 are shown in Table 4.3.

4.3 IMPORTANCE RATINGS OF ECOLOGICAL SERVICES

In the second section of the survey, respondents were asked to rate the importance of the various Ecological Services on a five-point scale, with 1 being "not at all important" and 5 being "extremely important." The mean importance ratings for the entire sample ranged from 4.05 for Biodiversity to 4.46 for Wildlife Habitat (see Table 4.4), suggesting that as a whole, respondents considered all of the Ecological Services as highly important. These results are not particularly meaningful on their own. Simply knowing that a respondent considers a particular Ecological Service to be 'extremely important' does not provide much information about the tradeoffs he/she is willing to make between a particular Ecological Service and any other attribute. These results will be discussed further in Section 4.6.1 as part of the discussion of the DCE results.

Table 4.4 Mean importance ratings for Ecological Services

Ecological Service	N	Mean Importance*	Std. Deviation
Fish habitat	898	4.44	0.83
Wildlife habitat	899	4.46	0.81
Rare & endangered species habitat	890	4.43	0.91
Biodiversity	878	4.05	1.00
Nutrient cycles	886	4.07	1.00
Carbon storage	889	4.30	0.92

*Measured on a 5-point scale, 1="Not at all Important" to 5="Extremely Important"

Table 4.5 summarises the significant differences in importance ratings of Ecological Services for the various segmentations. The Segmentation by Preferred Outcome produces the most consistent results, with the *Environmental* segment rating all six Ecological Services as more important than did the *Economic* segment. Only the segmentation by residence appears to be associated with only one difference, which might be considered a spurious result.

Table 4.5 Significant differences in mean importance ratings of Ecological Services between segments

Ecological Service	Preferred Outcome	Land Allocation	Recreation Participation	Residence
Fish habitat	*Environmental*		*Consumptive*	
Wildlife habitat	*Environmental*	*(More Parks)*		
Rare & endangered species habitat	*Environmental*	*More Parks*	*Non-consumptive*	
Biodiversity	*Environmental*	*More Parks*	*Non-consumptive*	*Urban*
Nutrient cycles	*Environmental*	*More Parks*	*Non-consumptive*	
Carbon storage	*Environmental*	*More Parks*	*Non-consumptive*	

*For those Ecological Services for which there was a significant ($p<0.05$) difference in mean importance ratings between segments, the segment which gave the higher mean rating is listed. Segments listed in parentheses indicate a difference that was significant only at $p<0.10$.

For the Segmentation by Recreation Participation, the results are more varied. As to be expected, the *Non-consumptive* segment rated the last four Ecological Services as significantly ($p<0.05$) more important than did the *Consumptive* segment. However, the two remaining Ecological Services, Fish Habitat and Wildlife Habitat, are both directly related to the abundance of game and fish and therefore should be deemed more important by the *Consumptive* segment. This is the case for Fish Habitat (significant at $p<0.05$) but no significant difference is observed for Wildlife Habitat. It appears that the *Non-consumptive* segment rates all the Ecological Services as being important, perhaps because these Ecological Services lead to an overall healthy environment or provide general benefits to society. The *Consumptive* segment, on the other hand, attributes more importance to those particular Ecological Services which benefit them directly and less importance to the other Ecological Services.

4.4 IDEAL LANDUSE PATTERNS

Respondents were asked to provide their own ideal pattern of landuse both for the area around their community and for all of northern Ontario (Table 4.6). Overall, respondents indicated that they would prefer to see less land within multiple use areas and more land designated specifically for the other three types of landuse. Interestingly, even though the percentage of land contained within parks and protected areas in Ontario has recently been doubled to approximately 12% (OMNR, 1999), respondents would like still more land protected both around their community (21%) and throughout Northern Ontario (19%).

Table 4.6 Current and ideal patterns of Landuse

Landuse	N	Current % of Land	Median Ideal % of Land	Mean Ideal % of Land	Std. Deviation
Throughout Northern Ontario					
Multiple use areas	824	83	70	60.0	23.64
Intensive forestry areas	824	0	0	6.4	10.50
Special management areas	824	5	10	14.3	14.98
Parks & protected areas	824	12	15	19.4	14.09
Around Community					
Multiple use areas	826		65	57.3	25.64
Intensive forestry areas	826		0	5.9	10.57
Special management areas	826		10	15.7	16.27
Parks & protected areas	826		15	21.1	15.81

The ideal Landuse patterns were also compared for the various segments. Table 4.7 shows where significant ($p<0.05$) differences were found between the mean ideal Landuse percents reported by each segment. The obvious pattern is that the *Environmental*, *More Parks*, and *Non-consumptive* segments seem to share similar views. In addition, the urban segment also has a higher preference for parks and protected areas.

Table 4.7 Significant differences in preferences for ideal Landuse between segments

Ideal Landuse %	Preferred Outcome	Land Allocation	Recreation Participation	Residence
Throughout Northern Ontario				
Multiple use areas	*Economic*	*Less Parks*	*Consumptive*	
Intensive forestry areas		*Less Parks*		
Special management areas	*Environmental*	*More Parks*	*(Non-consumptive)*	
Parks & protected areas	*Environmental*	*More Parks*	*Non-consumptive*	*Urban*
Around Community				
Multiple use areas	*Economic*	*Less Parks*	*Consumptive*	*Rural*
Intensive forestry areas				
Special management areas	*Environmental*	*More Parks*	*Non-consumptive*	
Parks & protected areas	*Environmental*	*More Parks*	*Non-consumptive*	*Urban*

*For those landuse types for which there was a significant ($p<0.05$) difference in ideal percents between segments, the segment which had the higher ideal percent is listed. Segments listed in parentheses indicate a difference that was significant only at $p<0.10$.

4.5 IDEAL ACCESS PATTERNS

In the Access & Recreation section of the survey, respondents were asked to indicate their preferred pattern of access both around their community and throughout northern Ontario (Table 4.8). The access described here only applies to land outside of parks and protected areas, since most access within parks is controlled through park zoning and park master plans. Currently, there are no substantial areas outside of parks and protected areas in which motorised access is prohibited. This means that the current pattern of access consists only of unroaded motorised and roaded motorised areas, depending on the presence of roads. Respondents indicated that they would like to see between 6% and 8% of the land placed within each of the non-motorised classes. This would result in corresponding reductions in both types of motorised access.

Table 4.8 Current and ideal patterns of Access

Access	N	Current % of Land	Median Ideal % of Land	Mean Ideal % of Land	Std. Deviation
Throughout Northern Ontario					
Unroaded motorised	817	45	40	38.3	14.06
Unroaded non-motorised	817	0	0	7.2	11.89
Roaded non-motorised	817	0	0	6.7	11.11
Roaded motorised	817	55	50	47.9	15.23
Around Community					
Unroaded motorised	815		40	37.5	15.20
Unroaded non-motorised	815		0	7.8	12.60
Roaded non-motorised	815		0	7.3	12.08
Roaded motorised	815		50	47.4	16.82

Again these ideal Access patterns were also compared for the various segments. Table 4.9 summarises significant ($p<0.05$) differences between the respective segments. The results are rather similar when compared to the Landuse preferences, in that the *Environmental*, *More Parks*, and *Non-consumptive* segments seem to share similar views, with the *Urban* segment aligning with the *Non-consumptive* and *Environmental* perspective on this question.

Table 4.9 Significant differences in pattern for ideal Access between segments

Ideal Access %	Preferred Outcome	Land Allocation	Recreation Participation	Residence
Throughout Northern Ontario				
Unroaded motorised	*Economic*	*Less Parks*	*Consumptive*	*Rural*
Unroaded non-motorised	*Environmental*	*More Parks*	*Non-consumptive*	*Urban*
Roaded non-motorised	*Environmental*	*More Parks*	*Non-consumptive*	*Urban*
Roaded motorised	*Economic*	*Less Parks*	*Consumptive*	
Around Community				
Unroaded motorised	*Economic*	*Less Parks*	*Consumptive*	*Rural*
Unroaded non-motorised	*Environmental*	*More Parks*	*Non-consumptive*	*Urban*
Roaded non-motorised	*Environmental*	*More Parks*	*Non-consumptive*	*Urban*
Roaded motorised	*Economic*	*Less Parks*	*Consumptive*	

*For those access types for which there was a significant ($p<0.05$) difference in ideal percents between segments, the segment which had the higher ideal percent is listed. Segments listed in parentheses indicate a difference that was significant only at $p<0.10$.

4.6 FOREST MANAGEMENT OUTCOMES: THE DCE

The presentation of the results of the DCE below is organised in the same order and by the same grouping as the attributes appeared in each Outcome. For each group of attributes (e.g. Ecological Services), the PWU estimates are presented graphically. The results are discussed briefly and, where appropriate, they are compared to results from other relevant sections of the survey. Thereafter, the results of the various segmentations are presented. The complete model results for each segmentation are presented in Appendix B.

The parameter estimates for the entire DCE are tabulated in Table 4.10. The greatest number of significant results is found among the Ecological Services Attributes. The adjusted rho-squared serves as a measure of the overall goodness-of-fit of the model. The reported value of 0.078 is below the desired level 0.2, however due to the size and complexity of the DCE, this result was to be expected. A simpler model may have produced a better goodness-of-fit, but may not have resulted in as useful a management tool.

Table 4.10 PWU for DCE (full model)

Attribute		Parameter estimate	Standard error	t-value*
Ecological Services				
Fish Habitat	linear	0.185	0.021	**8.834**
	quadratic	0.061	0.016	**3.775**
Wildlife Habitat	linear	0.157	0.019	**8.177**
	quadratic	0.084	0.018	**4.766**
Rare & Endangered Species Habitat	linear	0.104	0.020	**5.146**
	quadratic	0.059	0.018	**3.267**
Biodiversity	linear	0.086	0.020	**4.396**
	quadratic	0.035	0.017	**2.035**
Nutrient Cycles	linear	0.106	0.019	**5.525**
	quadratic	0.005	0.017	0.321
Carbon Storage	linear	0.127	0.020	**6.270**
	quadratic	0.039	0.017	**2.310**
Community Profile—Social				
Population	linear	0.029	0.020	1.478
Crime Rate	linear	-0.083	0.021	**-3.933**
Quality of Medical Care	linear	0.161	0.019	**8.397**
Quality of Education	linear	0.136	0.022	**6.114**
Community Profile—Economic				
Unemployment Rate	linear	-0.035	0.020	-1.736
	quadratic	0.022	0.017	1.329
Average Household Income	linear	0.076	0.021	**3.625**
	quadratic	0.032	0.017	1.859
Employment in Forestry	linear	0.018	0.021	0.842
	quadratic	0.029	0.016	1.782
Employment in Tourism / Recreation	linear	0.112	0.020	**5.708**
	quadratic	0.039	0.018	**2.208**
Landuse Allocation				
Timber Harvest		*-0.196*	*0.040*	***-4.907***
Preservation		0.082	0.036	**2.293**
Integration of Uses		0.074	0.042	1.751
Separation of Uses		0.040	0.042	0.960
Park Classes				
few wilderness parks		*-0.013*	*0.021*	*-0.620*
mostly wilderness parks		0.013	0.021	0.620
Access & Recreation				
Low Access		*0.010*	*0.038*	*0.260*
Moderately Low Access		0.006	0.037	0.152
Moderately High Access		-0.023	0.038	-0.597
High Access		0.007	0.040	0.177
Access Restrictions				
no restrictions on access		*-0.046*	*0.034*	*-1.343*
no hunting in recent clearcuts		0.057	0.035	1.623
no access to certain remote lakes		-0.011	0.034	-0.312

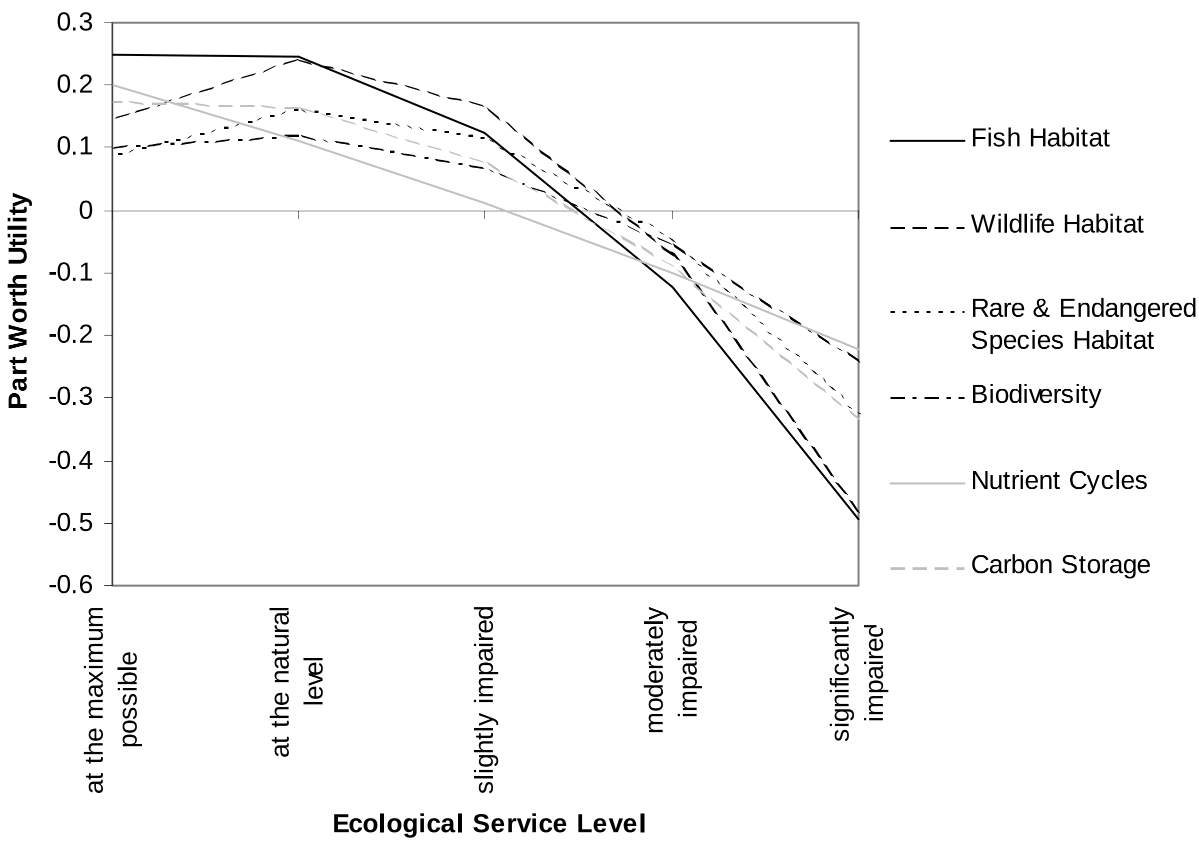
*bold indicates t-value significant at $p<0.05$ Adjusted Rho-Squared = 0.078

Note: For categorical attributes, the values in italics were calculated from the other level(s) for each attribute as follows: the parameter estimate is the negative sum of the estimates of the other level(s); the standard error is the mean of the standard errors for the other levels; the t-value is the parameter estimate divided by the standard error.

4.6.1 ECOLOGICAL SERVICES

Figure 4.1 shows the PWU functions for all Ecological Services for the entire sample. The graphs are calculated as a combination of the linear and quadratic estimates for each attribute. The shape of each of the utility functions for the Ecological Services is remarkably similar in that the utility declines as the level of each Ecological Service decreases. The quadratic nature of the utility functions becomes apparent as the utility decreases more sharply the farther each Ecological Service moves below the 'natural' level. There is virtually no change in utility for moving above the 'natural' level for Fish Habitat, Biodiversity, and Carbon Storage. For Wildlife Habitat, and Rare & Endangered Species Habitat, the utility actually appears to decrease above the 'natural' level. The only Ecological Service with a slightly different pattern is Nutrient Cycles, which displays a linear functional form, without a significant quadratic estimate.

Figure 4.1 Part worth utility functions for Ecological Services



A comparison between the PWU values and the mean importance ratings of the Ecological Services (Section 4.3) reveals a consistent pattern. Those Ecological Services which had the highest PWU 'at the natural level' (i.e. fish habitat and wildlife habitat) are also the services which obtained the highest mean importance ratings. This pattern holds true for all six Ecological Services, suggesting that the PWUs from the DCE are consistent with the values of respondents.

4.6.1.1 SEGMENTATIONS

Further information about the values that respondents place on the various Ecological Services can be gleaned from comparisons between the various segments (Table 4.11).

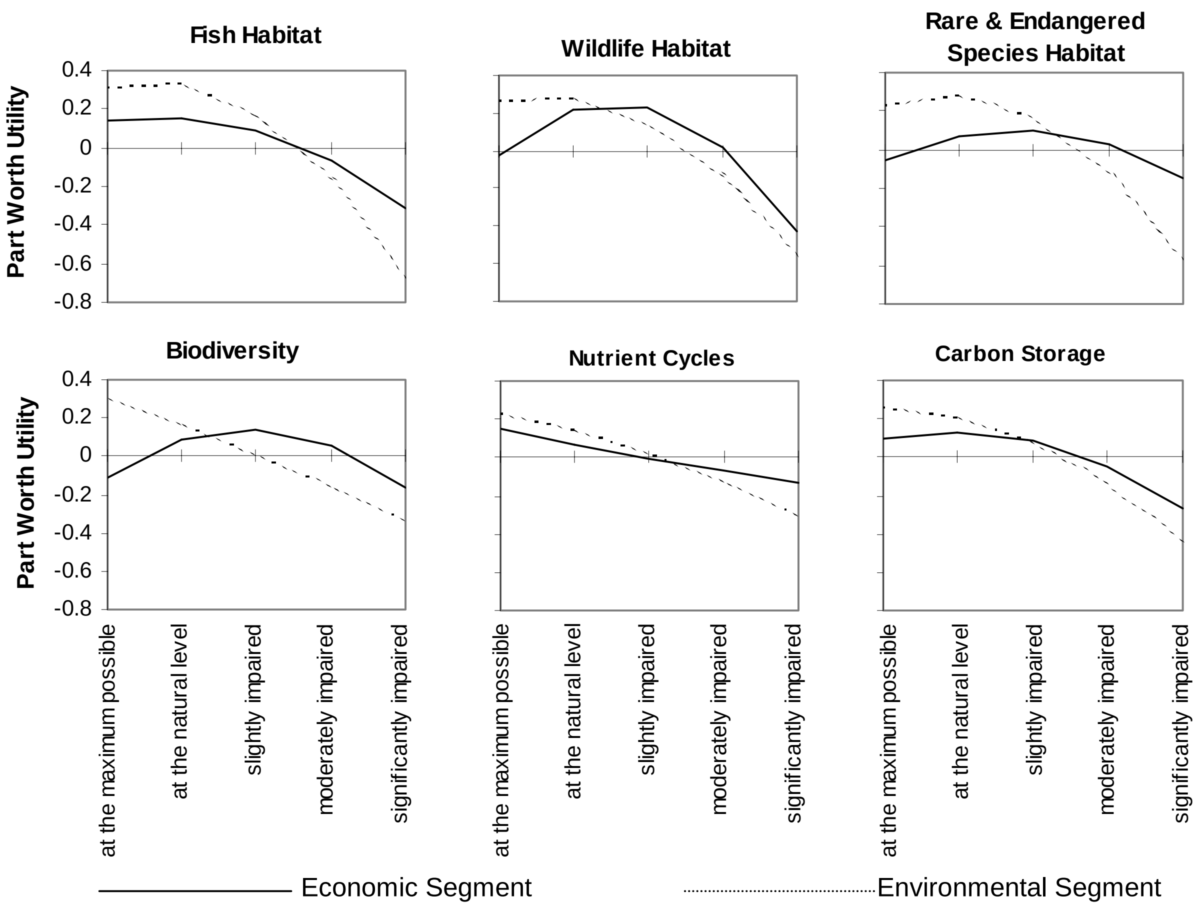
Table 4.11 Significant differences in part worth utility estimates for Ecological Services between segments

Ecological Service		**Preferred Outcome**	**Land Allocation**	**Recreation Participation**	**Residence**
Fish Habitat	linear	*Environmental*			
	quadratic				
Wildlife Habitat	linear	*Environmental*		*(Non-consumptive)*	
	quadratic				
Rare & Endangered Species Habitat	linear	*Environmental*	*More Parks*		
	quadratic		*More Parks*		
Biodiversity	linear	*Environmental*			
	quadratic	*(Economic)*			*Rural*
Nutrient Cycles	linear				
	quadratic				
Carbon Storage	linear	*Environmental*			
	quadratic				

*For those attributes/levels for which there was a significant (p<0.05) difference in PWU between segments, the segment which had the higher PWU is listed. Segments listed in parentheses indicate a difference that was significant only at p<0.10.

The Segmentation by Preferred Outcome produces the greatest number of significant (p<0.05) differences in PWUs between segments. For most of the Ecological Services, the *Environmental* Segment has a significantly more positive linear estimate than the *Economic* segment. Unlike the differences in importance that emerged between the two segments on the single rating question, where fish and wildlife habitat were rated as more important by the economic segment, no such pattern can be observed in the DCE results. The PWU functions for the *Economic* and *Environmental* segments are shown in Figure 4.2. The differences in utility between these two segments are most apparent at either end of the respective curves, with the *Environmental* segment having consistently more negative utilities associated with a reduction in any Ecological Service to the 'significantly impaired' level. The other obvious difference is found in the 'at the maximum possible' level. For the *Economic* segment the utility for several of the Ecological Services actually declines when that service is increased to 'the maximum possible.' The *Environmental* segment, on the other hand, does not display such a decline in utility. None of the other segmentations reveal as consistent a pattern as the Segmentation by Preferred Outcome.

