Using Environmental Assessment to Evaluate Forest Land Use Alternatives in British Columbia

Elizabeth Pope

A Manuscript Report Prepared for the
Canadian Environmental Assessment
Research Council
1986

MR 10-86

USING ENVIRONMENTAL IMPACT ASSESSMENT TO EVALUATE FOREST LAND USE ALTERNATIVES IN BRITISH COLUMBIA

Authored by

Liz Pope
Natural Resources Management Program
Simon Fraser University
Burnaby, B.C.
V5A 1S6

Commissioned by

CANADIAN ENVIRONMENTAL ASSESSMENT RESEARCH COUNCIL (CEARC)

FOREWORD

The Canadian Environmental Assessment Research Council (CEARC) was established in 1984 by the federal Minister of the Environment through the Federal Environmental Assessment Review Office (FEARO), to advance the theory and practice of environmental assessment (EA). As part of its commitment to improve EA in Canada, CEARC encouraged research in several areas related to environmental assessment. The research results are presented in three series of publications: Research Prospectus, Background Papers and Manuscript Reports.

This report is part of the Manuscript Report series which is composed primarily of individual research papers sponsored, completely or in part, by CEARC. The Manuscript Reports are provided in the language and format in which they were submitted. **They are not subject to peer review and do not necessarily reflect the views and policies of CEARC.**

Hard copies of CEARC publications can be ordered through:

Canada Communication Group - Publishing
Ottawa, Canada
K1A OS9

Tel: (819) 956-4802
Fax: (819) 994-1498

Microfiche copies of CEARC publications can be ordered through:

Micromedia Limited
165 Hotel de Ville
Place du Portage, Phase II
Hull, Quebec
G8X 3X2

Tel : I-800-567-1914 (Canada), (819) 770-9928
Fax : (819) 770-9265

For more information on CEARC's work, please contact:

Federal Environmental Assessment Review Office
Process Development Division
14th Floor, Fontaine Building
200 Sacré-Coeur Boulevard
Hull, Quebec K1A OH3
Tel : (819) 953-8591 or 953-0036
Fax : (819) 994-1469

ABSTRACT

One of the more pressing resource management problems in B.C. is the allocation of forest land between competing uses. This study examines one component of the EIA discipline as it applies to reaching land allocation decisions: the technical evaluation of alternative uses. A review of evaluative techniques commonly used by provincial agencies to assess resource use options reveals many deficiencies. In general, resource folios and aggregate measures fail to give comprehensive assessments of the net benefits to society from alternative resource uses. Cost-benefit analysis has the potential of improving upon the assessment of alternatives.

Using CBA to measure forestry values in B.C. has already been demonstrated. However, no attempt has yet been made to apply it to nonmarket wilderness amenities, although preservation is frequently one land use option. A survey of the literature regarding CBA techniques for valuing wilderness reveals documentation of well-established methods suitable for bettering the information made available to decision makers. The applicability of these methods to B.C. conflicts is demonstrated in a case study of the West Coast Trail. Recommendations are then made for incorporating CBA into assessments of land use alternatives in B.C.

ACKNOWLEDGEMENTS

I wish to thank the faculty, staff and students of the Natural Resources Management Program at Simon Fraser University for their encouragement. In particular, professor Tom Gunton was indispensable in providing direction and reviewing drafts. John Richards of the SFU faculty of Business Administration also made helpful comments regarding the case study.

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

1. INTRODUCTION

The single most important issue concerning land in Canada today is its allocation (Manning, 1980, p.5). Furthermore, competition between various uses is expected to escalate (Buckley et al., 1980, p.17). In British Columbia much of the conflict centers on forested land which is capable of providing fiber for the lumber industry at the exclusion of wildlife habitat, wilderness recreation, livestock grazing, or hydro-electric reservoirs. The Royal Commission on Forest Resources called for the redirection of resource management goals to address the reconciliation of conflicting demands on the resource base (Pearse, 1976, p.373).

Concern over the best way to divide up the finite resource base resulted in the 1971 formation of the Environment and Land Use Committee (ELUC). With one of the most powerful pieces of legislation in B.C., the cabinet body was given the duty of ensuring that "resource development commensurate with a maximum beneficial land use" (Environment and Land Use Act, R.S.B.C. 1979, c.110, s.3). Its responsibilities include making recommendations to the Lieutenant Governor in Council regarding development and use of land and other natural resources.

Despite ELUC's efforts, the need for improved methods to assess the impacts of alternative forest uses persists. A survey of forest users and managers, including the B.C. ministries of Forests, Environment, and Lands, Parks and Housing, the Outdoor Recreation Council, the Council of Forest Industries and the B.C. Wildlife Federation found that the methods currently used for making forest land use decisions were impediments to achieving their goals (Forest Research Council of B.C., 1983, p.25-34). Heightening public outcry concerning resource use conflicts prompted the provincial government to address the issue in another way by creating the Wilderness Advisory Committee in late 1985. The eight-member panel was instructed to report in three months on resource use designations for 24 areas. Their assignment, as several submissions to the panel pointed out, was by no means an exhaustive investigation of all the areas under dispute.

Deficiencies in a land use designation process can arise in many ways. Four criteria, derived from democratic norms, exist for appraising the goodness of a decision process (Bloodoff, 1981, p.37-38):

a. Decisions are based upon adequate information.

b. Decision making reflects representation of affected interests.

c. Decisions are effective.

d. The decision making process is efficient.

This study focuses upon assessing the adequacy of information which is acquired through technical analysis, using Environmental Impact Assessment methodologies, and provided to land use decision makers in B.C. It begins with a review of the techniques generally employed in the province. To overcome some of the shortcomings encountered, a suggestion is made for using cost-benefit analysis. The balance of the report investigates the suitability of CBA as an evaluative tool in resource allocations. This entails a review of the techniques, focusing on measuring nonpecuniary wilderness values, and then the application of CBA in a case study of the West Coast Trail. Finally, recommendations are made for improving resource use assessments.

1.1 Assessing Resource Use Alternatives

Until the early 1970s, government agencies relied on a referral process for handling resource allocation problems. Development proposals where simply passed along to other departments for comment. During the last thirteen years, two analytical techniques for resolving problems have been applied regularly. Resource folios planning is now well-established and, more recently, conflicts of special significance have been assessed with an array of gross measures. This section takes a closer look at the appropriateness of these EIA methods.

1.1.1 Resource Folios

Resource folio planning was introduced by the Ministry of Forests in 1973 (Pearce, 1976, p.259). It was further developed as a planning tool by the Resource Analysis Unit of the ELUC Secretariat (Walmsley, 1976, p.5). Roth agencies have extensively used resource folios for identifying resource opportunities and constraints. The technique, using biophysical resource capability maps to collate data, is essentially an application of what is commonly known as the McHarg overlay method. Canada Land Inventory classifications are used to identify an area's capabilities for agriculture, timber, recreation and wildlife. When resource maps are overlaid, land is allocated to the use with the highest capability.

There are several major flaws with the resource folio method of determining optimum land use. The technique's basic assumption, that a site's value for supporting alternative uses is a funtion only of its inherent biological capability, is fallacious. It disregards any so&-economic considerations. As Gold (1974, p.286) points out., "The McHarg scheme fails to recognize that it is 'intrinsic suitability' in conjunction with the values people place on the use of 'intrinsically' suitable land that should determine the correct allocation."

Although resource capability maps facilitate the communication of considerable quantities of information to decision makers and the public, they are replete with concealed value judgements (McAllister, 1980, p.201; Whitney and Maclaren, 1985, p.27). The maps themselves are a compilation of expert judgements by scientists. The values of this select group controls the outcome of the evaluation. Subjective assessments are also required to weight the relative importance of resource capabilities when the maps are overlaid.

A further important shortcoming of resource folio mapping is that it provides no mechanism for making allocation decisions. When an area has equivalent capabilities for two or more resources, the technique gives no solutions. For these reasons, the resource folio is not a comprehensive, nor an explicit evaluative method. McHarg-style methods are most useful in the early scoping stages of land use planning. From there, analysis should strive to acquire more precise information (McAllister, 1980, p.207).