Figure 4.2 Part worth utility functions for Ecological Services in Segmentation by Preferred Outcome

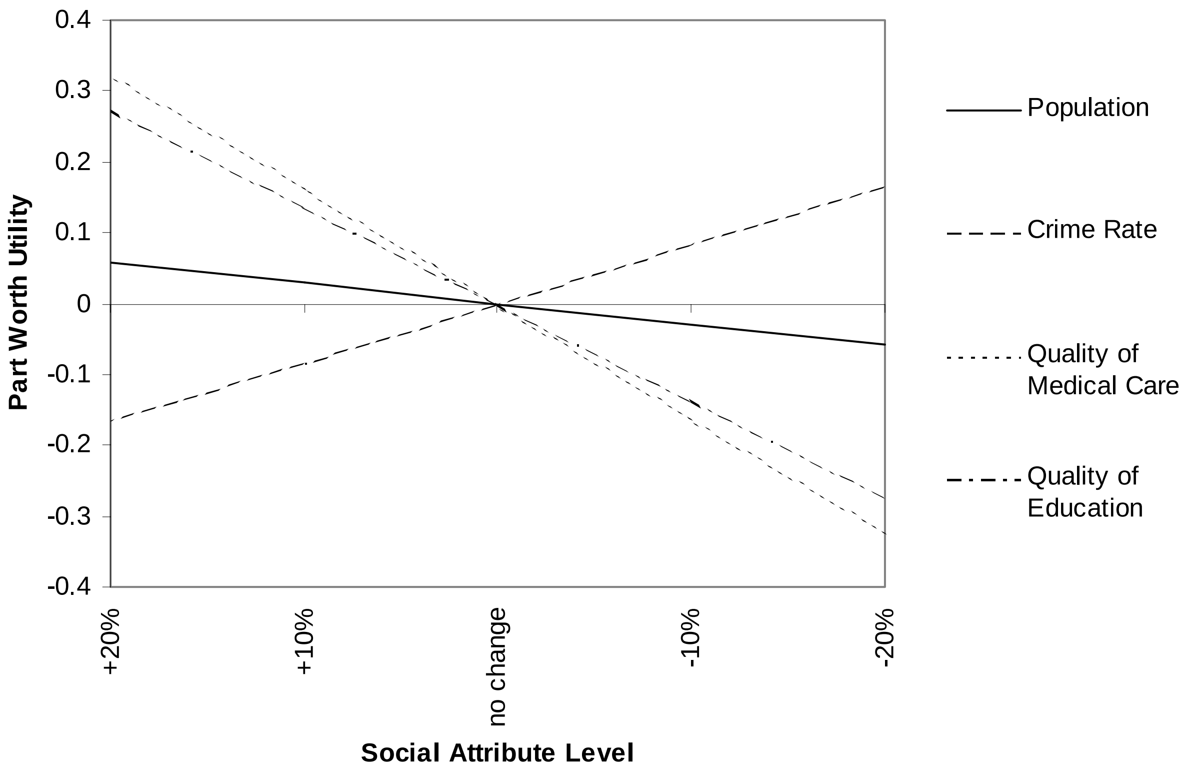


It is also interesting to note that while the Segmentation by Recreation Participation reveals many significant differences in the importance ratings of Ecological Services, this segmentation did not reveal any significant differences in the PWUs for Ecological Services. A possible explanation for these apparently contradictory results could relate to the inclusion of the Landuse and Access attributes in the DCE. When respondents evaluated the Ecological Services in isolation (i.e. in the importance ratings), they likely included their own use values for those services (e.g. Fish Habitat is important to provide better fishing opportunities). In the DCE, however, these use values may have been captured at least to some extent by the Landuse and Access attributes. This suggests that *Consumptive* and *Non-consumptive* respondents may differ more in their use values than in their non-use values.

4.6.2 Social Attributes

Figure 4.3 shows the PWU functions for the Social attributes. For Population, there is no significant PWU, suggesting that respondents were divided in their opinions on whether or not they would like to see the population change in northern Ontario. This result may also indicate that respondents, on the whole, were happy with the current population level of their region. The remaining three Social attributes had significant ($p<0.05$) linear estimates, showing that respondents were in favour of decreasing the Crime Rate and increasing both the Quality of Medical Care and the Quality of Education.

Figure 4.3 Part worth utility functions for Social Community Profile



4.6.2.1 Segmentations

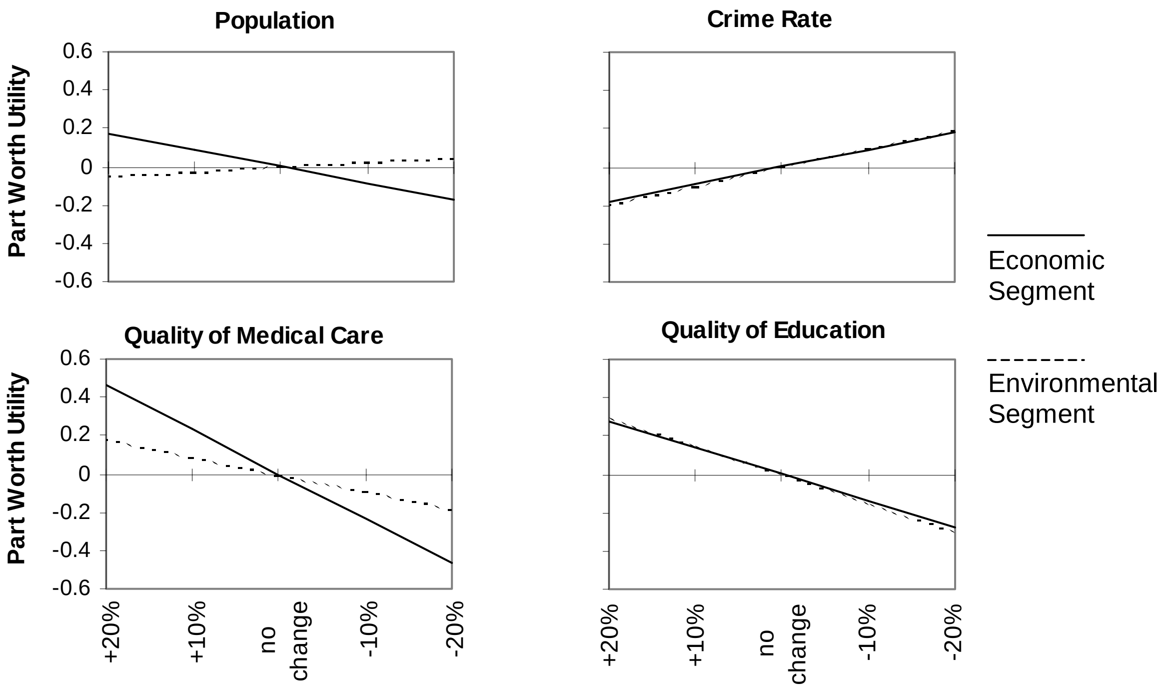
Significant differences in PWUs for Social Attributes are listed in Table 4.12. As with the Ecological Services, the only segmentation that reveals significant differences between the various segments is the Segmentation by Preferred Outcome. According to Figure 4.4, the *Economic* segment would prefer to see more population growth than the *Environmental* segment and is also more concerned about the Quality of Medical Care. For the other two attributes, the *Economic* and *Environmental* segments have virtually identical utilities.

Table 4.12 Significant differences in part worth utility estimates for Social Attributes between segments

Social Attribute		Preferred Outcome	Land Allocation	Recreation Participation	Residence
Population	linear	*Economic*			
Crime Rate	linear				
Quality of Medical Care	linear	*Economic*			
Quality of Education	linear				

*For those attributes/levels for which there was a significant (p<0.05) difference in PWU between segments, the segment which had the higher PWU is listed. Segments listed in parentheses indicate a difference that was significant only at p<0.10.

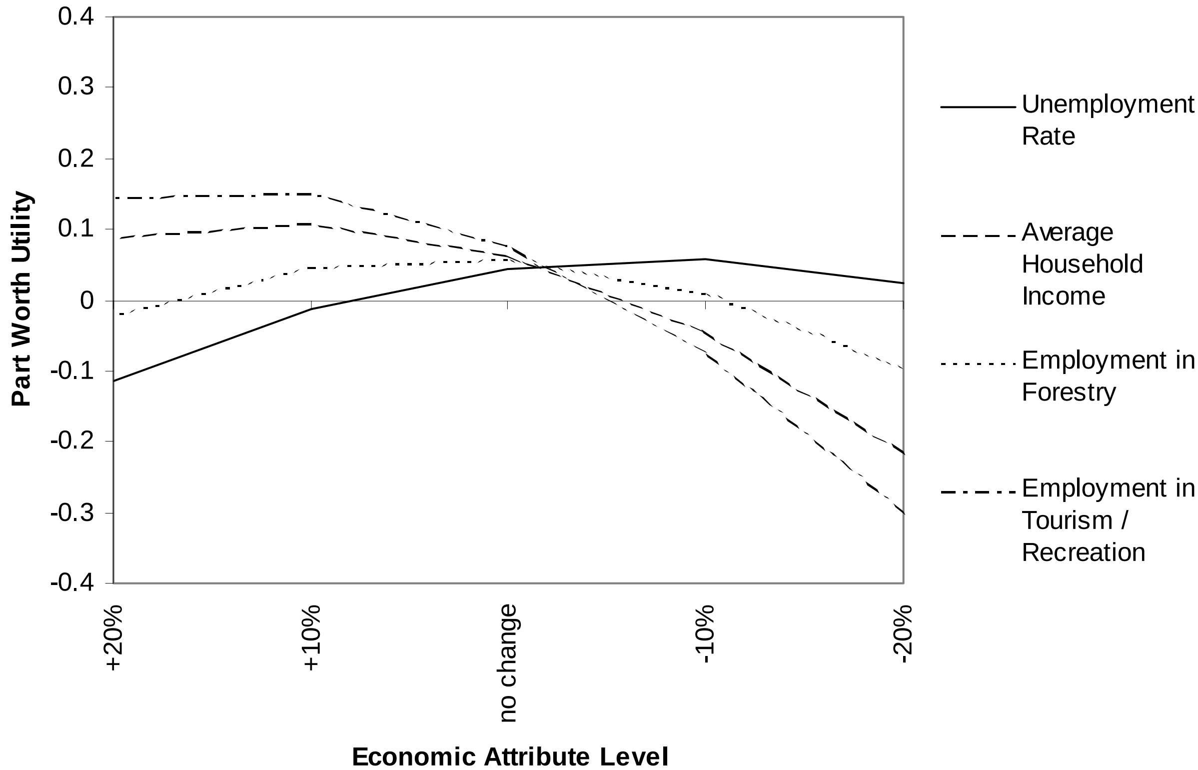
Figure 4.4 Part worth utility functions for Social Community Profile in Segmentation by Preferred Outcome



4.6.3 ECONOMIC ATTRIBUTES

With regards to the Economic attributes (Figure 4.5), neither the estimates for Unemployment Rate nor for Employment in Forestry were significant at the .05 level. The linear estimate for Unemployment Rate is significant at $p<0.10$. The lines in Figure 4.5 seem to suggest that the overall sample is somewhat opposed to a major increase in the Unemployment Rate, but are not too concerned about smaller changes in this attribute. For Average Household Income, the linear estimate was significant at $p<0.05$, and the quadratic estimate was significant at $p<0.10$. Obviously, respondents do not want to see their income decrease; while they were in favour of a 10% increase, the utility may actually begin to decline beyond this increase. The Employment in Tourism / Recreation shows a virtually identical pattern to the Average Household Income, although the former has significant ($p<0.05$) estimates for both linear and quadratic estimates.

Figure 4.5 Part worth utility functions for Economic Community Profile



4.6.3.1 SEGMENTATIONS

There are few significant differences in PWU for any of the Economic Attributes in any of the segmentations (Table 4.13). Even the segmentation by Preferred Outcome produces only one significant difference in this case. Several other segmentations showed differences in PWU estimates that were significant at p<0.10, but no clear patterns emerge in any segmentation.

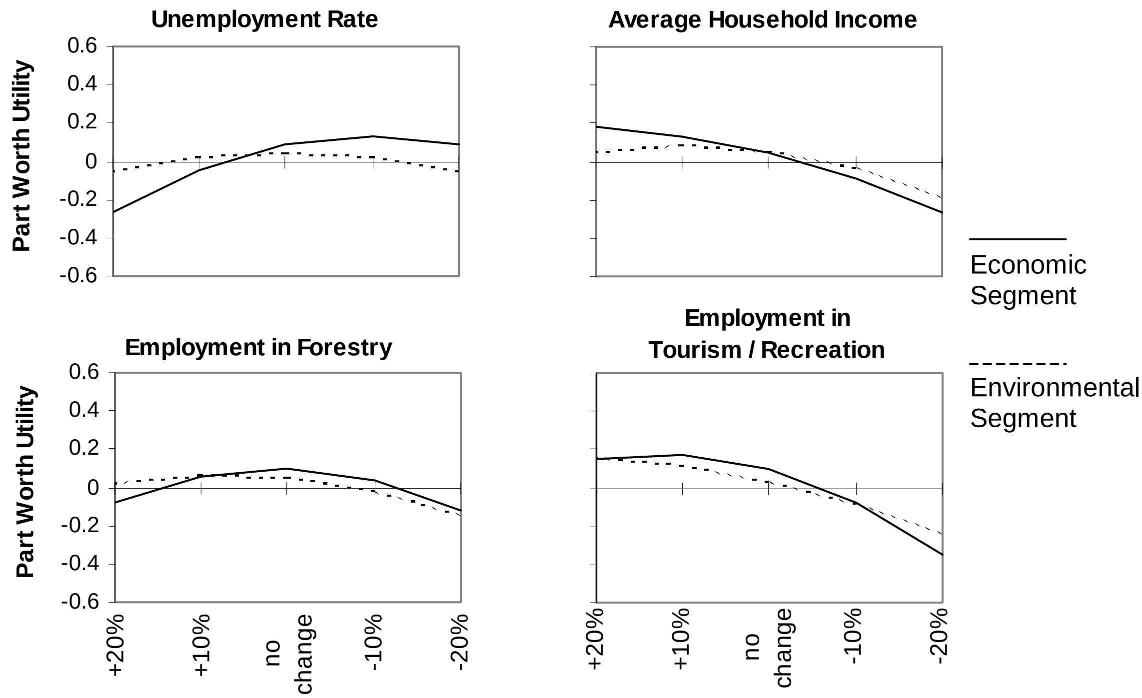
Table 4.13 Significant differences in part worth utility estimates for Economic Attributes between segments

Economic Attribute		Preferred Outcome	Land Allocation	Recreation Participation	Residence
Unemployment Rate	linear	*Economic*			
	quadratic				
Average Household Income	linear				*(Urban)*
	quadratic		*(More Parks)*		
Employment in Forestry	linear				
	quadratic		*More Parks*		
Employment in Tourism / Recreation	linear				*(Urban)*
	quadratic				*(Rural)*

*For those attributes/levels for which there was a significant (p<0.05) difference in PWU between segments, the segment which had the higher PWU is listed. Segments listed in parentheses indicate a difference that was significant only at p<0.10.

The separate PWU functions for the *Economic* and *Environmental* segments (Figure 4.6) reveal that the *Economic* segment clearly placed more importance on the Unemployment rate than did the *Environmental* segment. The *Economic* segment had a more positive utility associated with reducing the Unemployment Rate, and a more negative utility for an increase in the Unemployment Rate.

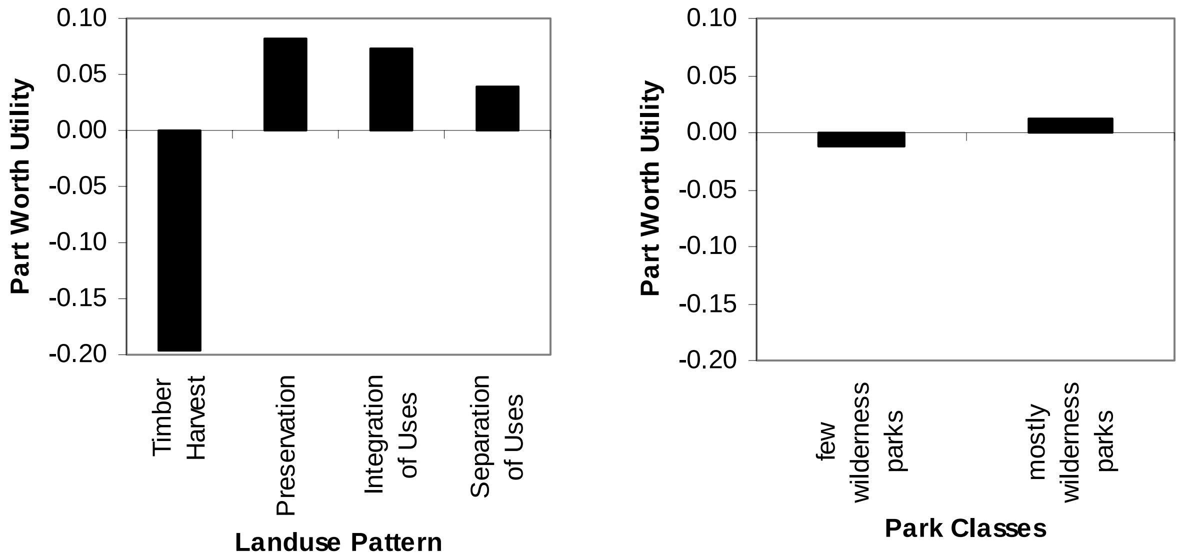
Figure 4.6 Part worth utility functions for Economic Community Profile in Segmentation by Preferred Outcome



4.6.4 LANDUSE

The Landuse Allocation and Park Classes attributes in the DCE were estimated using effects coding. This means that all but one of the levels in each attribute was estimated and the final level was defined as the negative sum of the other levels. For Landuse Allocation, the Timber Harvest pattern had a very significant negative utility, meaning that respondents do not like this pattern of landuse. The Preservation pattern, on the other hand, had a significantly positive utility. The remaining patterns of landuse were insignificant at $p<0.05$, and were in effect not significantly different from each other (Figure 4.7). These results are consistent with the results of the question about ideal Landuse patterns presented in Section 4.4. There, respondents indicated that they would like to see the amount of parks and protected areas increased to up to 20% of the land. Thus, it is not surprising that the Landuse pattern with the greatest percentage of parks and protected areas (i.e. the Preservation pattern) was the most preferred pattern among respondents. The estimates for few or many wilderness parks did not produce any significant differences.

Figure 4.7 Part worth utilities for Landuse Allocation and Park Classes attributes



* indicates t-value significant at p<0.05

4.6.4.1 SEGMENTATIONS

On the landuse attributes, the segmentations revealed several clear patterns (Table 4.14). While all segments had a negative utility estimate for the Timber Harvest pattern of landuse, both the *Economic* and *Less Parks* segments had significantly (p<0.05) less negative estimates for this pattern than the *Environmental* and *More Parks* segments respectively. Similarly, the *Environmental*, *More Parks*, and *Urban* segments had significantly more positive utilities for the Preservation pattern than did the *Economic*, *Less Parks*, and *Rural* segments. This pattern is repeated in the Park Classes attribute, with the *Economic* and *Less Parks* segments preferring ‘few wilderness parks’, while the *Environmental* and *More Parks* segments preferred ‘mostly wilderness parks.’ Once again, these results are fairly consistent with the results of the ideal Landuse patterns in which the *Environmental, More Parks, Non-consumptive*, and *Urban* segments all preferred to see significantly more parks & protected areas than did the *Economic*, *Less Parks*, *Consumptive*, and *Rural* segments. These results are consistent for both situations (i.e. throughout northern Ontario and around the communities). There, only one segmentation revealed any significant difference in the ideal percent of intensive forestry areas, suggesting that respondents are unfamiliar with the concept of intensive forestry areas. An occasional respondent also commented to the effect that he/she did not agree that the current situation has 0% intensive forestry areas. While no areas in Ontario are specifically designated for intensive forestry, apparently some respondents consider the level and type of forestry currently being practised in northern Ontario to be ‘intensive’.

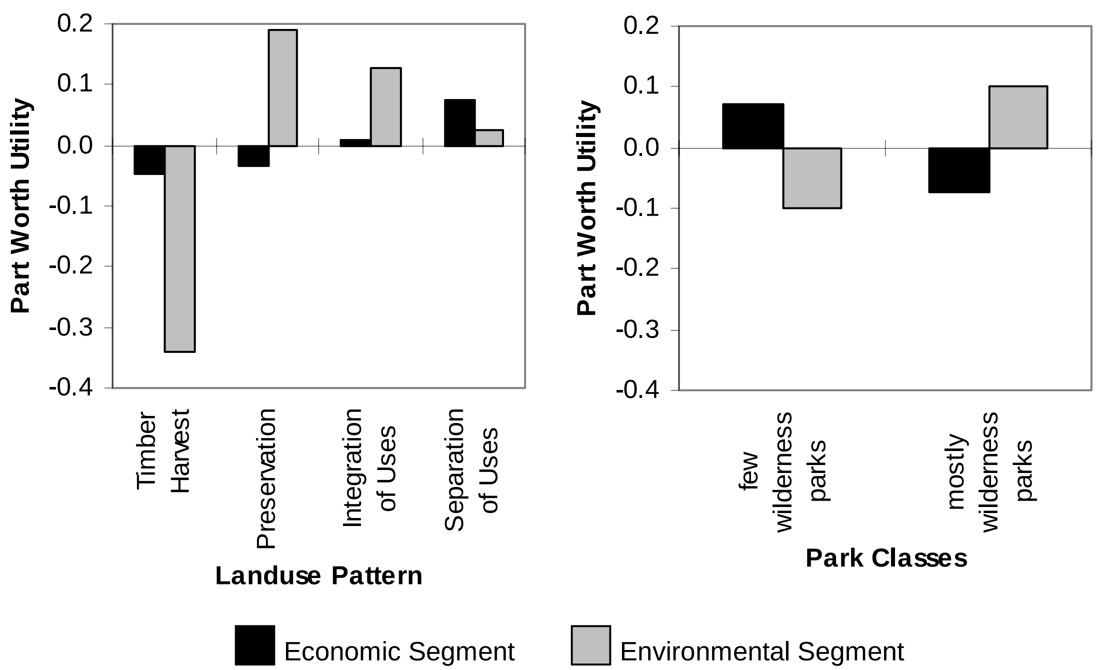
Table 4.14 Significant differences in part worth utility estimates for Landuse attributes between segments

Attribute	Preferred Outcome	Land Allocation	Recreation Participation	Residence
Landuse Allocation				
Timber Harvest	*Economic*	*Less Parks*		
Preservation	*Environmental*	*More Parks*		*Urban*
Integration of Uses				
Separation of Uses				
Park Classes				
few wilderness parks	*Economic*	*Less Parks*		
mostly wilderness parks	*Environmental*	*More Parks*		

*For those attributes/levels for which there was a significant (p<0.05) difference in PWU between segments, the segment which had the higher PWU is listed. Segments listed in parentheses indicate a difference that was significant only at p<0.10.