1.1.2 Gross Measures

More recently, specific areas of conflict have been analyzed with economically oriented approaches, generally consisting of an array of gross measures of impacts. For local resource use planning, the Ministry of Forests (1984, p.42) recommends that assessments use measures such as the number of jobs produced by each alternative and the effects on the annual allowable cut (AAC) of timber. A position paper by the Association of B.C. Professional Foresters (1985, p.17) also lays a framework for assessing alternatives. "The ABCPF recommends that all forest land use anaiyses encompass a wholistic [sic] view of the direct and indirect benefits generated by B.C.'s forest crops." For the forestry industry it measures direct and indirect employment, gross value of end-products, and expenditures in other sectors such as transportation and services. These techniques have been applied in two of the more sophisticated analyses of resource use options in B.C.: Meares Island and South Moresby.

For three alternative uses of Meares Island (Meares Island Planning Team, 1983) direct and indirect forestry employment were tallied, and reduction in the ACC estimated. The planning team detailed tourism expenditures and the gross revenues from timber harvesting and fishing. Preservation costs are identified as the sum of stumpage, timber tenure rental fees, forestry employee wage differential, forest industry wages, corporate income taxes and logging taxes. No attempt is made to consider the less tangible values of recreation nor to quantify preservation benefits.

Similarily, an assessment of land use alternatives for South Moresby (South Moresby Resource Planning Team, 1983) focuses on the gross value of milled forest products and the gross potential values of mineral reserves, even though none are economically viable. Figures are given for forestry employment, wages and benefits, provincial revenues and the AAC under each alternative. No measures are included for recreation or preservation benefits.

These analyses present misleading measures and lack comprehensive assessment. For one, they provide no indication of each option's net worth to society. Gross timber values, by not including the costs of production, reveal nothing about whether the investment is viable. Government revenues and total employment are also gross measures which do not reflect net benefits. A more appropriate assumption is that similar quantities of jobs and government revenues will be created by investing the capital elsewhere in the economy. When unemployment is high, not all workers in reality will find reemployment_ In these instances, the net changes in jobs and revenues is the relevant measure.

The choice of specific aggregate measures for these analyses has considerable bearing on the evaluation, allowing the analytical framework to hide subjective judgements of what is pertinent. This is especially true when analysis focuses on one or two sectors, in these cases forestry, while not similarly considering others, such as tourism. Notably, many less tangible values are not considered empirically, causing many values to go unnoticed. The lack of a common measurement unit further exacerbates the difficulty in comparing alternatives.

1.2 Using Cost-Benefit Analvsis in Land Use Evaluation

The need for more rigourous analysis, grounded in economic theory, to appraise land use alternatives has already been identified. Pearse (1977, p.26) calls for the use of well-established economic criteria to base land use decisions. Many resource users, including the Council of Forest Industries and the Outdoor Recreation Council of B.C. have advocated that forest land use decisions be based upon cost-benefit analysis (Forest Research Council of B.C., 1983, p.25-34). CBA seems to have significant potential for evaluating options without many of the problems encountered with resource folios and gross measures.

Some attempt has been made at introducing CBA into land use assessment. General guidelines for conducting CBA were published by the ELUC Secretariat (Loose, 1977). A more detailed set of techniques are outlined by the Ministry of Lands, Parks and Housing (1983). Although the publication is intended as a guide for assessing Ecological Reserve proposals, it only discusses the measurement of forestry values. Using CBA to assess less tangible values associated with wilderness preservation has not been addressed.

Nevertheless, the last 25 years have seen considerable development of CBA to measure nonmarket goods. Hotelling introduced CBA for outdoor recreation (Clawson and Knetsch, 1966, p.64), thereby expanding its use in comparing disparate values. Krutilla and Fisher (1975) demonstrated the application of CBA in comparing preservation of an area versus development. In the United States, CBA is now routinely incorporated into the assessment of resource use alternatives. Guidelines exist detailing procedures for using CBA as part of an overall EIA (US Water Resources Council, 1983).

CBA has the ability of objectively considering diverse values, including nonpecuniary amenities, with a common unit of measure. Importantly, it does so by addressing the objective of determining which alternative garners the maximum benefit to society. Although CBA has considerable potential as an EIA evaluative tool, its suitability for forest land use decisions in B.C. hinges on its ability to adequately estimate wilderness values. The next chapter investigates this application of CBA.

2. VALUING WILDERNESS

2.1. Introduction

Comparing the relative merits of alternative resource management regimes is greatly facilitated if the pros and cons of all options are measured with a common scale. Dollars is a convenient unit for comparing values. Many things are already directly measured by money, thereby allowing for the integration of otherwise unrelated factors. Cost-benefit analysis attempts to compare, in terms of money, the net worth of alternatives.

A challenge for benefit-cost analysts is finding a valid means for measuring in dollars those goods which are not traded in the market. In forest land use considerations, nonmarket values are most frequently associated with wilderness preservation options. Three sorts of wildland values have been measured by economists. These are (1) recreational value, (2) aesthetic value, and (3) preservation value. The three components of preservation value are option, existence and bequest value (Walsh et al., 1982, p.2). Specifically, option value is the retaining of the option to use a wilderness resource in the future. Existence value is derived from knowing that wilderness exists, regardless of whether it is used directly. Bequest value is that which an individual places on bequeathing wilderness to future generations.

For cost-benefit analysis of nonmarket goods, value has to be inferred. This has been done with most success for recreation. During the last 25 years considerable attention, especially in the U.S., has been focussed on developing techniques for measuring the value of outdoor recreation. Although some theoretical and conceptual questions remain unresolved, value estimates for nonmarket goods are reliable enough to improve resource allocation decisions, providing assumptions and limitations of the methods used are made clear. The methods have been refined to the point where they can be widely incorporated into analyses of public forest management options (Holecek, 1980, p.21). The U.S. Water Resources Council (1983) endorses their use in resource allocation planning. Despite being well established in the U.S., these techniques have yet to be applied to forest land use decisions in B.C.

Once regional guidelines for recreation valuation have been developed, their application to individual sites is quite straightforward (Stynes, 1980, p.22). This chapter outlines established techniques for valuing wilderness preservation options and discusses their applicability for B.C. forest land allocation decisions. Discussion focuses on techniques for measuring three values derived from wilderness: recreation, aesthetic and preservation. It is intended as a practitioners' guide, to facilitate more comprehensive economic evaluations of resource use alternatives.

2.2 Measuring Outdoor Recreation Values

The aim of benefit-cost analysis is to determine the net social welfare of an alternative in economic terms.[1] Even though consumers do not pay money for wilderness recreation experience, it does have value to them. That nonmarket benefit is what cost-benefit analysis attempts to measure when valuing outdoor recreation. Conceptually, it is the maximum amount an individual is willing to pay for a good, in addition to what he actually does spend. That quantity has been labelled consumer surplus. For a good provided publicly, without charge, the consumer surplus is the good's gross value (Loose, 1977, p.18).

The net present value of recreation benefits can be calculated using the equation:

$$TB = \Sigma \frac{(UD*(1+UI)**TIME)*(V*(1+VI)**TIME)}{((1+R)**TIME)}$$

where TB = net present value of total recreation benefits for the time span of the analysis.

UD = number of recreation user-days annually.

UI = annual compounded rate of change in demand for user-days.

V = value of a user-day.

VI = annual compounded rate of change in value of a user-day.

---

[1] Many overviews are available of the principles and theory behind cost-benefit analysis. A clearly written, applied approach is given by Verne Loose, 1977, Guidelines for Benefit-Cost Analysis, Victoria: Environment and Land Use Committee Secretariat. A more detailed, theoretical discussion can be found in E.J. Mishan, 1971, Cost-Benefit Analysis: An Introduction, New York: Praeger.

R = social discount rate.