The PWU estimates for Landuse Allocation and Park Classes for the *Economic* and *Environmental* segments are shown in Figure 4.8. The results coincide with the responses to the Landuse Allocation Question, with significant differences between the two respective segments on the patterns emphasising Timber Harvest and Preservation. On the Park Classes, the two segments were significantly different from each other, while the overall sample recorded a flat utility curve.

Figure 4.8 Part worth utilities for Landuse and Park Classes in Segmentation by Preferred Outcome

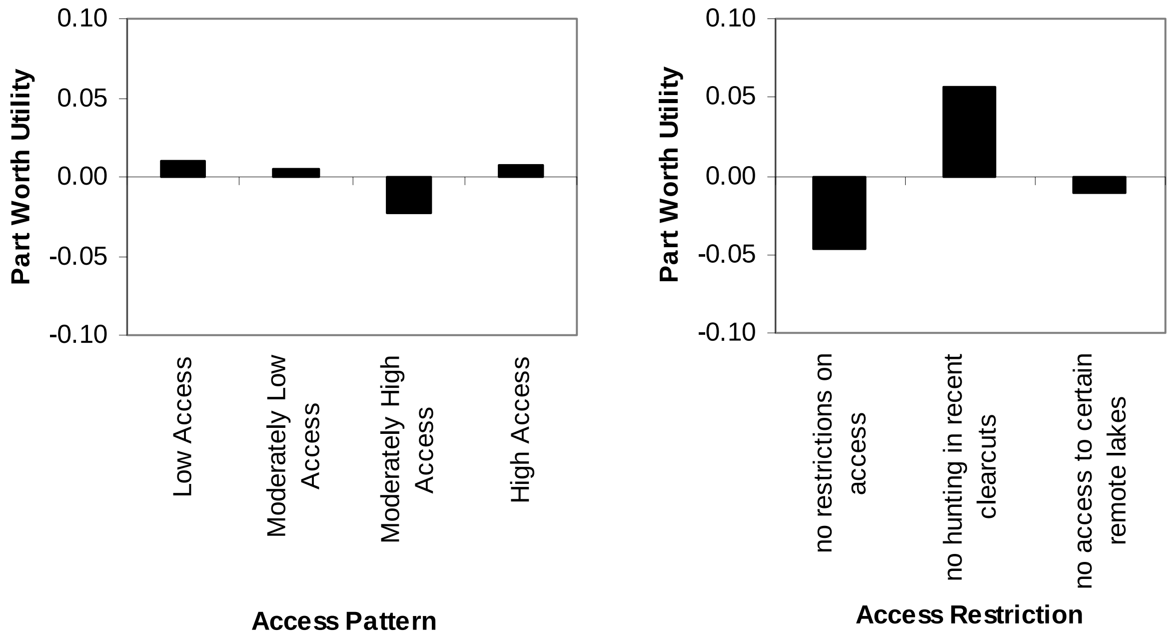


* indicates significant (p<0.05) difference in PWUs between segments

4.6.5 ACCESS

The variable describing four patterns of Access & Recreation was also effects coded. The PWUs for the entire sample were insignificant for both the Access attributes (Figure 4.9).

Figure 4.9 Part worth utilities for Access & Recreation and Access Restrictions attributes



4.6.5.1 SEGMENTATIONS

The segmentation results for the Access attributes (Table 4.15), and particularly the Access Restrictions attribute, reveal a similar pattern to the results of the Landuse Allocation and Park Classes attributes. Both the *Economic* and *Consumptive* segments had a significantly ($p<0.05$) more positive utility for the High Access pattern, than the *Environmental* and *Non-consumptive* segments. Conversely, the *Environmental*, *More Parks*, and *Non-consumptive* segments preferred the Low Access or Moderately Low Access Patterns.

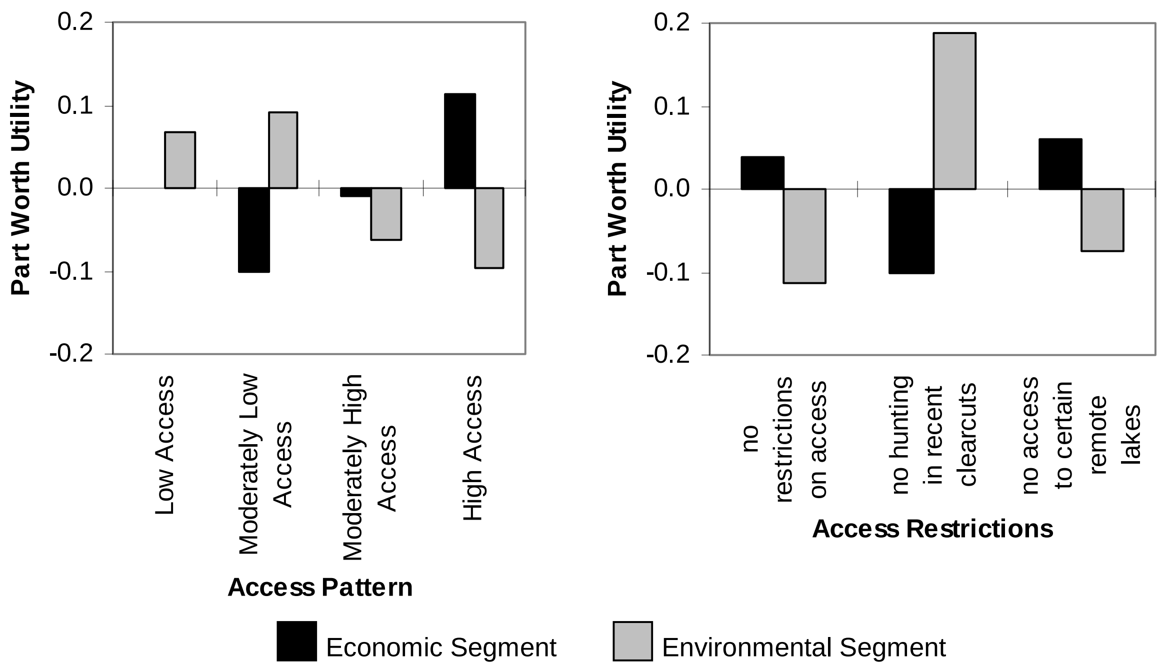
For Access Restrictions, the *Economic*, *Less Parks*, and *Consumptive* segments preferred the 'no restrictions on access' level, while the *Environmental*, *More Par*ks, *Non-consumptive*, and *Urban* segments all preferred the 'no hunting in recent clearcuts' level. This is one of the most striking examples of the pattern which has become apparent throughout the various sections of the questionnaire. The emerging pattern is one where the *Economic*, *Less Parks*, *Consumptive*, and *Rural* segments tend to display similar results, as do the corresponding *Environmental*, *More Parks*, *Non-consumptive*, and *Urban* segments. The Segmentation by Preferred Outcome (Figure 4.10) produces a trend similar to the responses to the question asking for allocation of the ideal Access percents. The *Environmental*, *More Parks*, *Non-Consumptive*, and *Urban* segments all indicated a preference for significantly more non-motorised land than the *Economic*, *Less Parks*, *Consumptive*, and *Rural* segments. For motorised land, the reverse is true. The only exception to this pattern is for roaded motorised land, for which there was no significant difference between the *Rural* and *Urban* segments.

Table 4.15 Significant differences in part worth utility estimates for Access attributes between segments

Attribute	Preferred Outcome	Land Allocation	Recreation Participation	Residence
Access & Recreation				
Low Access			*Non-consumptive*	
Moderately Low Access	*Environmental*	*(More Parks)*		
Moderately High Access				
High Access	*Economic*		*Consumptive*	
Access Restrictions				
no restrictions on access	*Economic*	*Less Parks*	*Consumptive*	
no hunting in recent clearcuts	*Environmental*	*More Parks*	*(Non-consumptive)*	*Urban*
no access to certain remote lakes	*(Economic)*			

*For those attributes/levels for which there was a significant ($p<0.05$) difference in PWU between segments, the segment which had the higher PWU is listed. Segments listed in parentheses indicate a difference that was significant only at $p<0.10$.

Figure 4.10 Part worth utilities for Access and Access Restrictions in Segmentation by Preferred Outcome



* indicates significant ($p<0.05$) difference in PWUs between segments

It is interesting to note here that respondents consistently distinguished between motorised and non-motorised access but not between roaded and unroaded access. For the entire sample and all the segments, respondents who indicated a preference for more unroaded non-motorised access also preferred more roaded non-motorised access. Similarly, respondents who preferred more unroaded motorised also preferred more roaded motorised access. This suggests that respondents are not particularly concerned about whether or not there are roads present to provide access into an area, but they do care whether or not motorised access (either on or off road) is allowed.

Overall the results from the RSVP survey provide a significant amount of useful information for resource managers. While there were some differences between various segments of the s ample, respondents consistently indicated a preference for more land in parks and protected areas and for ensuring continued access to the land for various types of recreation. The results from the preliminary sections of the survey instrument corroborate the findings of the DCE, suggesting that the DCE is an effective tool for determining respondents' preferences for forest management in northern Ontario. Some applications of the results of the DCE will be discussed in the following chapters.

CHAPTER FIVE: IMPLICATIONS FOR FOREST MANAGEMENT IN NORTHERN ONTARIO

The main objective of the RSVP was to provide information about the relative importance of various forest values in order to assist resource managers in future decision-making. This chapter begins with a discussion of some of the results described in Chapter Four. The focus here is on the use of a computerised DSS to examine tradeoffs and to develop various resource management scenarios. Specific issues such as access, recreation, protected areas, and the validity of the DCE model are also discussed.

5.1 ENVIRONMENTAL, SOCIAL, & ECONOMIC VALUES

The most consistent and striking pattern found in the DCE was the importance of the Ecological Services. The part worth utility functions for the entire sample, shown in Section 4.6, as well as for the various segments consistently showed that respondents opposed a decrease in any of the Ecological Services below the ‘natural’ level. Opinions were more varied with respect to increasing Ecological Services beyond their ‘natural’ level. In general, the entire sample and most of the segments did not display any significant preferences either for or against an increase in any of the Ecological Services to ‘the maximum possible’. This shows that people are generally ambivalent in their preferences for whether or not they would like to see Ecological Services increased beyond the ‘natural’ levels, although in certain segments of the population there is some opposition to increases in some Ecological Services. It is also possible that some respondents do not believe that humans can actually increase Ecological Services beyond the levels that occur naturally.

The results of the Social attributes provide few surprises. As expected, all segments are in favour of an increase in the Quality of Medical Care and the Quality of Education, and a decrease in the Crime Rate. Only to changes in Population were the majority of respondents indifferent.

For the Economic attributes, the part worth utility functions are again remarkably consistent across all the various segments. Respondents were generally in favour of an increase in both Average Household Income and Employment in Tourism / Recreation, and opposed to a decrease in either of these attributes. The PWU estimate for Unemployment Rate was significant only at $p<0.10$. This suggests that respondents are opposed to an increase in the Unemployment Rate, but apparently are less concerned about it than about other attributes. It is also interesting to compare the differences between the results for Employment in Tourism / Recreation and those for Employment in Forestry. As mentioned above, most respondents are in favour of an increase in Employment in Tourism / Recreation and opposed to a decrease in those attributes. For Employment in Forestry, on the other hand, the results are much more varied. For the entire sample, the PWU function shows that people are in favour of the current level of Employment in Forestry, and are opposed to either a large increase or a large decrease in this type of employment. This may mean that people want to see the current level of employment to be maintained, or it may indicate the presence of two distinct groups of people, some of whom are in favour of more Employment in Forestry, and some of whom are in favour of less. The results of the various segmentations did identify different groups, indicating more heterogeneity on this attribute when compared to others. For some respondents this may be a parameter that does not appear possible to increase further, while others are strongly opposed to a decrease in forestry employment in the future.

It is also important to keep in mind the relative importance of the various attributes. The part worth utilities associated with the Ecological Services, and in particular the negative utility associated with any reductions in these services, are so strong that they outweigh the utilities of many of the Social and Economic attributes. This suggests that to the majority of respondents, the Ecological Services are more important than certain Social and Economic benefits.

5.2 ACCESS & RECREATION

A frequently mentioned topic in the written comments by respondents was the importance of access to public lands, especially for various recreational activities. In the RSVP survey, Access was categorised according to the presence or absence of roads and whether or not motorised access was permitted. Currently in northern Ontario, there are no substantial non-motorised areas outside of parks and protected areas, which in effect means that the current pattern of access consists only of unroaded motorised and roaded motorised areas. Respondents indicated that they would like to see between 6% and 8% of the land placed within each of the non-motorised classes, resulting in corresponding reductions in both types of motorised access. The results from the various segmentations also suggest that respondents were much more concerned about motorised versus non-motorised access than they were about roaded versus unroaded access.

By looking at some of the segmentations, more can be learned about the relationship between respondents' preferred types of Access and their participation in various types of recreation activities. When segmenting by Recreation Participation, as to be expected, respondents who participate more frequently in consumptive and/or motorised recreation activities (i.e. the *Consumptive* segment) indicated that they would prefer to see less land designated as non-motorised than was preferred by the *Non-consumptive* recreationists. It is obvious that the *Consumptive* segment would like to see continued motorised access throughout most of Northern Ontario. The *Non-consumptive* segment, on the other hand, would like to see approximately 20% of the land both around their communities and throughout Northern Ontario designated as non-motorised. This is supported by the observation that *Non-consumptive* respondents had a significantly ($p<0.05$) more positive utility associated with the Low Access pattern and a significantly ($p<0.05$) more negative utility associated with the High Access pattern than did the *Consumptive* segment. This suggests that the utility derived from different levels of Access and different types of access restrictions depends partly on the type of recreation in which respondents like to participate.

It seems that a respondent's preferred recreation activities do have an influence on his or her preferences for different levels and types of access, although there are certainly other factors influencing this preference. Since the data indicate a sizeable demand for non-motorised access which is not recognised in the current management regime, and due to potential conflicts between the recreational activities of motorised versus non-motorised users, it seems that some areas should be set aside in northern Ontario for non-motorised recreation.

The results of the Access Restrictions are also interesting. There were no significant PWUs for any of the Access Restrictions for the entire sample. There were, however, a number of significant differences between the various segments, suggesting that opinions are divided on the restrictions modelled in the DCE. The Environmental, More Parks, Non-consumptive, and Urban segments all reported a significantly ($p<0.05$) positive PWU for 'no hunting in recent clearcuts' and a significantly ($p<0.05$) negative PWU for 'no restrictions on access.' The respective counterparts, however, were much more divided in their opinions, resulting in only one significant PWU estimate for any of the Access Restriction levels. This shows that at least in certain segments of the population, there is consistent support for certain restrictions on access. It is also interesting to note that neither the entire sample, nor any of the segments reported a significant utility (either positive or negative) for the 'no access to certain remote lakes' level. This may be due to the fact that people were not familiar with or did not understand, this type of access restriction. The idea of prohibiting anglers from using logging roads to access certain lakes (in order to protect remote tourism values) is used only in certain OMNR districts. Respondents from other parts of northern Ontario may have been unfamiliar with the reasons for this type of restriction and therefore may have been unable to value it accurately.

5.3 PARKS & PROTECTED AREAS

One of the most surprising findings of the RSVP survey was the desire for more land to be set aside as parks and protected areas. In the years prior to the RSVP survey, the Ontario government had initiated significant amounts of public debate about their doubling of the amount of protected areas in Ontario (through the Lands for Life and Ontario's Living Legacy initiatives) to meet the 12% goal suggested by the United Nations. Despite this recent increase, RSVP respondents reported that on average they would like to see between 15% and 20% of the land in northern Ontario set aside as parks or protected areas. Respondents in every segment (*Less Parks* by definition is excepted) were consistent in this desire to have more land protected. In addition to the parks and protected areas, respondents also reported a desire for 10% to 15% of the land to be managed as special management areas. These findings are supported by the results from the DCE, which revealed that the Preservation pattern of landuse, which contains the highest percentage of protected areas, also provided the greatest utility to respondents. Similarly, the Timber Harvest pattern, with a reduction in protected areas to 10%, was by far the least preferred pattern by all segments of the population.

There were some significant differences between segments both in the Ideal Landuse Patterns and the PWUs for the Landuse attributes. *Urban* residents indicated a preference for significantly more Parks and Protected Areas and had a significantly greater PWU for the Preservation pattern of landuse (with the greatest percentage of parks & protected areas) than did *Rural* residents. A possible explanation for this finding may be that *Rural* communities tend to be more dependent on resource extraction and may see parks as "locking up" land which could otherwise be used for their economic benefit. The Sociodemographic section of the questionnaire revealed that *Rural* residents were significantly more likely than *Urban* residents to be employed in resource-based industries such as forestry and mining, leading one to suspect that they might also be opposed to increasing the amount of parks and protected areas. Another possible contributing factor could be that *Rural* residents live surrounded by relatively undeveloped lands, while *Urban* residents, who have fewer natural areas nearby, may like to see more protected areas so that they have more opportunities to enjoy natural settings.

Given the strong level of support across all segments of the population for more parks and protected areas, the Government of Ontario may want to consider increasing the amount of protected lands in Ontario and should ensure that the level of protection in new and existing parks is maintained.

5.4 MEASURING TRADEOFFS WITH THE DSS

Another objective of this research was to create a decision support tool for resource management decision processes. The following sections describe a number of potential applications of the RSVP DSS to forest management decision making. Using such a DSS is not a privilege limited to resource managers; a DSS can also be an effective part of a public planning process, in which any party involved may test and explore the effects of different scenarios and assumptions.

5.4.1 SENSITIVITY TABLE

A simple application of the DSS is to create a sensitivity table as shown in Table 5.1. In this case, a sensitivity table shows how the public support for an Outcome would change in response to a change in one attribute, assuming that all other attributes remain unchanged. By examining Table 5.1, one can see, for example, that a reduction in the level of Fish Habitat from ‘at the natural level’ to ‘slightly impaired’ would result in a 3% decline in public support for that Outcome. This decline is equal to a 10% improvement in the Quality of Education, which in effect would amount to a tradeoff between these two attribute level changes. This is just one example of the thousands of tradeoffs that can be simulated in a DSS.[14]

The DSS can also estimate the changes in public support based on changes in Landuse and Access attributes. The sensitivity table (Table 5.2) shows how public support for each outcome would change based on changes in the categorical attribute. The PWU estimates reveal the most preferred level (i.e. the most positive PWU) for each of the categorical attributes. Setting all of the Landuse and Access attributes to their most preferred levels in Outcome A and to their least preferred levels in Outcome B effectively increases public support for Outcome A by approximately 10%. Most of this support is driven by the Landuse Allocation attribute; if the Landuse patterns are set equal, this increase in public support drops to only 4%. In the entire sample and all of the segments, the most obvious Landuse or Access results were the consistently negative utility for the Timber Harvest pattern of Landuse and the consistently positive utility for the Preservation pattern. While the names given to these patterns may have influenced respondents, the results send a clear message that people in northern Ontario do not want to see timber harvesting as the sole landuse in northern Ontario.

---

[14] It should also be mentioned that some of the predicted changes in public support appear counter-intuitive. For example, changing the Unemployment Rate from ‘no change’ to ‘-10%’ results in a 0.3% increase in public support. A change from ‘no change’ to ‘-20%’ however, results in a 0.5% decrease in public support. The reason for this discrepancy is due largely to the fact that the linear PWU estimate for Unemployment Rate was insignificant and the quadratic estimate was almost as strong as the linear estimate. While these changes might not make much sense, they are so small in magnitude that they do not significantly affect the predictive ability of the DSS.

Table 5.1 Sensitivity table for Ecological, Social, and Economic attributes

Attribute	Change from 'at the natural level' to: at the maximum possible	slightly impaired	moderately impaired	significantly impaired
Ecological Services				
Fish Habitat	+0.0	-3.1	-9.1	-17.7
Wildlife Habitat	-2.4	-1.8	-7.8	-17.3
Rare & Endangered Species Habitat	-1.9	-1.1	-5.2	-12.0
Biodiversity	-0.5	-1.3	-4.3	-9.0
Nutrient Cycles	+2.2	-2.5	-5.3	-8.3
Carbon Storage	+0.2	-2.2	-6.3	-12.2
	Change from 'no change' to:			
	+ 20%	**+10%**	**-10%**	**-20%**
Community Profile—Social				
Population	+1.5	+0.7	-0.7	-1.5
Crime Rate	-4.1	-2.1	+2.1	+4.1
Quality of Medical Care	+8.0	+4.0	-4.0	-8.0
Quality of Education	+6.8	+3.4	-3.4	-6.8
Community Profile—Economic				
Unemployment Rate	-4.0	-1.4	+0.3	-0.5
Average Household Income	+0.6	+1.1	-2.7	-7.0
Employment in Forestry	-2.0	-0.3	-1.2	-3.8
Employment in Tourism / Recreation	+1.7	+1.8	-3.7	-9.3

Table 5.2 Sensitivity table for Landuse and Access attributes

Landuse Allocation	Change from given level to: Timber Harvest	Preservation	Integration of Uses	Separation of Uses
Timber Harvest	*NA*	+6.9	+6.7	+5.9
Preservation	-6.9	*NA*	-0.2	-1.0
Integration of Uses	-6.7	+0.2	*NA*	-0.8
Separation of Uses	-5.9	+1.0	+0.8	*NA*
Park Classes	**few wilderness parks**		**mostly wilderness parks**	
few wilderness parks	*NA*		+0.7	
mostly wilderness parks	-0.7		*NA*	
Access & Recreation	**Low Access**	**Moderately Low Access**	**Moderately High Access**	**High Access**
Low Access	*NA*	-0.1	-0.8	-0.1
Moderately Low Access	+0.1	*NA*	-0.7	0.0
Moderately High Access	+0.8	+0.7	*NA*	+0.7
High Access	+0.1	0.0	-0.7	*NA*
Access Restrictions	**no restrictions on access**	**no hunting in recent clearcuts**	**no access to certain remote lakes**	
no restrictions on access	*NA*	+2.6	+0.9	
no hunting in recent clearcuts	-2.6	*NA*	-1.7	
no access to certain remote lakes	-0.9	+1.7	*NA*	

5.4.2 SCENARIO BUILDING

One of the most powerful applications of a DSS is its use to predict changes in public support associated with various assumptions about a possible forest management scenario. These simulations truly exploit the multivariate basis of the DCE, and allow managers and the public to run through many different if – when situations. This concept is best illustrated with an example. Suppose that one wants to examine the effects of a management strategy that is focused on expanding the amount of land contained within parks and protected areas. The first step is to make the attributes for both Outcomes the same, presumably to approximate the current situation (or status quo) around the community in question. For the example in Table 5.3 it is assumed that all Ecological Services are currently at a slightly impaired level, and, by definition, the Social and Economic parameters need to be set to no change. The landuse and access attributes are also identical, and therefore public support is 50% for each Outcome.

Table 5.3 Public support for a hypothetical park creation scenario. Simulation stage 0—starting configuration

Attribute	Outcome A (status quo)	Outcome B (park creation)
Ecological Services		
Fish Habitat	slightly impaired	slightly impaired
Wildlife Habitat	slightly impaired	slightly impaired
Rare & Endangered Species Habitat	slightly impaired	slightly impaired
Biodiversity	slightly impaired	slightly impaired
Nutrient Cycles	slightly impaired	slightly impaired
Carbon Storage	slightly impaired	slightly impaired
Community Profile—Social		
Population	no change	no change
Crime Rate	no change	no change
Quality of Medical Care	no change	no change
Quality of Education	no change	no change
Community Profile—Economic		
Unemployment Rate	no change	no change
Average Household Income	no change	no change
Employment in Forestry	no change	no change
Employment in Tourism / Recreation	no change	no change
Landuse Allocation	Integration of Uses	Integration of Uses
Park Classes	few wilderness parks	few wilderness parks
Access & Recreation	Moderately Low Access	Moderately Low Access
Access Restrictions	no restrictions on access	no restrictions on access
Public Support (%)	50.0	50.0

In the simulations below, all of the attributes in Outcome A (status quo) will remain unchanged so that a comparison with the current situation can be made. The levels in Outcome B (park creation) will be changed to represent the anticipated changes associated with a more preservation oriented management approach. In the first stage of the simulation (Table 5.4), the Landuse and Access attributes are set to reflect the proposed park creation strategy, resulting in increased public support for Outcome B.

Table 5.4 Public support for a hypothetical park creation scenario. Simulation stage 1—management strategy

Attribute	Outcome A (status quo)	Outcome B (park creation)
Landuse Allocation	Integration of Uses	Preservation
Park Classes	few wilderness parks	mostly wilderness parks
Access & Recreation	Moderately Low Access	Low Access
Access Restrictions	no restrictions on access	no hunting in recent clearcuts
Public Support (%)	46.5	53.5

Next, various assumptions about the impacts associated with the expansion of parks can be explored. For example, one could assume that the increase in protected areas would result in fewer forestry jobs and an increase in the unemployment rate. There might be more jobs in tourism and recreation, but these jobs tend to be lower paying than forestry jobs, so the average income might also fall. The results of these assumptions (Table 5.5) show that the economic losses would actually make the park creation scenario somewhat less attractive than the status quo.

Table 5.5 Public support for a hypothetical park creation scenario. Simulation stage 2—assumed economic effects

Attribute	Outcome A (status quo)	Outcome B (park creation)
Community Profile—Economic		
Unemployment Rate	no change	+ 10%
Average Household Income	no change	- 10%
Employment in Forestry	no change	- 20%
Employment in Tourism / Recreation	no change	+ 20%
Public Support (%)	52.7	47.3

In addition, one could assume that more protected areas would improve the ecological conditions around the community (Table 5.6); the resulting improvement in ecological integrity would make the park creation scenario considerably more attractive to the public than the status quo.

The assumptions shown in Tables 5.5 and 5.6 are just one set of possible assumptions. One could test a different or additional set of assumptions, such as testing the effects of changing some of the Social attributes. The scenario building exercise described here could be undertaken by managers but could also become part of a public planning process. The DSS could easily be used in stakeholder meetings or even at public information sessions.

Table 5.6 Public support for a hypothetical park creation scenario. Simulation stage 3—assumed ecological effects

Attribute	Outcome A (status quo)	Outcome B (park creation)
Ecological Services		
Fish Habitat	slightly impaired	at the natural level
Wildlife Habitat	slightly impaired	at the natural level
Rare & Endangered Species Habitat	slightly impaired	at the natural level
Biodiversity	slightly impaired	at the natural level
Nutrient Cycles	slightly impaired	at the natural level
Carbon Storage	slightly impaired	at the natural level
Public Support (%)[a]	40.8	59.2

The point of the DSS is not to provide all the answers about how forests should be sustainably managed to provide the greatest benefits to society. Rather, in meeting the third research objective, the DSS is a useful tool to provide information to resource managers about the public's preferences about various management options. As shown in Figure 1.1, this information is intended to be used in conjunction with biophysical information about forest conditions to guide resource management decisions.

5.5 MODEL VALIDITY

One drawback associated with a SP survey technique is that the results are difficult, if not impossible to validate. One method of testing the validity of a DCE model is to include a 'holdout' set (or sets) in the survey that is common across all versions of the survey. In the RSVP survey, two such holdout sets were included (Sets 9 and 10; see Section 3.2.1.7 and Appendix A). The DSS was then used to predict the percentage of respondents who would select each Outcome in each of the holdout sets. Table 5.7 compares these predicted choice probabilities with the actual choices made by the survey respondents. The percentages in Table 5.7 can be thought of as the percent of the public who would support each Outcome, assuming that those were the only Outcomes available to each respondent. In the case of RSVP, this test of validity is less direct than is usually the case in a DCE. This is because the holdout sets contained full profiles of all the variables, rather than the partial sets used in the orthogonal design.

From Table 5.7, it appears that the DSS does an excellent job of predicting the choices made by respondents in Set 9, but the DSS does not predict well the actual choices for Set 10. Set 9 was designed so that Outcome A approximated the current situation in northern Ontario, while Outcome B represented a reasonably likely future outcome based on current trends and practices in forest management. The two Outcomes in Set 9 were similar to many of the Outcomes presented in the other choice sets which were based on the orthogonal design plan. Set 10, conversely, was deliberately designed to force respondents to choose between a strongly environmental outcome and a strongly social and economic outcome (for a further explanation, please refer to segmentation 1 in section 3.4.2). The outcomes in Set 10 represent 'extreme' outcomes in that they contain attribute combinations outside of the bounds of the orthogonal design used in the DCE. In order to operationalise the partial design, we needed to ask respondents to assume that in each Outcome, the three Ecological Services that were not present were at the 'slightly impaired' level. In Outcome B of Set 10, however, all of the Ecological Services are either 'at the natural level' or 'at the maximum possible.' The orthogonal nature of the design also implies that most of the choice sets were fairly well-balanced (i.e. there are only few choice sets in which all attributes appear at the best or worst levels at the same time. The resulting DSS, which relies on the partial design can only be valid to predict choices within the bounds of that original design. This means that the failure of the DSS to accurately predict Set 10 merely illustrates a limitation of the DSS and does not have any implications for the ability of the DSS to predict choices *within the bounds for which it was designed*.

Table 5.7 Percent of respondents selecting each Outcome in holdout sets (full model)

	Set 9		**Set 10**	
	Outcome A	**Outcome B**	**Outcome A**	**Outcome B**
Entire Sample				
Predicted (DSS)	57.4	42.6	22.2	77.8
Actual (from Survey)	59.9	40.1	45.1	54.9
Economic Segment				
Predicted (DSS)	43.9	56.1	67.3	32.7
Actual (from Survey)	53.6	46.4	100.0	0.0
Environmental Segment				
Predicted (DSS)	70.2	29.8	4.9	95.1
Actual (from Survey)	65.1	34.9	0.0	100.0

The DSS prediction for Set 10 shows the strength of the utilities associated with the various Ecological Services. Respondents' have such a negative utility associated with serious declines in the Ecological Services, that no improvement in the Social and/or Economic attributes can compensate for declines in the Ecological Services. The DSS seems to exaggerate this trend, but it is still an interesting trend to note. The fact that the DSS predicts poorly at the extremes is neither unexpected nor necessarily a problem. Since the DSS accurately predicted the choices in Set 9, it appears that the DSS can accurately predict the preferences of respondents, assuming that at least some of the attributes are in the middle of their range. This may not actually be a limitation in the DSS, as can be illustrated by the following examples. First, while humans may be able to ‘improve’ one or perhaps several Ecological Services, it is very unlikely that it would be possible to manage a forest in such a way that all of the Ecological Services are simultaneously improved beyond their ‘natural’ levels. Similarly, while humans could conceivably force all of the Ecological Services to a ‘significantly impaired’ condition, such a management strategy would almost certainly not be sustainable. Since the purpose of this study was to examine the tradeoffs people are willing to make within the limits imposed by a requirement of sustainability, then it appears that the DSS is accurate within similar limits.

The results from the RSVP survey have a number of implications for forest management in northern Ontario. In addition to specific information about environmental, social, and economic values of respondents, the survey also reveals some interesting information about respondents’ preferences for protected areas and for access and recreation. The DSS created from the results of the DCE is a particularly useful too for resource managers. This chapter has shown several applications of how the DSS can be used to examine the tradeoffs people are willing to make among the various attributes. An application of the DSS to determine public support for a hypothetical management strategy was also illustrated.

CHAPTER SIX: SUSTAINABILITY TRADEOFFS—THE COLLAPSED MODEL

While the full DCE model described in Chapters Four and Five provide some very useful and interesting information about forest values in northern Ontario, the answer to the second research question regarding general tradeoffs among environmental, social, and economic attributes remains elusive. A trend that was apparent in the full model was the similarity in functional forms among most of the Ecological Services, and to a lesser extent among the Social and the Economic attributes. Referring back to Figure 4.1, it is obvious that PWU increases as one moves from ‘significantly impaired’ to ‘at the natural level.’ Beyond this point, the PWU curve flattens out and in some cases declines. This similarity suggests that it might be possible to estimate a single PWU function for the Ecological Services in general. If such a model makes sense, this more parsimonious model form should produce a significant improvement in the model fit for the collapsed model. Also, this reduction makes sense from a management perspective as it follows the logic frequently applied when identifying and monitoring criteria and indicators. The same logic can then be applied to the Social and Economic attributes.

To explore this idea, a collapsed model form was analysed. To create the collapsed model, summary variables were created for the Ecological Services, and the Social and Economic attributes using the scoring system explained in Table 6.1.

Table 6.1 Scoring for summary variables in collapsed model

Ecological Services Level	Social or Economic Level*	Score for Summary Variable
significantly impaired		-3
moderately impaired	-20%	-2
slightly impaired	-10%	-1
at the natural level	no change	0
at the maximum possible	+10	1
	+20%	2

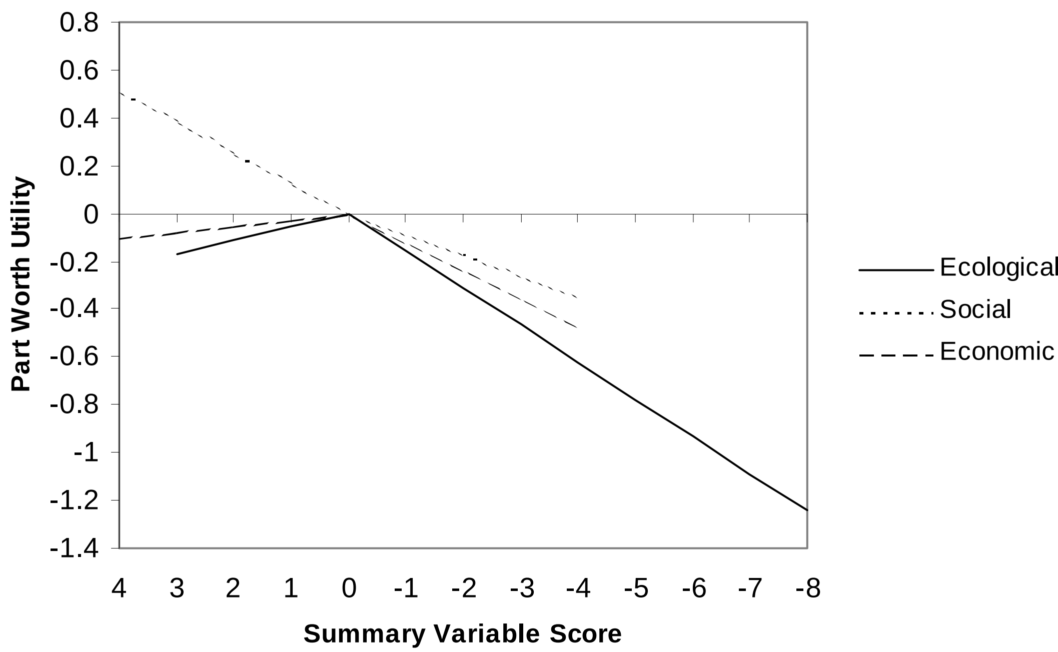
* Note: For Crime Rate and Unemployment Rate, the scales were reversed (i.e. +20% scored a –2, and –20% scored a +2)

For each Outcome, the positive and negative scores were summed separately to create two linear estimates for each summary variable. For the Ecological summary variable, the first linear estimate represents the utility associated with moving from ‘significantly impaired’ to ‘at the natural level’, while the second linear estimate represents the utility for moving from ‘at the natural level’ to ‘at the maximum possible.’ For the Social and Economic summary variables, the first linear estimate represents a move from ‘-20%’ to ‘no change’ and the second estimate corresponds to a move from ‘no change' to '+20%'.[15] The reason for including two separate linear estimates for each attribute is to capture the differences in utility associated with an increase versus a decrease in each attribute. The shape of the utility functions in the full model showed that people place a different value on changes in environmental and economic attributes, depending on whether that change was above or below the 'natural' or current level. The Landuse and Access attributes were included in the collapsed model in the same way as in the full model (i.e. as effects coded categorical variables).

6.1 COLLAPSED MODEL RESULTS

The results of this model are presented graphically in Figure 6.1 and are listed in Table 6.2. The adjusted rho-squared value of 0.069 for the collapsed model is slightly poorer than the 0.078 reported for the full model. A likelihood ratio test comparing the full and collapsed models produces a result of 100.67. This exceeds the critical chi-squared value (28.87, 18 df, $p<0.05$), indicating that the full model has a significantly better goodness-of-fit that the collapsed model.

Figure 6.1 Part worth utility functions (collapsed model) for summary variables



[15] For the Crime Rate and Unemployment Rate attributes the estimates represent the opposite changes and the scores were adjusted accordingly.

Table 6.2 PWUs for DCE (collapsed model)

Attribute	Parameter estimate	Standard error	t-value*
Ecological Summary			
1st linear	0.156	0.010	**15.122**
2nd linear	-0.056	0.030	-1.865
Social Summary			
1st linear	0.086	0.022	**3.893**
2nd linear	0.130	0.021	**6.326**
Economic Summary			
1st linear	0.118	0.021	**5.761**
2nd linear	-0.025	0.021	-1.172
Landuse Allocation			
Timber Harvest	-0.206	0.035	**-5.964**
Preservation	0.131	0.034	**3.840**
Integration of Uses	0.093	0.035	**2.699**
Separation of Uses	-0.019	0.035	-0.536
Park Classes			
few wilderness parks	-0.032	0.020	-1.653
mostly wilderness parks	0.032	0.020	1.654
Access & Recreation			
Low Access	-0.031	0.034	-0.919
Moderately Low Access	0.014	0.033	0.430
Moderately High Access	-0.023	0.035	-0.658
High Access	0.040	0.034	1.185
Access Restrictions			
no restrictions on access	-0.027	0.030	-0.888
no hunting in recent clearcuts	0.012	0.031	0.396
no access to certain remote lakes	0.015	0.030	0.494

*bold indicates t-value significant at p<0.05 Adjusted Rho-Squared = 0.069

Note: For categorical attributes, the values in italics were calculated from the other level(s) for each attribute as follows: the parameter estimate is the negative sum of the estimates of the other level(s); the standard error is the mean of the standard errors for the other levels; the t-value is the parameter estimate divided by the standard error.

The PWU functions for the collapsed model are shown in Figure 6.1. While the Social summary attribute shows a relatively consistent linear pattern both above and below the current level, the Economic and Ecological summary attributes both show a decline in utility for increasing any of the attributes above the current or ‘natural’ level. For the Economic summary attribute, this decline in utility is not significant but for the Ecological summary attribute the decline is significant at p<0.10. These results summarise some of the issues that were raised already earlier in the discussion of the full model; while respondents are opposed to a decline in any of the three summary variables, they are most concerned about an improvement in the Social attributes. It appears that respondents would like to see Ecological Services maintained at the ‘natural’ level and are satisfied with the current economic conditions, but would also like see an improvement in the social aspects of their communities. This may reflect a view that the current environmental conditions (whether they are at the ‘natural’ level or somewhat impaired) are acceptable to most people; no improvement is necessary or desirable, but any decline in environmental conditions would have a negative impact on the utility which people derive from forests.

6.2 USING THE COLLAPSED MODEL TO MEASURE TRADEOFFS

A second DSS was created for the collapsed model; this DSS can be used to examine the tradeoffs people are willing to make among the three types of attributes. Table 6.3 is a sensitivity table showing how the public support for each Outcome would change in response to a change in one summary attribute, assuming that all other attributes remain unchanged.

Table 6.3 Percentage changes in public support in response to single level changes in Ecological, Social, and Economic summary attributes

Summary Attribute	increase	Decrease
Ecological	-1.4	-3.9
Social	+3.2	-2.2
Economic	-0.6	-3.0

Note: increase and decrease refer to changes from 'at the natural level' or 'no change'

The results from Table 6.3 clearly illustrate the tradeoffs respondents are willing to make among the Ecological, Social, and Economic attributes. Respondents would be willing to trade a decrease in economic or environmental conditions for an improvement in social conditions. However, since people appear to be satisfied with the current economic conditions, they do not appear to be willing to accept an improvement in economic conditions in exchange for a decline in either social or economic conditions. The tradeoffs involving the Ecological attributes are a little more complex and depend on the current environmental conditions. If one assumes that the Ecological attributes are currently 'at the natural level,' then any 'improvement' beyond this level is associated with a negative utility. In other words, people do not want to see conditions increased beyond what is 'natural' so they are not willing to trade off such an improvement against declines in any other attribute. If, however, one assumes that the current environmental conditions are at some point below the 'natural' level, then an improvement towards the 'natural' level results is desirable. In this situation, people would be willing to trade a decline in either social or economic conditions for an improvement in environmental conditions. The magnitudes of the changes in public support from Table 6.3 also provide some useful information. Decreases in the Ecological attribute are valued more negatively than declines in either of the other types of attributes. This suggests that people would be more willing to see a decline in social or economic conditions as opposed to environmental conditions.

The finding that people are somewhat opposed to increasing the Ecological Services above the 'natural' level is not particularly surprising. The term 'natural' could imply that this is how things should be; the natural world functions perfectly in the absence of human interference, so if we can keep the environment at the 'natural' level, then we do not need to worry about whether we are doing long term damage to the Earth. Adamowicz and others (1998b) reported similar findings in a DCE study in which respondents were told that the minimum viable population for caribou was 600. The utility of caribou was found to be non-linear, with respondents reporting a much greater utility for increasing the caribou population from 400 to 600 than for increasing the population above 600 (Adamowicz et al., 1998b).

The finding that people are also slightly opposed (or at least neutral) to an increase in the Economic attributes is somewhat unexpected. This finding seems to suggest that Economic attributes such as increased income or reduced unemployment are simply not as important to residents of northern Ontario as are Ecological Services or many of the Social attributes. People do not want economic conditions to get worse, but they are willing to forgo improved economic conditions in favour of maintaining a healthy environment or improving social conditions.

The above findings should be considered with a degree of caution. It is possible that there are economic attributes that are more important to people than the four that were selected for this study. While the selection of attributes for RSVP involved extensive pre-testing and consultation with resource managers and members of the public, it is still possible that an important attribute was missed. Further research using these and other economic attributes would serve to either reinforce or contradict the findings presented here. Another possible explanation for these findings is that people recognise that economic conditions, and particularly income, are not all that important in and of themselves. Money on its own does not provide much utility to most people. Rather it is the ability of money to purchase goods and services which is valuable to people. Economic sustainability is important only as a means to ensuring social and environmental sustainability.

6.3 DIFFERENCES IN PART WORTH UTILITIES (COLLAPSED MODEL) BETWEEN SEGMENTS

The collapsed models revealed few significant differences between segments on any of the summary attributes. The exception is the Segmentation by Preferred Outcome in which the *Environmental* segment had significantly ($p<0.05$) higher PWUs for both the Ecological summary estimates. This suggests that there is a remarkable consistency in opinions about the relative importance of all three types of attributes across all segments. Much stronger differences between segments emerged for the Landuse and Access attributes. These results are consistent with the results of the corresponding attributes in the full model and will not be discussed further in this section. The significant differences between segments are listed in Table 6.4, while the complete results of the collapsed model runs are presented in Appendix C.

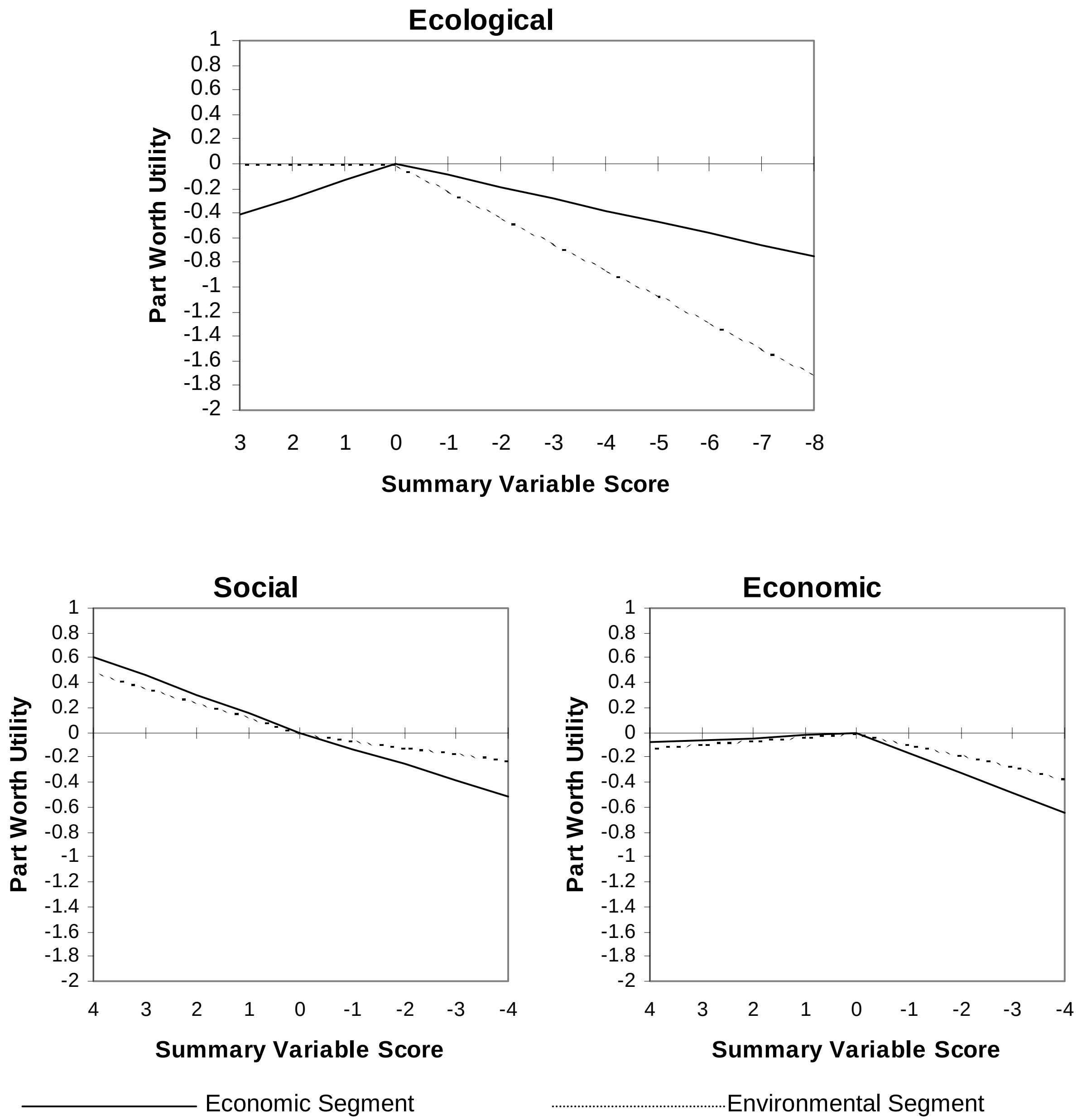
The PWU functions for all three summary variables are shown in Figure 6.2. As mentioned above, the only significant differences between the Preferred Outcome segments were for the Ecological estimates. In Figure 6.2, the linear estimate for increasing Ecological conditions for the *Economic* segment is so close to zero that the line is essentially parallel to the x-axis.

Table 6.4 Significant differences in part worth utility estimates (collapsed model) between segments

Attribute	Preferred Outcome	Land Allocation	Recreation Participation	Residence
Ecological Summary				
1st linear	*Environmental*			
2nd linear	*Environmental*			
Social Summary				
1st linear				
2nd linear		*(More Parks)*		
Economic Summary				
1st linear	*(Economic)*			
2nd linear				
Landuse Allocation				
Timber Harvest	*Economic*	*Less Parks*	*(Consumptive)*	*(Rural)*
Preservation	*Environmental*	*(More Parks)*		*Urban*
Integration of Uses				
Separation of Uses				
Park Classes				
few wilderness parks	*Economic*	*Less Parks*		
mostly wilderness parks	*Environmental*	*More Parks*		
Access & Recreation				
Low Access			*(Non-consumptive)*	
Moderately Low Access	*Environmental*	*(More Parks)*		
Moderately High Access				
High Access	*(Economic)*		*Consumptive*	
Access Restrictions				
no restrictions on access	*Economic*	*Less Parks*	*Consumptive*	*Rural*
no hunting in recent clearcuts	*Environmental*	*More Parks*	*Non-consumptive*	*Urban*
no access to certain remote lakes	*(Economic)*			

*For those attributes/levels for which there was a significant ($p<0.05$) difference in PWU between segments, the segment which had the higher PWU is listed. Segments listed in parentheses indicate a difference that was significant only at $p<0.10$.

Figure 6.2 Part worth utility functions for summary variables (collapsed model) in Segmentation by Preferred Outcome



6.4 MODEL VALIDITY

As with the full model, the holdout sets can be used to test the validity of the collapsed model. The results of this test are shown in Table 6.5. It appears that the collapsed model is approximately as accurate at predicting the public support for the Outcomes in Choice Set 9 as the full model; the collapsed model also predicts equally poorly as the full model for Choice Set 10.

Table 6.5 Percent of respondents selecting each Outcome in holdout set 9 (collapsed model)

	Outcome A	Outcome B
Entire Sample		
Predicted (DSS)	63.9	36.1
Actual (from Survey)	59.9	40.1
Economic Segment		
Predicted (DSS)	56.5	43.5
Actual (from Survey)	53.6	46.4
Environmental Segment		
Predicted (DSS)	70.0	30.0
Actual (from Survey)	65.1	34.9

Note: Due to the inability of the DSS to calculate valid predictions for Set 10, only the results of Set 9 are included.

In addition to the tradeoffs among specific environmental, social, and economic attributes, the DCE can also be used to examine the more general tradeoffs respondents are willing to make among the various types of attributes. A collapsed model form and corresponding DSS were used to examine these general tradeoffs. In general, respondents would like to see environmental and economic conditions to be maintained at the ‘natural’ or current level. Additionally, respondents would like to see an improvement in social conditions. These findings could potentially be compared with future similar studies to examine possible underlying trends in preferences for environmental, social, and economic values.

CHAPTER SEVEN: CONCLUSIONS

This chapter summarises the results of the research, including the implications of RSVP on forest management in northern Ontario, and the usefulness of DCEs and other stated preference techniques for measuring sustainability in ecosystem management. This is followed by a discussion of survey limitations, suggestions for further research, and some final remarks.

7.1 RSVP AND THE IMPLICATIONS FOR FOREST MANAGEMENT IN NORTHERN ONTARIO

This section is intended as a general summary of the significant results from RSVP with respect to how these results might influence forest management in northern Ontario. First of all, it is obvious that forest management is an issue that concerns many residents of northern Ontario. Over 900 people were willing to invest their time and effort in completing the survey and many respondents included comments demonstrating a high degree of concern for a number of forest management issues. The DCE showed that most respondents placed a lot of importance on ensuring that all the various Ecological Services be maintained at close to the natural level, even if this meant trading off some Social and Economic benefits. The full model provides useful information about a number of specific Ecological, Social, and Economic attributes and can be used to construct a computerised DSS which allows resource managers to compare the public support for various management options. Specific tradeoffs people are willing to make among individual Ecological Services and Social and Economic attributes can also be explored with this DSS. Thus, the full model is successful in meeting the first three research objectives and provides an example to answer the first research question. The RSVP is a clear example of how survey techniques can be used to inform resource managers about the environmental, social, and economic values held by the general public of northern Ontario.

Some specific results from RSVP include the following. In general, residents are opposed to any decline in any Ecological Services below the ‘natural’ level but are neutral or opposed to any increase beyond what is ‘natural.’ The Social attributes reveal that people would like to see a decreased rate of crime and improvements in the quality of both education and medical care. For the Economic attributes, respondents are relatively satisfied with their current level of income and the current unemployment rate, but they would not like to see either of these attributes made worse. Residents do not want to see any change in the level of employment in the forest industry but would like to see employment in tourism and recreation increased.

Results from other sections of the survey reveal that despite some differences between various segments of the population, residents of northern Ontario desire to have more protected areas and to ensure that local residents have the right to access forested land for a variety of recreational and other purposes.

The collapsed model shows the more general tradeoffs people are willing to make among Ecological, Social, and Economic attributes. These results suggest that, in general, people want to see all the Ecological Services maintained at their 'natural' levels, would like to see an improvement in the social conditions, and are satisfied with current economic conditions. Residents are opposed to a decline in any of the three types of attributes, but declines in the Ecological attributes are of the greatest concern.

7.2 DISCRETE CHOICE EXPERIMENTS AS A TOOL FOR MEASURING SUSTAINABILITY TRADEOFFS

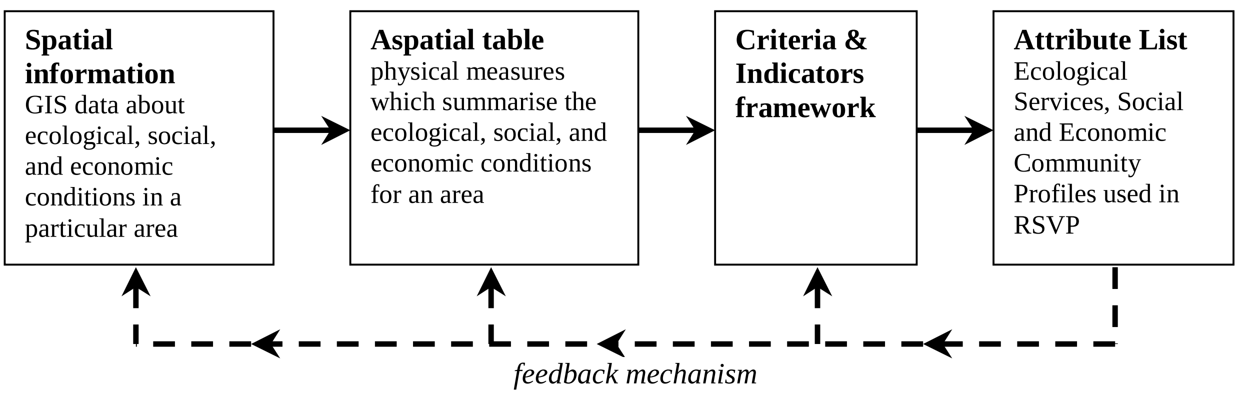
Discrete choice experiments are by no means a panacea to solve the problem of sustainability. They can, however, provide essential information about the tradeoffs which people are willing to make amongst the environmental, social, and economic dimensions of sustainability. The 'moderate' sustainability framework described in Section 2.3.2 includes certain minimum critical levels of environmental, social, and economic conditions which must be maintained. It is within these limits that the various aspects of sustainability may be traded off against one another and herein lies the potential of DCE to aid in decision-making. As long as the critical minimum levels are maintained, many different combinations of environmental, social, and economic conditions can be considered sustainable. The challenge facing resource managers is to determine which combination of environmental, social, and economic attributes will provide the greatest benefits to society. This determination requires information about people's values and preferences for different environmental, social, and economic attributes. The results of this research clearly demonstrate that a carefully designed DCE can provide this information. In addition to measuring people's preferences for specific environmental, social, and economic attributes, the collapsed model shows that a DCE can also be used to measure more general tradeoffs among the three types of values. This meets the fourth research objective and provides an affirmative answer to the first research question about whether or not survey techniques can be used to measure environmental, social, and economic values.

A DSS developed from the results of a DCE can be used to estimate public support for a wide range of different resource management options. While this paper has focused specifically on applying a DCE to measuring sustainability, other SP techniques may also be useful for providing similar information. As discussed in Chapter Two, a significant amount of research has been invested into the use of CVM to measure non-use or passive-use values. This project, along with the other DCE studies described in

Chapter Two, shows that DCE can also be successfully applied to measuring environmental values and tradeoffs.

One way of making the RSVP results more useful to resource managers would be to translate the levels used to measure each attribute back into more easily measurable terms. There are a number of possible methods by which this might be accomplished; while actually implementing these ideas is beyond the scope of this paper, the basic concept shall be presented here. The selection of attributes for the DCE was based on the notion that physical measures of the resources in a given area or ecosystem can be summarised in an aspatial table (Figure 3.1). In turn, these measures can be used to describe the current status of an ecosystem in terms of various indicators from the C&I framework. In order for the public to evaluate and trade off these measures, the indicators needed to be simplified further into the Ecological Services and Social and Economic attributes used in the DCE, all of which were described on two common scales. The analysis of the DCE provided information about people's preferences for different levels of these Ecological Services. The challenge is to relate the PWUs from the DCE back to indicators, or possibly even to measures in the aspatial table (Figure 7.1).

Figure 7.1 Re-integrating values and tradeoffs with measures of ecological, social, and economic conditions



This conversion could take a number of forms. For example, it might be possible to describe each attribute in terms of one or more indicators from the C&I framework. For Biodiversity, for example, there has been a significant amount of research on establishing indicators of biodiversity at various scales (see, for example, Xu, 1997; Montgomery, Pollack, Freemark, & White, 1999; Stefans, Hoehn, & Lupi, 2000). It might be fairly simple to derive a single measure for biodiversity that could be easily linked to the scale used to measure Biodiversity in the DCE. For other attributes, perhaps several indicators could be combined to produce a measure that is closely related to an attribute used in the DCE. There might be several different combinations of indicators that would equate to a level of ‘moderately impaired’ for a particular Ecological Service. The eventual goal would be to be able to take the information about people’s values provided by the DCE and link it directly to physical measures. A resource manager would then be able to map out the ecological conditions of an area and use the DSS to predict public support for different management strategies based on future ecological conditions which would likely be created by that strategy. While this concept requires further development, it could be very beneficial to resource managers.

7.3 STUDY LIMITATIONS

7.3.1 ABORIGINAL ISSUES

One of the weaknesses of this survey was that Aboriginal rights and values were not included as an attribute in the DCE, nor were they addressed elsewhere in the survey instrument. Nine respondents made comments (some strongly worded) regarding Aboriginal hunting and fishing rights, so these issues are obviously of concern to some residents of northern Ontario.

While there was no demographic question to identify Aboriginal respondents, only one respondent identified her/himself as an Aboriginal. Adamowicz and others (1998a) discuss a number of difficulties of using non-market valuation techniques for Aboriginal peoples. Based on some of these difficulties, I suspect that the RSVP survey instrument likely did not capture many Aboriginal values and also likely failed to present tradeoffs in a context relevant to many Aboriginal people. This may have contributed to a low response rate among Aboriginal respondents.

7.3.2 ECOLOGICAL SERVICES INDICATORS

One of the potentially serious limitations of the RSVP survey is the ease with which the results can be translated into actual management decisions. For example, while the DSS can be used to show the level of public support for (or opposition to) a one level change in a particular attribute, it is more difficult to explain exactly what this change implies in the real world. Operationalising these attributes in more quantitative terms would make the resulting PWUs easier to apply to management decisions. The key is to find a way to ensure that the indicators are both easy to operationalise and meaningful to respondents. On a cautionary note, using different scales to measure the different Ecological Services could have made the choice task even more difficult, if not impossible, for respondents.

7.3.3 FORMAT OF SURVEY INSTRUMENT

Many respondents (and non-respondents) indicated that the RSVP survey, and particularly the DCE portion of the survey, was quite complicated and time-consuming to complete. This affected the response rate negatively, and may have created biases in the sample (e.g. bias towards more highly educated respondents). Although the RSVP survey was the product of more than a year of refinements, stakeholder consultations, pre-testing, and expert suggestions, there will always be room for improvement. The difficulties arose in large part from the desire to simultaneously measure a diverse suite of values in a context which is unfamiliar to most respondents. Due to budgetary constraints and the requirements of a large sample size, a mail survey was the only feasible format for RSVP. Despite the efforts that were made to introduce respondents to the various concepts in the DCE, and attempts to clearly explain the DCE task, many respondents still had difficulties with the survey. It is likely that some of these difficulties could have been overcome through changing the survey instrument from a mailout to a one-on-one or small group survey session. The presence of an interviewer or facilitator would have had a number of benefits. Not only would someone have been available to answer questions, but once respondents went to the effort of attending the survey session, they would potentially be more likely to put the extra effort into completing the survey instrument, rather than simply giving up and failing to mail it back. In-person surveying would also open up the possibilities of a computerised survey instrument with the flexibility for many interesting variations on the survey instrument. A drawback of in-person surveying would be the greatly increased cost. In addition to paying an interviewer or facilitator, there would also be the costs of renting facilities and the cost of some sort of incentive for respondents. Despite the extra costs, the potential improvements could be dramatic.

7.3.4 Welfare Estimation

It could be argued that the lack of a payment vehicle is a limitation of the RSVP survey. Another possible limitation is the lack of a 'base alternative' in the DCE. The inclusion of a payment vehicle and a status quo option would have made some welfare estimations simpler, but would also have created other difficulties. The reasons for excluding the payment vehicle are discussed in earlier sections of this paper and likely outweigh the benefits of a payment vehicle, especially since the calculation of dollar values was not necessary to answer the research questions. A status quo option in each choice set would have been necessary for estimating such dollar values, but would also have allowed some interesting comparisons between the current situation and the possible future Outcomes. The reasons for not including a status quo option were largely to avoid making an already complicated survey instrument even more arduous. Another reason was the impossibility of customising the status quo to accurately represent the conditions around a respondent's particular community. While it was possible to estimate the current patterns of landuse and access averaged across northern Ontario, defining these patterns for each individual community was beyond the possible scope of RSVP. It might have been useful, however, to at least include landuse and access patterns which more closely represented the current situation in the orthogonal design of the DCE.

7.4 SUGGESTIONS FOR FUTURE RESEARCH

A mentioned in the previous chapter, there is a lot of potential for a computerised survey instrument. Such an instrument could enable researchers to gain even more information about people's values and preferences. A computerised survey could enable the responses to questions from one part of the survey to be used as a basis for later questions. Surveys could thus be personalised and made more relevant to respondents. Another benefit would be that pictures or other graphics could be used in ways that simply are not possible in a mailout survey instrument.

The RSVP survey contained six ecological indicators and four each of the social and economic indicators. Obviously there are many other indicators which could also be used to value forests and other ecosystems. One interesting direction for future research would be to conduct a similar study using a different suite of indicators. It would be interesting to see if a different set of indicators would produce similar results, especially in the summary indicators. A comparison of summary indicators from several studies might provide useful information about which indicators are really the most meaningful and important to members of the public.

7.5 FINAL REMARKS

The Resource Services Valuation Project has resulted in a great deal of interesting and useful information about the values people place on various aspects of forests and forest management. In meeting the various research objectives, a decision support tool was created to predict the level of public support for a wide range of management Outcomes. Much of this information could be used as input into forest management planning processes, providing much-needed information about many non-market and non-use values which are often overlooked when making important decisions about how to manage natural resources. Beyond the specific application to forest management in northern Ontario, RSVP also provides some insights into the broader tradeoffs people are willing to make among environmental, social, and economic sustainability. It is only through this formal consideration of all aspects of sustainability that we can hope to achieve a paradigm of resource management which is truly sustainable.

REFERENCES

Adamowicz, W., Beckley, T., Hatton MacDonald, D., Just, L., Luckert, M., Murray, E., et al. (1998a). In search of forest resource values of indigenous peoples: Are nonmarket valuation techniques applicable? *Society & Natural Resources, 11*, 51-66.

Adamowicz, W., Boxall, P., Williams, M., & Louviere, J. (1998b). Stated preference approaches for measuring passive use values: Choice experiments and contingent valuation. *American Journal of Agricultural Economics, 80*, 64-75.

Adamowicz, W., Louviere, J., & Williams, M. (1994). Combining revealed and stated preference methods for valuing environmental amenities. *Journal of Environmental Economics and Management, 26*, 271-292.

Adamowicz, W., Swait, J., Boxall, P., Louviere, J., & Williams, M. (1997). Perceptions versus objective measures of environmental quality in combined revealed and stated preference models of environmental valuation. *Journal of Environmental Economics and Management, 32*, 65-84.

Adamowicz, W. & Veeman, T. S. (1998). Forest policy and the environment: Changing paradigms. *Canadian Public Policy, 24*(Suppl. 2), S51-S61.

Arrow, K., Solow, R., Portney, P., Leamer, E., Radner, R., & Schuman, H. (1993). Report of the NOAA panel on contingent valuation. *Federal Register, 58*(10), 4602-4614.

Balick, M. J. & Mendelsohn, R. (1992). Assessing the economic value of traditional medicines from tropical rain forests. *Conservation Biology, 6*(1), 128-130.

Barbier, E. B. (1987). The concept of sustainable economic development. *Environmental Conservation, 14*(2), 101-110.

Ben Akiva M.E. & Lerman, S. (1985). *Discrete choice analysis: Theory and application to travel demand*. Cambridge, MA: MIT Press.

Bengston, D. N. (1994). Changing forest values and ecosystem management. *Society and Natural Resources, 7*, 515-533.

Blamey, R. K., Bennett, J. W., Louviere, J. J., Morrison, M. D., & Rolfe, J. (2000). A test of policy labels in environmental choice modelling studies. *Ecological Economics, 32*, 269-286.

Blamey, R., Gordon, J., & Chapman, R. (1999). Choice modelling: Assessing the environmental values of water supply options. *Australian Journal of Agricultural and Resource Economics, 45*(3), 337-357.

Boxall, P. C., Adamowicz, W. L., Swait, J., Williams, M., & Louviere, J. (1996). A comparison of stated preference methods for environmental valuation. *Ecological Economics, 18*, 243-253.

Canadian Council of Forest Ministers. (2000). *Criteria and indicators of sustainable forest management in Canada: National status 2000.* Ottawa, ON: Natural Resources Canada.

Carson, R. (1998). Valuation of tropical rainforests: Philosophical and practical issues in the use of contingent valuation. *Ecological Economics, 24*, 15-29.

Carson, R. T., Louviere, J. J., Anderson, D. A., Arabie, P., Bunch, D. S., Hensher, D. A., et al. (1994). Experimental analysis of choice. *Marketing Letters*, *5*(4), 351-368.

Christensen, N.L., Bartuska, A.M., Brown, J.H., Carpenter, S., D'Antonio, C., Francis, R., et al. (1996). The report of the Ecological Society of America committee on the scientific basis for ecosystem management. *Ecological Applications, 6*(3), 665-691.

Clark, R. & Stankey, G. (1978). *The Recreation Opportunity Spectrum: A framework for planning, managing and research* (General Tech. Rep. PNW-98). Seattle, WA: Pacific Northwest Forest and Range Experiment Station, United States Department of Agriculture, Forest Service.

Costanza, R. (1996). Ecological economics: Creating a transdisciplinary science. In P.H. May & R. Serôa da Motta (Eds.), *Pricing the planet: Economic analysis for sustainable development* (pp. 149-169). New York: Columbia University Press.

Costanza, R. & Daly, H.E. (1992). Natural capital and sustainable development. *Conservation Biology, 6*, 37-46.

Costanza, R. & Patten, B. C. (1995). Defining and predicting sustainability. *Ecological Economics, 15*, 193-196.

Daily, G. C. (1997). Introduction: What are ecosystem services? In *Nature's services: Societal dependence on natural ecosystems* (pp. 1-10). Washington, DC: Island Press.

Daly, H. E. (1987). The economic growth debate: What some economists have leaned but many have not. *Journal of Environmental Economics and Management*, *14*, 323-336.

Dillman, D. A. (2000). *Mail and internet surveys: The tailored design method* (2nd ed.). Toronto, ON: John Wiley & Sons.

Dodds, S. (1997). Towards a 'science of sustainability': Improving the way ecological economics understands human well-being. *Ecological Economics, 23*, 95-111.

Godoy, R., Lubowski, R., & Markandya, A. (1993). A method for the economic valuation of non-timber tropical rainforest products. *Economic Botany, 47*(3), 220-233.

Goodland, R. (1995). The concept of environmental sustainability. *Annual Review of Ecology and Systematics, 26*, 1-24.

Greene, W.H. (1998). Limdep (Version 7.0) [Computer software]. Plainview NY: Econometric Software.

Grumbine, R. E. (1994). What is ecosystem management? *Conservation Biology, 8*, 27-38.

Haider, W., Anderson, D. A., Daniel, T. C., Louviere, J. J., Orland, B., & Williams, M. (1998). Combining calibrated digital imagery and discrete choice experiments: An application to remote tourism in northern Ontario. In M. E. Johnston, G. D. Twynam, & W. Haider (Eds.), *Shaping tomorrow's North: The role of tourism and recreation* (pp. 257-278). Proceedings of an International Conference on Northern Tourism and Recreation. Centre for Northern Studies, Lakehead University, Thunder Bay, ON.

Hanley, N., MacMillan, D., Wright, R. E., Bullock, C., Simpson, I., Parsisson, D., et al. (1998a). Contingent versus choice experiments: Estimating the benefits of Environmentally Sensitive Areas in Scotland. *Journal of Agricultural Economics, 49*(1), 1-15.

Hanley, N., Wright, R. E., & Adamowicz, W. (1998b). Using choice experiments to value the environment: Design issues, current experience and future prospects. *Environmental and Resource Economics, 11*(3-4), 413-428.

Hediger, W. (2000). Sustainable development and social welfare. *Ecological Economics, 32*, 481-492.

Hunt, L., Twynam, D., Haider, W., & Robinson, D. (2000) Examining the Desirability for Recreating in Logged Settings. *Society and Natural Resources, 13*, 717-734.

Jakobsson, K. M. & Dragun, A. K. (1996). *Contingent valuation and endangered species: Methodological issues and applications.* Cheltenham, UK: Edward Elgar.

Jamieson, D. (1998). Sustainability and beyond. *Ecological Economics, 24*, 183-192.

Johnston, R. J., Swallow, S. K., & Weaver, T. F. (1999). Estimating willingness to pay and resource tradeoffs with different payment mechanisms: An evaluation of a funding guarantee for watershed management. *Journal of Environmental Economics and Management, 38*, 97-120.

Jorgensen, B. S., Syme, G.J ., Bishop, B. J., & Nancarrow, B. E. (1999). Protest responses in contingent valuation. *Environmental and Resource Economics, 14*, 131-150.

Kahneman, D. & Knetsch, J. (1992). Valuing public goods: The purchase of moral satisfaction. *Journal of Environmental Economics and Management, 22*(1), 57-70.

Keeney, R. (1992). *Value focused thinking: A path to creative decision making*. Cambridge, MA: Harvard University Press.

Knetsch, J. (1994). Environmental valuation: Some problems of wrong questions and misleading answers. *Environmental Values, 3*, 351-368.

Knowler, D. & Lovett, J. (1996). *Training manual for environmental assessment in Asian forestry.* Bangkok, Thailand: Food and Agricultural Organization.

Leopold, A. (1949). *A sand county almanac*. New York: Ballantine Books.

Levitt, L. (1989). Therapeutic value of wilderness. In *Wilderness Benchmark 1988: Proceedings of the National Wilderness Colloquium* (General Tech. Rep. SE-51, pp. 156-168). Tampa, FL: United States Department of Agriculture, Forest Service.

Loomis, J., Lockwood, M., & DeLacy, T. (1993). Some empirical evidence on embedding effects in contingent valuation of forest protection. *Journal of Environmental Economics and Management, 24*, 45-55.

Louviere, J.J., Hensher, D.A., & Swait, J.D. (2000). *Stated choice methods: Analysis and applications.* New York: Cambridge University Press.

Mallawaarachchi, T., Blamey, R. K., Morrison, M. D., Johnson, A. K. L., & Bennett, J. W. (2001). Community values for environmental protection in a cane farming catchment in Northern Australia: A choice modelling study. *Journal of Environmental Management, 62*, 301-316.

Manning, R. E. (1989). Social research in wilderness: Man in nature. In *Wilderness Benchmark 1988: Proceedings of the National Wilderness Colloquium* (General Tech. Rep. SE-51, pp. 120-131). Tampa, FL: United States Department of Agriculture, Forest Service.

McConnell, K. E. (1995). Consumer surplus from discrete choice models. *Journal of Environmental Economics and Management, 29*, 263-270.

McDonald, B., Guldin, R., & Wetherhill, G. R. (1989). The spirit in the wilderness: The use and opportunity of wilderness experience for spiritual growth. In *Wilderness Benchmark 1988: Proceedings of the National Wilderness Colloquium* (General Tech. Rep. SE-51, pp. 193-207). Tampa, FL: United States Department of Agriculture, Forest Service.

McFadden, D. (1974). Conditional logit analysis of qualitative choice behaviour. In P. Zamembka (Ed.), *Frontiers in Econometrics* (pp. 105-142). New York: Academic Press.

Mitchell, R. C. & Carson, R. T. (1989). *Using Surveys to Value Public Goods: The Contingent Valuation Method.* Baltimore, MD: Johns Hopkins University Press for Resources for the Future.

Montgomery, C. A., Pollack, R. A., Freemark, K., & White, D. (1999). Pricing biodiversity. *Journal of Environmental Economics and Management, 38*, 1-19.

Morrison, M., Bennett, J., & Blamey, R. (1999). Valuing improved wetland quality using choice modeling. *Water Resources Research, 35*(9), 2805-2814.

Munda, G. 1997). Environmental economics, ecological economics, and the concept of sustainable development. *Environmental Values, 6*(2), 213-233.

Muth, R. G. & Glass, R. J. (1989). Wilderness and subsistence-use opportunities: benefits and limitations. In *Wilderness Benchmark 1988: Proceedings of the National Wilderness Colloquium* (General Tech. Rep. SE-51, pp. 142-155). Tampa, FL: United States Department of Agriculture, Forest Service.

Ontario Ministry of Natural Resources. (1996). *Forest management planning manual for Ontario's Crown forests.* Toronto, ON: Queen's Printer for Ontario.

Ontario Ministry of Natural Resources. (1999). *Ontario's Living Legacy land use strategy.* Toronto, ON: Queen's Printer for Ontario.

Pearce, D. W., Atkinson, G. D., & Dubourg, W. R. (1994). The economics of sustainable development. *Annual Review of Energy and the Environment, 19*, 457-474.

Raktoe, R.L., Hedayat, A. & Federer, W.T. (1981). *Factorial Designs*. New York: John Wiley and Sons.

Ribe, R. G. (1989). The aesthetics of forestry: What has empirical preference research taught us? *Environmental Management, 13*(1), 55-74.

Rolston, H., III. (1985). Valuing wildlands. *Environmental Ethics, 7*, 23-48.

Rolston, H., III. (1988). Human values and natural systems. *Society and Natural Resources 1*, 271-283.

Ross, M. M. (1995). *Forest management in Canada.* Calgary, AB: Canadian Institute of Resources Law.

Runyon, R.P. & Haber, A. (1991). *Fundamentals of behavioral statistics* (7th ed.). Toronto, ON: McGraw-Hill.

Scott, M. J., Bilyard, G. R., Link, S. O., Ulibarri, C. A., & Westerdahl, H. E. (1998). Valuation of ecological resources and functions. *Environmental Management*, *22*(1), 49-68.

Stankey, G. H. & Clark, R. N. (1992*). Social aspects of new perspectives in forestry: A problem analysis* (Pinchot Institute for Conservation Monograph Series). Milford, PA: Grey Towers Press.

Stefans, K., Hoehn, J. P., & Lupi, F. (2000, August). *Natural resource user preferences and biodiversity indicators.* Paper presented at the American Agricultural Economics Association Meeting, Tampa, FL.

Train, K. (1986). *Qualitative choice analysis: Theory, econometrics, and an application to automobile demand.* Cambridge, MA: MIT Press.

Walsh, R. G. & Loomis, J. B. (1989). The non-traditional public valuation (option, bequest, existence) of wilderness. In *Wilderness Benchmark 1988: Proceedings of the National Wilderness Colloquium* (General Tech. Rep. SE-51, pp. 181-191). Tampa, FL: United States Department of Agriculture, Forest Service.

World Commission on Environment and Development. (1987). *Our common future*. New York: Oxford University Press.

Xu, W. (1997). *Experimental choice analysis of non-market values for ecosystem management with preference heterogeneity*. Unpublished doctoral dissertation, College of Forest Resources, University of Washington.

Yoo, S.-H., Kwak, S.-J., & Kim, T.-Y. (2001). Modelling willingness to pay responses from dichotomous choice contingent valuation surveys with zero observations. *Applied Economics*, *33*, 523-529.

APPENDIX A: EXAMPLE SURVEY INSTRUMENT

RSVP

Resource Services Valuation Project

Photograph of a forest scene omitted

A questionnaire about forests in Northern Ontario

OUTDOOR RECREATION PARTICIPATION

For each of the outdoor activities listed below, please answer the following questions:

1 **Please indicate how many days you participated in each activity in Northern Ontario during the past year (2000).**

2 **Please estimate the typical distance you travel from your home in order to participate in each activity.**

	1 Never	1 – 4 Days	5 – 9 Days	10 – 24 Days	> 25 Days	2 Usual Distance
day hiking and nature walking	❑	❑	❑	❑	❑	___ km
backpacking (multi-day)	❑	❑	❑	❑	❑	___ km
motor boating (without fishing)	❑	❑	❑	❑	❑	___ km
canoeing / kayaking	❑	❑	❑	❑	❑	___ km
fishing from boat (for pickerel, pike, bass)	❑	❑	❑	❑	❑	___ km
fishing from boat (for laketrout)	❑	❑	❑	❑	❑	___ km
fishing from shore	❑	❑	❑	❑	❑	___ km
fishing on ice	❑	❑	❑	❑	❑	___ km
big game hunting (moose/deer/bear)	❑	❑	❑	❑	❑	___ km
small game hunting (grouse/ducks/rabbits)	❑	❑	❑	❑	❑	___ km
wildlife viewing or study	❑	❑	❑	❑	❑	___ km
landscape photography or art	❑	❑	❑	❑	❑	___ km
bird watching	❑	❑	❑	❑	❑	___ km
cross-country skiing	❑	❑	❑	❑	❑	___ km
snowmobiling	❑	❑	❑	❑	❑	___ km
driving all terrain vehicles (ATVs)	❑	❑	❑	❑	❑	___ km
mountain biking	❑	❑	❑	❑	❑	___ km
gathering (berries / mushrooms etc.)	❑	❑	❑	❑	❑	___ km
cutting fuelwood / firewood	❑	❑	❑	❑	❑	___ km
camping on private land (campground)	❑	❑	❑	❑	❑	___ km
camping in parks	❑	❑	❑	❑	❑	___ km
camping on crown land	❑	❑	❑	❑	❑	___ km
other (please list) ________________	❑	❑	❑	❑	❑	___ km
________________	❑	❑	❑	❑	❑	___ km

ECOLOGICAL SERVICES

Forests provide many ecological services that benefit people both directly and indirectly. These benefits may be immediate, local, and obvious, (e.g. maintaining a healthy moose population), or more long-term and global in nature (e.g. maintaining a stable global climate). Each of the phrases below describes one such ecological service.

3 **Please tell us how important each of these services is to you.** *(Circle the appropriate number on the scale beside each service.)*

Ecological Services	Your Importance Rating
	Not at all Important ... Extremely Important
3.1 Fish Habitat—the quality of the habitat required to maintain healthy fish populations. [The habitat might be affected by trees providing shade along streams, water levels and temperatures, and sedimentation of spawning beds.]	1 2 3 4 5
3.2 Wildlife Habitat—the quality of the habitat required to maintain healthy populations of various wildlife species. [Wildlife requires adequate food, water, and shelter throughout the year.]	1 2 3 4 5
3.3 Rare and Endangered Species Habitat—the quality of the habitat required to maintain healthy populations of species in your area which are classified as rare, threatened, or endangered in Northern Ontario by COSEWIC. [The Committee on the Status of Endangered Wildlife in Canada, a group of scientists who monitor and classify endangered species in Canada.]	1 2 3 4 5
3.4 Biodiversity— a measure of the number and diversity of all species. [Areas with high biodiversity are considered more resilient to human or natural disturbances, are often valuable sites for biological research, and may contribute to future medical discoveries. Biodiversity includes all organisms; i.e. animals, plants, fungi, and bacteria. In forests, biodiversity depends primarily on the total number of species of trees, on which species are dominant, and on the complex spatial and temporal patterns that occur in forests.]	1 2 3 4 5
3.5 Nutrient Cycles—nutrients such as nitrogen, potassium, and many others are constantly circulating through the ecosystem. [If these cycles are interrupted the health and productivity of an ecosystem is compromised. Forests may be slower to grow, and animal populations may be affected.]	1 2 3 4 5
3.6 Carbon Storage—forests remove carbon from the atmosphere and store it in the soil, plants, and trees. [This carbon storage reduces the effects of global warming.]	1 2 3 4 5
	Not at all Important ... Extremely Important

Note: In the Short Ecological Services version, the parts of the above definitions in square brackets were omitted.

LANDUSE

Crown land forests in Northern Ontario are managed for many different purposes. On this page, we simplify the situation by considering only the following four landuses:

- **Multiple Use Areas**—in these areas, timber harvesting and other land uses (e.g. recreation and tourism) are managed according to current (2001) provincial guidelines.
- **Intensive Forestry Areas**—in these areas, the focus is primarily on timber production. Other values are still considered, but less importance is given to other forest users.
- **Special Management Areas**—these areas are similar to Multiple Use Areas, but certain land uses (e.g. remote tourism, fish and wildlife habitat, prime recreation sites, or significant natural features) take precedence over timber harvesting. Timber harvesting still takes place, but may be modified to protect these other values.
- **Parks & Protected Areas**—areas which are protected by law as National Parks, Provincial Parks, or Conservation Reserves. Logging and mining are not allowed in these areas.

In the table below, the left column contains the current pattern of landuses in Northern Ontario.

4 What would be your ideal pattern for these landuses throughout Northern Ontario?

5 What would be your ideal pattern for these landuses for the area around your community?
(Please write your preferred percentages in the two columns below. The total of your percentages should add to 100% in each column)

	Current Pattern of Landuses in Northern Ontario	4 Your Ideal Pattern of Landuses Throughout Northern Ontario	5 Your Ideal Pattern of Landuses Around Your Community
Multiple Use Areas	83%	___ %	___ %
Intensive Forestry Areas	0%	___ %	___ %
Special Management Areas	5%	___ %	___ %
Parks & Protected Areas	12%	___ %	___ %
		100 %	100 %

ACCESS & RECREATION

One important influence on the quality of forests and recreation opportunities is access provided by roads and/or off-road vehicles. This produces the following types of access:

- **Unroaded Motorised**—Areas which are more than 1 km from a paved highway or gravel logging road; motorised use is allowed.
- **Unroaded Non-motorised**—Areas which are more than 1 km from a paved highway or gravel logging road; no motorised use permitted (i.e. no snowmobiles or ATVs).
- **Roaded Non-motorised**—Areas which are within 1 km of a paved highway or gravel logging road; no public motorised access (on or off road) is permitted.
- **Roaded Motorised**—Areas which are within 1 km of a paved highway or gravel logging road; motorised use is allowed.

Note: The access described here applies only to those areas outside of parks and protected areas. Restrictions on motorised access do not apply to motorboats.

In the table below, the left column contains the current distribution of access types in Northern Ontario.

6 What would be your ideal pattern for these access types throughout Northern Ontario?

7 What would be your ideal pattern for these access types for the area around your community?
(Please write your preferred percentages in the two columns below. The total of your percentages should add to 100% in each column)

	Current Pattern of Access in Northern Ontario	6 Your Ideal Pattern of Access Throughout Northern Ontario	7 Your Ideal Pattern of Access Around Your Community
Unroaded Motorised	45%	___ %	___ %
Unroaded Non-motorised	0%	___ %	___ %
Roaded Non-Motorised	0%	___ %	___ %
Roaded Motorised	55%	___ %	___ %
		100 %	100 %

! Before you turn the page…

Starting on the next page, we ask you to evaluate possible "Outcomes" of what your community and the surrounding forests could be like in 30 years time. These Outcomes are composed mostly of the questions you answered above, and therefore should be fairly familiar to you.

On each page:

- read through 2 possible Outcomes, and
- pick which one you prefer.

When making your choice, please consult the instructions on the next page (p. 6).

FOREST MANAGEMENT OUTCOMES IN 30 YEARS TIME

On each of the following seven pages, the future Outcomes (results) of two landuse and forest management strategies are described for your community and the surrounding forest area in 30 years time. Typically, several different management approaches can lead to a similar Outcome. Please focus only on the **Outcomes** during your evaluation.

---

8 **Which Outcome would you prefer to see in your community and surrounding forest in 30 years time?** *(Please check ONE box at the bottom of each page to indicate your preference for either Outcome A or Outcome B.)*

When responding, please:

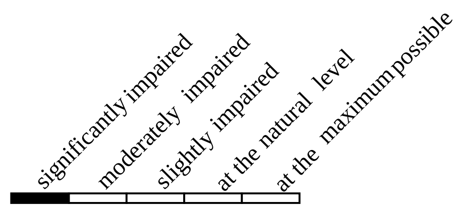
- consider all the values that are important to you, including social, economic, and ecological benefits;
- keep in mind the outdoor activities you like to participate in within your area, and how these Outcomes potentially affect your participation in these activities; and,
- evaluate the Outcomes at face value, even if you think that a particular Outcome is unlikely given the other descriptions. (e.g. How can a reduction in land used for timber harvest lead to higher employment in the forestry sector? Possible Answer: By increased value-added production).

Each description of an Outcome contains the following information:

ECOLOGICAL SERVICES: Forests provide important ecological services (see page 3). The amount and/or quality of each ecological service depends both on the natural conditions of the forest, and on the type of forest management practised in your area.

- In the absence of human influence, each ecological service would be produced at a **natural** level.
- Forest management practices may increase the amount of an ecological service beyond the natural conditions to produce the **maximum** amount possible
- In other cases, forest management and other activities may **impair** the availability of one or more ecological services.

The amount and/or quality of each ecological service is measured on the following scale:



COMMUNITY PROFILES (SOCIAL & ECONOMIC): Inevitably, forest management and use will influence the social and economic situation, and the quality of life in your community.

LANDUSE: On page 4, you allocated 4 landuses to create your preferred pattern of landuse distribution around your community. In the Outcomes, we will use only the following 4 patterns (see the Key for a description of each Landuse Pattern):

- Pattern 1: Emphasis on Timber Harvest
- Pattern 2: Emphasis on Preservation
- Pattern 3: Emphasis on Integration of Uses
- Pattern 4: Emphasis on Separation of Uses

Also, note that the type of parks varies. "Mostly wilderness parks" means that most of the parks are large, remote parks with little development and an emphasis on backcountry use. "Few wilderness parks" means that most of the parks are smaller and more developed, with an emphasis on drive-in camping and day-use.

ACCESS & RECREATION: On page 5, you allocated 4 types of access to create your preferred pattern of access around your community. In the Outcomes, we will use only the following 4 patterns (see the Key for a description of each Access pattern):

- Pattern 1: Low Access
- Pattern 2: Moderately Low Access
- Pattern 3: Moderately High Access
- Pattern 4: High Access

Also, note that roads may be subject to certain restrictions: "no access to certain remote lakes"; or, "no hunting in recent clearcuts".

Peel Off

In this and the following questions, please assume that:

- Ecological Services not specified are "slightly impaired" for both Outcomes
- Community Profile Items not specified are at "no change" for both Outcomes

YOUR COMMUNITY AND SURROUNDING FOREST IN 30 YEARS TIME

	OUTCOME A	**OUTCOME B**
ECOLOGICAL SERVICES		
Fish Habitat	*moderately impaired*	*at the maximum possible*
Biodiversity	*at the natural level*	*slightly impaired*
Nutrient Cycles	*significantly impaired*	*slightly impaired*
COMMUNITY PROFILE - SOCIAL		
Crime Rate	- *20%*	*no change*
Quality of Education	- *10%*	+ *10%*
COMMUNITY PROFILE – ECONOMIC		
Unemployment Rate	- *10%*	+ *10%*
Employment in Forestry	*no change*	+ *10%*
LANDUSE ALLOCATION	*Focus on* **Separation of Uses**	*Focus on* **Timber Harvest**
Park Classes	*few wilderness parks*	*mostly wilderness parks*
ACCESS & RECREATION	**Moderately Low Access**	**High Access**
Access Restrictions	*no hunting in recent clearcuts*	*no restrictions on access*
8.1 **Please choose either Outcome A or Outcome B.**	☐ **OUTCOME A**	☐ **OUTCOME B**

Notes: A glossary containing graphical representations of the Landuse and Access patterns was attached to the survey instrument below the "Peel Here" instructions. This glossary is presented at the end of the survey instrument. The next seven choice sets have been omitted from this appendix to save space.

YOUR COMMUNITY AND SURROUNDING FOREST IN 30 YEARS TIME

	OUTCOME A	**OUTCOME B**
ECOLOGICAL SERVICES		
Fish Habitat	*slightly impaired*	*slightly impaired*
Wildlife Habitat	*slightly impaired*	*slightly impaired*
Rare & Endangered Species Habitat	*slightly impaired*	*moderately impaired*
Biodiversity	*slightly impaired*	*moderately impaired*
Nutrient Cycles	*slightly impaired*	*moderately impaired*
Carbon Storage	*slightly impaired*	*slightly impaired*
COMMUNITY PROFILE - SOCIAL		
Population	*no change*	+ *10%*
Crime Rate	*no change*	*no change*
Quality of Medical Care	*no change*	+ *10%*
Quality of Education	*no change*	- *10%*
COMMUNITY PROFILE – ECONOMIC		
Unemployment Rate	*no change*	*no change*
Average Household Income	*no change*	+ *10%*
Employment in Forestry	*no change*	- *10%*
Employment in Tourism / Recreation	*no change*	+ *10%*
LANDUSE ALLOCATION	*Focus on* **Integration of Uses**	*Focus on* **Separation of Uses**
Park Classes	*few wilderness parks*	*few wilderness parks*
ACCESS & RECREATION	**Moderately Low Access**	**Moderately High Access**
Access Restrictions	*no restrictions on access*	*no access to certain remote lakes*

8.9 **Please choose either Outcome A or Outcome B.**

☐ **OUTCOME A** ☐ **OUTCOME B**

8.10 **Do you consider Outcome A an acceptable Outcome for your community and surrounding forest?**

☐ Yes ☐ No

8.11 **Do you consider Outcome B an acceptable Outcome for your community and surrounding forest?**

☐ Yes ☐ No

Note: This is Holdout Set 9

YOUR COMMUNITY AND SURROUNDING FOREST IN 30 YEARS TIME

	OUTCOME A	OUTCOME B
ECOLOGICAL SERVICES		
Fish Habitat	*moderately impaired*	*at the maximum possible*
Wildlife Habitat	*slightly impaired*	*at the natural level*
Rare & Endangered Species Habitat	*significantly impaired*	*at the maximum possible*
Biodiversity	*moderately impaired*	*at the natural level*
Nutrient Cycles	*significantly impaired*	*at the maximum possible*
Carbon Storage	*slightly impaired*	*at the natural level*
COMMUNITY PROFILE - SOCIAL		
Population	*no change*	*no change*
Crime Rate	- *10%*	+ *10%*
Quality of Medical Care	+ *10%*	- *10%*
Quality of Education	+ *10%*	*no change*
COMMUNITY PROFILE – ECONOMIC		
Unemployment Rate	- *10%*	+ *10%*
Average Household Income	+ *10%*	- *10%*
Employment in Forestry	+ *20%*	- *20%*
Employment in Tourism / Recreation	- *10%*	+ *10%*
LANDUSE ALLOCATION	*Focus on* **Timber Harvest**	*Focus on* **Preservation**
Park Classes	*few wilderness parks*	*mostly wilderness parks*
ACCESS & RECREATION	**High Access**	**Low Access**
Access Restrictions	*no restrictions on access*	*no hunting in recent clearcuts*

8.12 **Please choose either Outcome A or Outcome B.** ☐ **OUTCOME A** ☐ **OUTCOME B**

8.13 **Do you consider Outcome A an acceptable Outcome for your community and surrounding forest?** ☐ Yes ☐ No

8.14 **Do you consider Outcome B an acceptable Outcome for your community and surrounding forest?** ☐ Yes ☐ No

Note: This is Holdout Set 10

SOME QUESTIONS ABOUT YOURSELF

A reminder: Your answers to the survey will remain completely confidential and will be released only as summaries in which no individual answers can be identified.

9 What is your gender?

- ❑ Male
- ❑ Female

10 Which of the following age categories describes you?

- ❑ 18 - 29
- ❑ 30 - 39
- ❑ 40 - 49
- ❑ 50 - 59
- ❑ 60 - 69
- ❑ 70 or over

11 How would you best describe you employment status? *(Please check only <u>one</u> box)*

- ❑ Unemployed
- ❑ Retired
- ❑ Homemaker
- ❑ Student

→ **SKIP to 13**

- ❑ Full-time employment
- ❑ Part-time employment
- ❑ Seasonal employment

→ **12 (If employed) Among the employment sectors listed below, please check the <u>one</u> that best describes your major source of income:**

- ❑ Agriculture
- ❑ Forestry and forest industry sector
- ❑ Mining and prospecting
- ❑ Other industries (primary and manufacturing)
- ❑ Public sector (includes teachers, medical fields, civil servants)
- ❑ Tourism or recreation
- ❑ Other service industries (includes retailing, banking, etc.)
- ❑ Professional (doctor, dentist, lawyer, etc.)
- ❑ Other (please specify) ________________________

13 Are you a member of any of the following groups?

Angling or hunting club (e.g. OFAH)…...…………..	Yes ❑	No ❑
Snowmobile club…………………………………….	Yes ❑	No ❑
Trappers' association………………………………..	Yes ❑	No ❑
Environmental advocacy group……………………..	Yes ❑	No ❑
Cottagers' association……………………………….	Yes ❑	No ❑
Nature interpretation / ornithology…………………..	Yes ❑	No ❑
Canoe club or outdoors club…………………………	Yes ❑	No ❑
Other (please specify) _____________________ …..	Yes ❑	No ❑

14 **How long have you lived in NorthernOntario?**

|__|__| Years

15 **Have you ever participated in a land use / resource management planning process?** *(This could include anything from attending an open house or public meeting about a local land use plan, to being part of a planning team).*

- ❑ Yes
- ❑ No → **SKIP to 18**

16 **Please indicate how you have been involved in land use / resource management planning processes?**

Attended open house / information session……………………	❑ Yes	❑ No
Submitted written comments to planning team / Round Table…	❑ Yes	❑ No
Made formal presentation to planning team / Round Table……	❑ Yes	❑ No
Served as member of a local citizens committee………………	❑ Yes	❑ No
Served as member of a planning team……………………………	❑ Yes	❑ No
Other *(please specify)* ______________________….	❑ Yes	❑ No

17 **What specific land use / resource management planning process have you participated in?**

Lands for Life…………………………………………..	❑ Yes	❑ No
Forest Management Plan………………………………..	❑ Yes	❑ No
Provincial Park Master Plan…………………………….	❑ Yes	❑ No
Other *(please specify)* ____________________ …	❑ Yes	❑ No

18 **What is the highest level of education you have completed?**

- ❑ Completed elementary school
- ❑ Some high school
- ❑ Completed high school
- ❑ Technical training / college
- ❑ Some university
- ❑ Completed university
- ❑ Postgraduate study

19 **What was your household income for the year 2000?**

- ❑ Under $30 000
- ❑ $30 000 - $49 999
- ❑ $50 000 - $69 999
- ❑ $70 000 - $89 999
- ❑ $90 000 or over

20 **How many people live in your household?**

|__|__| People

21 **What is your postal code?**

|__|__|__|__|__|__| Postal Code

22 **Please use the space below for any further comments you may have about forest management in Northern Ontario, or for comments about this questionnaire.**

Thank you for participating in this study.

Printed on recycled paper

APPENDIX B: MODEL COMPARISONS BY SEGMENT (FULL MODEL)

Table A1 Differences in part worth utility estimates (full model) between Preferred Outcome segments

		Economic			Environmental			
Attribute	**Level**	**Parameter estimate**	**Std err**	**t-value***	**Parameter estimate**	**Std err**	**t-value***	**t-stat***
Ecological Services								
Fish Habitat	linear	0.113	0.033	**3.423**	0.248	0.029	**8.466**	**-3.072**
	quadratic	0.043	0.024	1.745	0.088	0.023	**3.766**	-1.351
Wildlife Habitat	linear	0.101	0.029	**3.441**	0.207	0.027	**7.561**	**-2.641**
	quadratic	0.115	0.027	**4.192**	0.073	0.025	**2.915**	1.135
Rare & Endangered Species Habitat	linear	0.021	0.030	0.699	0.201	0.030	**6.753**	**-4.249**
	quadratic	0.051	0.027	1.894	0.084	0.026	**3.202**	-0.879
Biodiversity	linear	0.013	0.030	0.436	0.161	0.028	**5.782**	**-3.624**
	quadratic	0.070	0.027	**2.651**	0.007	0.025	0.272	1.759
Nutrient Cycles	linear	0.070	0.029	**2.387**	0.133	0.027	**4.954**	-1.568
	quadratic	-0.004	0.026	-0.160	0.014	0.024	0.612	-0.533
Carbon Storage	linear	0.090	0.030	**2.937**	0.175	0.029	**6.032**	**-2.028**
	quadratic	0.043	0.025	1.722	0.042	0.025	1.686	0.039
Community Profile—Social								
Population	linear	0.088	0.030	**2.896**	-0.021	0.028	-0.762	**2.656**
Crime Rate	linear	-0.090	0.032	**-2.798**	-0.098	0.030	**-3.265**	0.182
Quality of Medical Care	linear	0.231	0.029	**7.934**	0.094	0.027	**3.435**	**3.442**
Quality of Education	linear	0.140	0.033	**4.191**	0.148	0.033	**4.545**	-0.169
Community Profile—Economic								
Unemployment Rate	linear	-0.089	0.030	**-2.955**	-0.002	0.028	-0.059	**-2.115**
	quadratic	0.042	0.026	1.629	0.024	0.024	0.988	0.511
Average Household Income	linear	0.113	0.032	**3.491**	0.060	0.030	**2.012**	1.211
	quadratic	0.022	0.026	0.844	0.031	0.025	1.216	-0.233
Employment in Forestry	linear	0.009	0.033	0.282	0.042	0.031	1.374	-0.729
	quadratic	0.049	0.025	1.948	0.028	0.023	1.223	0.598
Employment in Tourism / Recreation	linear	0.125	0.029	**4.286**	0.100	0.028	**3.518**	0.616
	quadratic	0.051	0.027	1.924	0.020	0.025	0.792	0.853
Landuse Allocation								
Timber Harvest		*-0.047*	*0.061*	*-0.761*	*-0.340*	*0.056*	***-6.043***	***3.532***
Preservation		-0.034	0.054	-0.632	0.189	0.051	**3.721**	**-3.007**
Integration of Uses		0.007	0.065	0.111	0.127	0.060	**2.135**	-1.360
Separation of Uses		0.073	0.064	1.144	0.024	0.058	0.412	0.569
Park Classes								
few wilderness parks		*0.073*	*0.033*	***2.179***	*-0.101*	*0.030*	***-3.405***	***3.888***
mostly wilderness parks		-0.073	0.033	**-2.179**	0.101	0.030	**3.405**	**-3.888**
Access & Recreation								
Low Access		*-0.001*	*0.057*	*-0.020*	*0.068*	*0.055*	*1.229*	*-0.865*
Moderately Low Access		-0.102	0.055	-1.847	0.093	0.053	1.752	**-2.546**
Moderately High Access		-0.010	0.057	-0.172	-0.064	0.054	-1.181	0.690
High Access		0.113	0.060	1.901	-0.096	0.058	-1.660	**2.520**
Access Restrictions								
no restrictions on access		*0.039*	*0.051*	*0.756*	*-0.113*	*0.050*	***-2.275***	***2.127***
no hunting in recent clearcuts		-0.100	0.052	-1.916	0.187	0.051	**3.661**	**-3.929**
no access to certain remote lakes		0.061	0.050	1.217	-0.074	0.049	-1.515	1.928

*bold indicates t-value significant at $p<0.05$ Adjusted Rho-Squared: Economic = 0.070; Environmental = 0.114

Note: For categorical attributes, the values in italics were calculated from the other level(s) for each attribute as follows: the parameter estimate is the negative sum of the estimates of the other level(s); the standard error is the mean of the standard errors for the other levels; the t-value is the parameter estimate divided by the standard error.

Table A2 Differences in part worth utility estimates (full model) between Land Allocation segments

		Less Parks			More Parks			
Attribute	**Level**	**Parameter estimate**	**Std err**	**t-value***	**Parameter estimate**	**Std err**	**t-value***	**t-stat***
Ecological Services								
Fish Habitat	linear	0.183	0.040	**4.582**	0.204	0.030	**6.873**	-0.429
	quadratic	0.046	0.031	1.481	0.066	0.023	**2.867**	-0.537
Wildlife Habitat	linear	0.140	0.037	**3.782**	0.185	0.027	**6.844**	-0.989
	quadratic	0.081	0.033	**2.453**	0.085	0.025	**3.356**	-0.097
Rare & Endangered Species Habitat	linear	0.058	0.038	1.529	0.172	0.030	**5.842**	**-2.364**
	quadratic	-0.002	0.034	-0.059	0.081	0.026	**3.141**	**-1.961**
Biodiversity	linear	0.069	0.037	1.837	0.124	0.028	**4.518**	-1.199
	quadratic	0.076	0.033	**2.287**	0.014	0.025	0.583	1.486
Nutrient Cycles	linear	0.144	0.037	**3.947**	0.114	0.027	**4.203**	0.655
	quadratic	0.037	0.032	1.127	0.000	0.024	0.009	0.907
Carbon Storage	linear	0.084	0.038	**2.210**	0.151	0.029	**5.227**	-1.420
	quadratic	0.033	0.032	1.039	0.074	0.024	**3.048**	-1.032
Community Profile—Social								
Population	linear	0.037	0.038	0.984	0.021	0.027	0.759	0.347
Crime Rate	linear	-0.124	0.040	**-3.133**	-0.086	0.030	**-2.905**	-0.765
Quality of Medical Care	linear	0.189	0.036	**5.182**	0.174	0.027	**6.338**	0.330
Quality of Education	linear	0.176	0.042	**4.175**	0.127	0.032	**3.974**	0.924
Community Profile—Economic								
Unemployment Rate	linear	-0.058	0.038	-1.508	-0.023	0.028	-0.814	-0.736
	quadratic	0.042	0.033	1.263	0.018	0.024	0.739	0.588
Average Household Income	linear	0.119	0.039	**3.021**	0.080	0.030	**2.633**	0.793
	quadratic	-0.011	0.033	-0.336	0.061	0.025	**2.487**	-1.759
Employment in Forestry	linear	0.003	0.040	0.086	0.029	0.031	0.958	-0.516
	quadratic	-0.031	0.031	-0.979	0.057	0.023	**2.467**	**-2.254**
Employment in Tourism / Recreation	linear	0.113	0.037	**3.054**	0.107	0.028	**3.837**	0.135
	quadratic	0.072	0.033	**2.150**	0.022	0.025	0.897	1.193
Landuse Allocation								
Timber Harvest		*-0.063*	*0.076*	*-0.822*	*-0.285*	*0.056*	***-5.081***	***2.343***
Preservation		-0.046	0.067	-0.679	0.161	0.051	**3.189**	**-2.458**
Integration of Uses		0.037	0.080	0.457	0.124	0.060	**2.074**	-0.872
Separation of Uses		0.072	0.082	0.880	0.000	0.058	-0.006	0.722
Park Classes								
few wilderness parks		*0.113*	*0.040*	***2.817***	*-0.112*	*0.030*	***-3.709***	***4.481***
mostly wilderness parks		-0.113	0.040	**-2.817**	0.112	0.030	**3.709**	**-4.481**
Access & Recreation								
Low Access		*-0.005*	*0.070*	*-0.065*	*0.051*	*0.055*	*0.934*	*-0.625*
Moderately Low Access		-0.110	0.069	-1.599	0.041	0.053	0.782	-1.744
Moderately High Access		0.030	0.069	0.433	-0.047	0.054	-0.868	0.877
High Access		0.084	0.074	1.143	-0.045	0.057	-0.786	1.385
Access Restrictions								
no restrictions on access		*0.137*	*0.065*	***2.119***	*-0.133*	*0.049*	***-2.715***	***3.329***
no hunting in recent clearcuts		-0.110	0.066	-1.682	0.132	0.050	**2.644**	**-2.940**
no access to certain remote lakes		-0.027	0.064	-0.419	0.001	0.048	0.017	-0.345

*bold indicates t-value significant at p<0.05 Adjusted Rho-Squared: Less Parks = 0.073; More Parks = 0.104

Note: For categorical attributes, the values in italics were calculated from the other level(s) for each attribute as follows: the parameter estimate is the negative sum of the estimates of the other level(s); the standard error is the mean of the standard errors for the other levels; the t-value is the parameter estimate divided by the standard error.

Table A3 Differences in part worth utility estimates (full model) between Recreation Participation segments

Attribute	Level	Consumptive			Non-consumptive			
		Parameter estimate	Std err	t-value*	Parameter estimate	Std err	t-value*	t-stat*
Ecological Services								
Fish Habitat	linear	0.175	0.030	**5.731**	0.205	0.034	**6.000**	-0.660
	quadratic	0.073	0.023	**3.094**	0.079	0.027	**2.992**	-0.195
Wildlife Habitat	linear	0.133	0.028	**4.794**	0.205	0.031	**6.633**	-1.727
	quadratic	0.075	0.025	**2.946**	0.107	0.029	**3.727**	-0.838
Rare & Endangered Species Habitat	linear	0.089	0.029	**3.035**	0.135	0.033	**4.145**	-1.047
	quadratic	0.064	0.026	**2.490**	0.062	0.030	**2.076**	0.070
Biodiversity	linear	0.077	0.028	**2.708**	0.123	0.032	**3.906**	-1.096
	quadratic	0.046	0.025	1.835	0.045	0.028	1.620	0.039
Nutrient Cycles	linear	0.110	0.028	**3.929**	0.131	0.031	**4.294**	-0.521
	quadratic	0.042	0.024	1.707	-0.001	0.027	-0.043	1.175
Carbon Storage	linear	0.109	0.029	**3.753**	0.170	0.033	**5.100**	-1.382
	quadratic	0.035	0.024	1.445	0.044	0.028	1.562	-0.239
Community Profile—Social								
Population	linear	0.041	0.028	1.439	0.002	0.032	0.070	0.907
Crime Rate	linear	-0.045	0.030	-1.489	-0.096	0.035	**-2.739**	1.105
Quality of Medical Care	linear	0.146	0.027	**5.340**	0.168	0.032	**5.298**	-0.509
Quality of Education	linear	0.114	0.032	**3.586**	0.127	0.036	**3.506**	-0.263
Community Profile—Economic								
Unemployment Rate	linear	-0.028	0.029	-0.986	-0.026	0.033	-0.781	-0.055
	quadratic	0.017	0.025	0.695	0.015	0.027	0.544	0.068
Average Household Income	linear	0.076	0.031	**2.483**	0.103	0.034	**3.077**	-0.589
	quadratic	0.034	0.025	1.370	0.054	0.028	1.930	-0.518
Employment in Forestry	linear	0.012	0.031	0.372	0.061	0.034	1.783	-1.067
	quadratic	0.013	0.024	0.530	0.041	0.026	1.584	-0.805
Employment in Tourism / Recreation	linear	0.118	0.028	**4.237**	0.106	0.033	**3.231**	0.277
	quadratic	0.017	0.026	0.674	0.068	0.028	**2.460**	-1.356
Landuse Allocation								
Timber Harvest		*-0.140*	*0.057*	***-2.441***	*-0.269*	*0.065*	***-4.133***	*1.494*
Preservation		0.058	0.051	1.128	0.112	0.058	1.932	-0.704
Integration of Uses		0.078	0.060	1.295	0.099	0.069	1.436	-0.233
Separation of Uses		0.004	0.060	0.068	0.058	0.068	0.847	-0.589
Park Classes								
few wilderness parks		*0.001*	*0.031*	*0.021*	*-0.038*	*0.034*	*-1.098*	*0.830*
mostly wilderness parks		-0.001	0.031	-0.021	0.038	0.034	1.098	-0.830
Access & Recreation								
Low Access		*-0.063*	*0.055*	*-1.152*	*0.113*	*0.062*	*1.825*	***-2.131***
Moderately Low Access		0.057	0.053	1.088	-0.022	0.059	-0.366	0.998
Moderately High Access		-0.059	0.055	-1.074	0.047	0.061	0.766	-1.286
High Access		0.064	0.057	1.128	-0.138	0.065	**-2.123**	**2.342**
Access Restrictions								
no restrictions on access		*0.055*	*0.049*	*1.112*	*-0.159*	*0.055*	***-2.859***	***2.874***
no hunting in recent clearcuts		-0.013	0.050	-0.261	0.134	0.057	**2.371**	-1.945
no access to certain remote lakes		-0.042	0.049	-0.861	0.025	0.054	0.452	-0.911

*bold indicates t-value significant at $p<0.05$ Adjusted Rho-Squared: Consumptive = 0.062; Non-consumptive = 0.101

Note: For categorical attributes, the values in italics were calculated from the other level(s) for each attribute as follows: the parameter estimate is the negative sum of the estimates of the other level(s); the standard error is the mean of the standard errors for the other levels; the t-value is the parameter estimate divided by the standard error.

Table A4 Differences in part worth utility estimates (full model) between Residence segments

Attribute	Level	Rural Parameter estimate	Rural Std err	Rural t-value*	Urban Parameter estimate	Urban Std err	Urban t-value*	t-stat*
Ecological Services								
Fish Habitat	linear	0.178	0.030	**6.013**	0.190	0.030	**6.364**	-0.289
	quadratic	0.054	0.023	**2.362**	0.072	0.023	**3.081**	-0.543
Wildlife Habitat	linear	0.160	0.027	**5.816**	0.152	0.027	**5.609**	0.204
	quadratic	0.066	0.025	**2.626**	0.104	0.025	**4.157**	-1.067
Rare & Endangered Species Habitat	linear	0.103	0.029	**3.611**	0.108	0.029	**3.744**	-0.102
	quadratic	0.059	0.026	**2.280**	0.063	0.026	**2.434**	-0.123
Biodiversity	linear	0.074	0.028	**2.630**	0.104	0.028	**3.770**	-0.776
	quadratic	0.076	0.024	**3.132**	-0.009	0.025	-0.372	**2.467**
Nutrient Cycles	linear	0.093	0.027	**3.431**	0.116	0.027	**4.261**	-0.604
	quadratic	0.011	0.024	0.439	0.001	0.024	0.060	0.271
Carbon Storage	linear	0.147	0.029	**5.161**	0.111	0.029	**3.824**	0.901
	quadratic	0.029	0.024	1.208	0.051	0.025	**2.063**	-0.635
Community Profile—Social								
Population	linear	0.025	0.028	0.871	0.032	0.028	1.173	-0.199
Crime Rate	linear	-0.106	0.030	**-3.526**	-0.060	0.030	**-2.002**	-1.104
Quality of Medical Care	linear	0.168	0.027	**6.195**	0.151	0.027	**5.523**	0.427
Quality of Education	linear	0.119	0.031	**3.797**	0.162	0.032	**5.063**	-0.952
Community Profile—Economic								
Unemployment Rate	linear	-0.014	0.028	-0.508	-0.059	0.028	**-2.080**	1.104
	quadratic	0.023	0.024	0.973	0.023	0.024	0.945	0.016
Average Household Income	linear	0.041	0.030	1.364	0.112	0.030	**3.727**	-1.687
	quadratic	0.008	0.025	0.317	0.057	0.025	**2.291**	-1.400
Employment in Forestry	linear	-0.007	0.030	-0.231	0.045	0.030	1.497	-1.224
	quadratic	0.026	0.023	1.118	0.031	0.023	1.355	-0.151
Employment in Tourism / Recreation	linear	0.077	0.027	**2.811**	0.148	0.028	**5.232**	-1.791
	quadratic	0.067	0.025	**2.716**	0.009	0.025	0.358	1.666
Landuse Allocation								
Timber Harvest		*-0.140*	*0.056*	***-2.480***	*-0.263*	*0.057*	***-4.635***	*1.543*
Preservation		0.012	0.050	0.249	0.160	0.051	**3.136**	**-2.068**
Integration of Uses		0.044	0.060	0.729	0.112	0.060	1.856	-0.805
Separation of Uses		0.084	0.059	1.410	-0.009	0.059	-0.147	1.104
Park Classes								
few wilderness parks		*-0.001*	*0.030*	*-0.032*	*-0.028*	*0.030*	*-0.939*	*0.642*
mostly wilderness parks		0.001	0.030	0.032	0.028	0.030	0.939	-0.642
Access & Recreation								
Low Access		*0.005*	*0.054*	*0.098*	*0.019*	*0.054*	*0.352*	*-0.182*
Moderately Low Access		-0.039	0.052	-0.763	0.056	0.052	1.064	-1.293
Moderately High Access		-0.001	0.053	-0.024	-0.046	0.054	-0.855	0.592
High Access		0.035	0.056	0.630	-0.029	0.057	-0.503	0.800
Access Restrictions								
no restrictions on access		*0.012*	*0.049*	*0.237*	*-0.098*	*0.049*	***-2.004***	*1.587*
no hunting in recent clearcuts		-0.022	0.049	-0.446	0.136	0.050	**2.720**	**-2.247**
no access to certain remote lakes		0.010	0.048	0.217	-0.038	0.048	-0.789	0.711

*bold indicates t-value significant at $p<0.05$ Adjusted Rho-Squared: Rural = 0.071; Urban = 0.083

Note: For categorical attributes, the values in italics were calculated from the other level(s) for each attribute as follows: the parameter estimate is the negative sum of the estimates of the other level(s); the standard error is the mean of the standard errors for the other levels; the t-value is the parameter estimate divided by the standard error.

Table A5 Differences in part worth utility estimates (full model) between Survey Version segments

		Long			Short			
Attribute	**Level**	**Parameter estimate**	**Std err**	**t-value***	**Parameter estimate**	**Std err**	**t-value***	**t-stat***
Ecological Services								
Fish Habitat	linear	0.184	0.029	**6.253**	0.190	0.030	**6.318**	-0.152
	quadratic	0.082	0.023	**3.569**	0.041	0.023	1.741	1.267
Wildlife Habitat	linear	0.134	0.027	**4.976**	0.180	0.028	**6.517**	-1.190
	quadratic	0.107	0.025	**4.211**	0.064	0.025	**2.563**	1.225
Rare & Endangered Species Habitat	linear	0.113	0.028	**3.974**	0.095	0.029	**3.269**	0.443
	quadratic	0.067	0.026	**2.618**	0.047	0.026	1.827	0.560
Biodiversity	linear	0.108	0.028	**3.894**	0.066	0.028	**2.362**	1.087
	quadratic	0.048	0.025	1.934	0.024	0.024	0.969	0.690
Nutrient Cycles	linear	0.104	0.027	**3.864**	0.108	0.028	**3.916**	-0.113
	quadratic	0.032	0.024	1.343	-0.020	0.024	-0.855	1.553
Carbon Storage	linear	0.119	0.029	**4.160**	0.138	0.029	**4.787**	-0.474
	quadratic	0.054	0.024	**2.254**	0.024	0.024	1.000	0.863
Community Profile—Social								
Population	linear	0.033	0.028	1.184	0.022	0.028	0.767	0.278
Crime Rate	linear	-0.092	0.030	**-3.090**	-0.072	0.030	**-2.415**	-0.476
Quality of Medical Care	linear	0.198	0.027	**7.336**	0.122	0.027	**4.451**	**1.981**
Quality of Education	linear	0.149	0.032	**4.696**	0.124	0.031	**3.960**	0.551
Community Profile—Economic								
Unemployment Rate	linear	-0.037	0.028	-1.294	-0.034	0.028	-1.217	-0.067
	quadratic	0.037	0.024	1.539	0.008	0.024	0.331	0.852
Average Household Income	linear	0.069	0.030	**2.326**	0.081	0.030	**2.689**	-0.278
	quadratic	0.063	0.024	**2.604**	-0.001	0.025	-0.033	1.837
Employment in Forestry	linear	-0.004	0.030	-0.139	0.041	0.030	1.348	-1.057
	quadratic	0.006	0.023	0.266	0.053	0.023	**2.282**	-1.440
Employment in Tourism / Recreation	linear	0.094	0.028	**3.406**	0.129	0.028	**4.656**	-0.894
	quadratic	0.023	0.025	0.917	0.056	0.025	**2.203**	-0.938
Landuse Allocation								
Timber Harvest		*-0.151*	*0.056*	***-2.673***	*-0.237*	*0.057*	***-4.171***	*1.072*
Preservation		0.069	0.050	1.375	0.094	0.051	1.850	-0.344
Integration of Uses		0.102	0.060	1.703	0.042	0.060	0.693	0.714
Separation of Uses		-0.020	0.059	-0.344	0.101	0.060	1.702	-1.451
Park Classes								
few wilderness parks		*-0.036*	*0.030*	*-1.193*	*0.009*	*0.030*	*0.294*	*-1.053*
mostly wilderness parks		0.036	0.030	1.193	-0.009	0.030	-0.294	1.053
Access & Recreation								
Low Access		*0.029*	*0.054*	*0.533*	*-0.016*	*0.054*	*-0.300*	*0.589*
Moderately Low Access		-0.047	0.052	-0.918	0.067	0.052	1.284	-1.559
Moderately High Access		0.000	0.053	-0.003	-0.047	0.054	-0.870	0.615
High Access		0.019	0.056	0.337	-0.004	0.057	-0.069	0.285
Access Restrictions								
no restrictions on access		*-0.031*	*0.048*	*-0.633*	*-0.060*	*0.049*	*-1.221*	*0.431*
no hunting in recent clearcuts		0.102	0.049	**2.071**	0.003	0.050	0.065	1.404
no access to certain remote lakes		-0.071	0.047	-1.506	0.057	0.049	1.173	-1.891

*bold indicates t-value significant at p<0.05 Adjusted Rho-Squared: Long = 0.085; Short = 0.069

Note: For categorical attributes, the values in italics were calculated from the other level(s) for each attribute as follows: the parameter estimate is the negative sum of the estimates of the other level(s); the standard error is the mean of the standard errors for the other levels; the t-value is the parameter estimate divided by the standard error.

APPENDIX C: MODEL COMPARISONS BY SEGMENT (COLLAPSED MODEL)

Table A6 Differences in part worth utility estimates (collapsed model) between Preferred Outcome segments

	Economic			Environmental			
Attribute	**Parameter estimate**	**Std err**	**t-value***	**Parameter estimate**	**Std err**	**t-value***	**t-stat***
Ecological Summary							
1st linear	0.094	0.015	**6.155**	0.214	0.015	**14.414**	**-5.631**
2nd linear	-0.139	0.045	**-3.065**	-0.001	0.043	-0.022	**-2.216**
Social Summary							
1st linear	0.130	0.034	**3.846**	0.057	0.031	1.843	1.578
2nd linear	0.153	0.031	**4.994**	0.121	0.029	**4.126**	0.751
Economic Summary							
1st linear	0.163	0.031	**5.218**	0.091	0.029	**3.164**	1.688
2nd linear	-0.021	0.032	-0.639	-0.032	0.030	-1.081	0.257
Landuse Allocation							
Timber Harvest	*-0.057*	*0.053*	*-1.089*	*-0.342*	*0.048*	***-7.062***	***3.974***
Preservation	0.028	0.052	0.544	0.225	0.049	**4.635**	**-2.774**
Integration of Uses	0.052	0.053	0.981	0.128	0.049	**2.640**	-1.064
Separation of Uses	-0.023	0.054	-0.419	-0.011	0.048	-0.226	-0.161
Park Classes							
few wilderness parks	*0.080*	*0.030*	***2.641***	*-0.126*	*0.027*	***-4.586***	***5.039***
mostly wilderness parks	-0.080	0.030	**-2.641**	0.126	0.027	**4.586**	**-5.039**
Access & Recreation							
Low Access	*-0.021*	*0.052*	*-0.416*	*-0.008*	*0.048*	*-0.172*	*-0.185*
Moderately Low Access	-0.095	0.051	-1.881	0.085	0.047	1.792	**-2.598**
Moderately High Access	0.009	0.052	0.173	-0.066	0.050	-1.319	1.038
High Access	0.108	0.052	**2.081**	-0.011	0.047	-0.223	1.685
Access Restrictions							
no restrictions on access	*0.056*	*0.045*	*1.226*	*-0.094*	*0.043*	***-2.188***	***2.396***
no hunting in recent clearcuts	-0.132	0.046	**-2.879**	0.131	0.044	**2.988**	**-4.146**
no access to certain remote lakes	0.076	0.045	1.693	-0.037	0.042	-0.876	1.833

*bold indicates t-value significant at $p<0.05$ Adjusted Rho-Squared: Economic = 0.066; Environmental = 0.105

Note: For categorical attributes, the values in italics were calculated from the other level(s) for each attribute as follows: the parameter estimate is the negative sum of the estimates of the other level(s); the standard error is the mean of the standard errors for the other levels; the t-value is the parameter estimate divided by the standard error.

Table A7 Differences in part worth utility estimates (collapsed model) between Land Allocation segments

	Less Parks			More Parks			
Attribute	**Parameter estimate**	**Std err**	**t-value***	**Parameter estimate**	**Std err**	**t-value***	**t-stat***
Ecological Summary							
1st linear	0.139	0.019	**7.213**	0.178	0.015	**12.129**	-1.587
2nd linear	-0.031	0.057	-0.548	-0.024	0.042	-0.579	-0.096
Social Summary							
1st linear	0.160	0.043	**3.748**	0.091	0.031	**2.920**	1.300
2nd linear	0.071	0.039	1.816	0.150	0.029	**5.198**	-1.636
Economic Summary							
1st linear	0.104	0.039	**2.667**	0.128	0.029	**4.422**	-0.507
2nd linear	0.019	0.041	0.448	-0.039	0.030	-1.311	1.127
Landuse Allocation							
Timber Harvest	*-0.015*	*0.066*	*-0.227*	*-0.317*	*0.049*	***-6.492***	***3.695***
Preservation	0.038	0.064	0.584	0.194	0.049	**3.988**	-1.944
Integration of Uses	0.095	0.065	1.471	0.129	0.049	**2.628**	-0.415
Separation of Uses	-0.118	0.067	-1.750	-0.007	0.048	-0.142	-1.339
Park Classes							
few wilderness parks	*0.099*	*0.037*	***2.686***	*-0.135*	*0.028*	***-4.856***	***5.066***
mostly wilderness parks	-0.099	0.037	**-2.686**	0.135	0.028	**4.856**	**-5.066**
Access & Recreation							
Low Access	*-0.043*	*0.064*	*-0.673*	*-0.013*	*0.048*	*-0.260*	*-0.379*
Moderately Low Access	-0.069	0.063	-1.107	0.044	0.047	0.933	-1.445
Moderately High Access	-0.002	0.065	-0.038	-0.042	0.050	-0.850	0.488
High Access	0.115	0.064	1.797	0.011	0.048	0.224	1.303
Access Restrictions							
no restrictions on access	*0.155*	*0.057*	***2.725***	*-0.120*	*0.043*	***-2.816***	***3.871***
no hunting in recent clearcuts	-0.143	0.058	**-2.486**	0.072	0.043	1.648	**-2.977**
no access to certain remote lakes	-0.012	0.056	-0.211	0.049	0.042	1.159	-0.864

*bold indicates t-value significant at p<0.05 Adjusted Rho-Squared: Less Park s= 0.072; More Parks = 0.096

Note: For categorical attributes, the values in italics were calculated from the other level(s) for each attribute as follows: the parameter estimate is the negative sum of the estimates of the other level(s); the standard error is the mean of the standard errors for the other levels; the t-value is the parameter estimate divided by the standard error.

Table A8 Differences in part worth utility estimates (collapsed model) between Recreation Participation segments

	Consumptive			Non-consumptive			
Attribute	Parameter estimate	Std err	t-value*	Parameter estimate	Std err	t-value*	t-stat*
Ecological Summary							
1st linear	0.156	0.015	**10.357**	0.190	0.017	**11.458**	-1.486
2nd linear	-0.119	0.043	**-2.746**	-0.037	0.049	-0.757	-1.254
Social Summary							
1st linear	0.053	0.032	1.645	0.121	0.036	**3.412**	-1.432
2nd linear	0.118	0.030	**3.985**	0.103	0.033	**3.125**	0.336
Economic Summary							
1st linear	0.094	0.030	**3.172**	0.150	0.033	**4.489**	-1.252
2nd linear	-0.014	0.031	-0.463	-0.020	0.034	-0.577	0.118
Landuse Allocation							
Timber Harvest	*-0.136*	*0.049*	***-2.757***	*-0.276*	*0.056*	***-4.902***	*1.866*
Preservation	0.098	0.049	**1.989**	0.199	0.056	**3.565**	-1.364
Integration of Uses	0.074	0.049	1.504	0.120	0.057	**2.115**	-0.614
Separation of Uses	-0.035	0.050	-0.699	-0.043	0.057	-0.754	0.100
Park Classes							
few wilderness parks	*-0.012*	*0.028*	*-0.419*	*-0.067*	*0.031*	***-2.149***	*1.305*
mostly wilderness parks	0.012	0.028	0.419	0.067	0.031	**2.149**	-1.305
Access & Recreation							
Low Access	*-0.075*	*0.049*	*-1.529*	*0.065*	*0.055*	*1.179*	*-1.898*
Moderately Low Access	0.053	0.048	1.106	-0.011	0.054	-0.207	0.887
Moderately High Access	-0.069	0.051	-1.369	0.053	0.056	0.941	-1.615
High Access	0.092	0.049	1.871	-0.107	0.055	-1.954	**2.704**
Access Restrictions							
no restrictions on access	*0.081*	*0.044*	*1.863*	*-0.148*	*0.048*	***-3.061***	***3.522***
no hunting in recent clearcuts	-0.064	0.044	-1.436	0.086	0.050	1.731	**-2.248**
no access to certain remote lakes	-0.018	0.043	-0.412	0.063	0.047	1.321	-1.255

*bold indicates t-value significant at $p<0.05$ Adjusted Rho-Squared: Consumptive = 0.062; Non-consumptive = 0.092
Note: For categorical attributes, the values in italics were calculated from the other level(s) for each attribute as follows: the parameter estimate is the negative sum of the estimates of the other level(s); the standard error is the mean of the standard errors for the other levels; the t-value is the parameter estimate divided by the standard error.

Table A9 Differences in part worth utility estimates (collapsed model) between Residence segments

	Rural			Urban			
Attribute	**Parameter estimate**	**Std err**	**t-value***	**Parameter estimate**	**Std err**	**t-value***	**t-stat***
Ecological Summary							
1st linear	0.159	0.015	**10.863**	0.153	0.015	**10.513**	0.278
2nd linear	-0.098	0.043	**-2.313**	-0.014	0.043	-0.340	-1.394
Social Summary							
1st linear	0.054	0.031	1.725	0.117	0.031	**3.738**	-1.429
2nd linear	0.149	0.029	**5.095**	0.113	0.029	**3.897**	0.885
Economic Summary							
1st linear	0.104	0.029	**3.600**	0.134	0.029	**4.563**	-0.725
2nd linear	-0.055	0.030	-1.813	0.004	0.030	0.126	-1.382
Landuse Allocation							
Timber Harvest	*-0.150*	*0.049*	***-3.058***	*-0.271*	*0.049*	***-5.541***	*1.755*
Preservation	0.052	0.048	1.084	0.216	0.049	**4.420**	**-2.376**
Integration of Uses	0.104	0.049	**2.126**	0.084	0.049	1.715	0.279
Separation of Uses	-0.006	0.050	-0.125	-0.029	0.049	-0.587	0.322
Park Classes							
few wilderness parks	*-0.022*	*0.028*	*-0.792*	*-0.046*	*0.028*	*-1.667*	*0.617*
mostly wilderness parks	0.022	0.028	0.792	0.046	0.028	1.667	-0.617
Access & Recreation							
Low Access	*-0.027*	*0.048*	*-0.567*	*-0.035*	*0.048*	*-0.733*	*0.117*
Moderately Low Access	-0.008	0.047	-0.178	0.037	0.048	0.770	-0.673
Moderately High Access	-0.022	0.050	-0.438	-0.025	0.050	-0.499	0.043
High Access	0.058	0.048	1.199	0.024	0.048	0.492	0.503
Access Restrictions							
no restrictions on access	*0.038*	*0.043*	*0.890*	*-0.089*	*0.043*	***-2.085***	***2.101***
no hunting in recent clearcuts	-0.050	0.044	-1.134	0.072	0.043	1.657	**-1.973**
no access to certain remote lakes	0.011	0.042	0.265	0.017	0.042	0.408	-0.099

*bold indicates t-value significant at $p<0.05$ Adjusted Rho-Squared: Rural = 0.069; Urban = 0.074

Note: For categorical attributes, the values in italics were calculated from the other level(s) for each attribute as follows: the parameter estimate is the negative sum of the estimates of the other level(s); the standard error is the mean of the standard errors for the other levels; the t-value is the parameter estimate divided by the standard error.

Table A10 Differences in part worth utility estimates (collapsed model) between Survey Version segments

	Long			Short			
Attribute	**Parameter estimate**	**Std err**	**t-value***	**Parameter estimate**	**Std err**	**t-value***	**t-stat***
Ecological Summary							
1st linear	0.169	0.015	**11.636**	0.142	0.015	**9.717**	1.343
2nd linear	-0.109	0.042	**-2.588**	0.001	0.043	0.014	-1.815
Social Summary							
1st linear	0.109	0.031	**3.540**	0.062	0.032	1.948	1.064
2nd linear	0.135	0.029	**4.678**	0.124	0.029	**4.236**	0.257
Economic Summary							
1st linear	0.109	0.029	**3.776**	0.129	0.029	**4.370**	-0.487
2nd linear	-0.045	0.030	-1.514	-0.004	0.030	-0.123	-0.970
Landuse Allocation							
Timber Harvest	*-0.165*	*0.049*	***-3.389***	*-0.247*	*0.049*	***-5.027***	*1.176*
Preservation	0.135	0.048	**2.791**	0.131	0.049	**2.687**	0.054
Integration of Uses	0.101	0.049	**2.057**	0.085	0.049	1.740	0.221
Separation of Uses	-0.070	0.049	-1.420	0.031	0.050	0.617	-1.438
Park Classes							
few wilderness parks	*-0.050*	*0.028*	*-1.829*	*-0.014*	*0.028*	*-0.514*	*-0.925*
mostly wilderness parks	0.050	0.028	1.829	0.014	0.028	0.514	0.925
Access & Recreation							
Low Access	*-0.007*	*0.048*	*-0.148*	*-0.061*	*0.049*	*-1.259*	*0.792*
Moderately Low Access	-0.055	0.047	-1.156	0.086	0.048	1.813	**-2.101**
Moderately High Access	-0.005	0.049	-0.094	-0.040	0.050	-0.806	0.507
High Access	0.066	0.048	1.397	0.015	0.048	0.317	0.753
Access Restrictions							
no restrictions on access	*-0.020*	*0.043*	*-0.479*	*-0.032*	*0.043*	*-0.743*	*0.193*
no hunting in recent clearcuts	0.040	0.043	0.918	-0.021	0.044	-0.482	0.990
no access to certain remote lakes	-0.020	0.042	-0.468	0.053	0.043	1.242	-1.217

*bold indicates t-value significant at $p<0.05$ Adjusted Rho-Squared: Long = 0.079; Short = 0.063

Note: For categorical attributes, the values in italics were calculated from the other level(s) for each attribute as follows: the parameter estimate is the negative sum of the estimates of the other level(s); the standard error is the mean of the standard errors for the other levels; the t-value is the parameter estimate divided by the standard error.