TIME = year for which benefits calculated.

The following examines the theories and techniques for measuring the components of the recreation benefits equation. Discussion will focus on cost-benefit techniques specific to valuing recreation: measuring the worth of a user-day (V), and estimating future demand (UI and VI).

2.2.1 *Valuing a Recreation User- Day*

Two general ways exist for inferring nonrnarket values. One group of methods determines value by directly asking consumers what the good is worth to them. This is called the Contingent Value Method (CVM). A second set of techniques observes what is spent on economic surrogates. For outdoor recreation, the most accepted method is calculating the cost of travelling to the recreation site by the Travel Cost Method (TCM). Both these methods have been used to derive standard values for a unit of recreation activity.

Contingent Value Method (CVM). Information about the value of nonmarket goods can be collected by asking consumers what they would be willing to pay for them. This technique has been applied to many environmental intangibles, including air pollution, wildlife management, water resources as well as outdoor recreation and wilderness preservation. The method is versatile and flexible. Much information can be gleaned from interviews which are tailored to gather details about the relative value of an array of options for designated sites. To use the method, a random and representative sample of recreationists is asked direct questions about their maximum willingness to pay to use an area contingent upon real or hypothetical site conditions (Walsh et al., 1982, p.20).

The willingness to pay to engage in an activity is one of two alternative measures of consumer surplus. Another form of questioning asks recreationists what minimum amount of payment they would accept to give up their recreation. In these instances, compensation demanded is measured. There is considerable disagreement concerning which of the two measures is appropriate. The choice of which to use depends upon the circumstances under which the good is provided. A general guideline is to measure maximum willingness to pay for benefits from extra consumption, and measure the minimum amount that will be accepted for the loss when the right to consume goods is withdrawn (Sinden and Worrell, 1979, p.306). In cases where recreationists already use public land, the value of their loss, should resource development such as timber harvesting occur, is the appropriate measure of welfare (Knetsch, 1984, p.5).

Even for tangible goods, compensation demanded questioning produces higher responses than willingness to pay (Bishop et al., 1984, Knetsch and Sinden, 1984). People may be reluctant to relinquish what they already have because they regard opportunity costs as less significant than out-of-pocket costs. Since consumers view transactions as changes from a reference point, rather than total utility, losses are more important than gains (Knetsch, pers. comm.).

Two widely employed questioning approaches exist for determining recreationists' consumer surplus. Both techniques take the form of standardized interviews where the same set of questions is asked in the same sequence to all participants. The simpler of the two is to directly ask the single question: 'What is the maximum amount you are willing to pay (or minimum compensation you will accept) for this item?" Such a question can be asked during interviews, with mailed question&es, or on a trail head registration form. A refinement of this approach requires direct interviews, By asking a series of questions concerning what the subject is willing to pay, eliciting yes or no answers, it converges on the actual amount. A typical bidding game might go like this:

> Interviewer: "Are you willing to pay $2 to hike this trail for one day?"
> Respondent: "Yes. "
> Interviewer: "Are you willing to pay $100 for a day's hike?"
> Respondent: "No. "
> Interviewer: "Are you willing to pay $15 for the hike?"
> Respondent: "Yes. "
> Interviewer: "Are you willing to pay $80 for a day of hiking the trail?"
> Respondent: "No. "

The questioning continues until the answers reveal an acceptable range or precise figure for willingness to pay. This method is believed to produce more reliable results than a single direct question (Schulze et al., 1981, p.158). Direct interviews also enhance accuracy since they allow researchers to ensure respondents understand the hypothetical situation. For these reasons the bidding game is the questioning technique most often used.

It is critical to collect responses from a sample size large enough to give statistically significant results. Techniques to mathematically derive a sample size tailored to meet the research requirements are given in most statistics texts.[2] A general guideline provided by the U.S. Water Resources Council (1983, p.84) recommends no fewer than 200 households be interviewed. When mailed questionaires are used, sending out a reminder postcard and questionaire will help increase response rate.[3] A random follow-up telephone survey of nonresponses provides the data to test for nonresponse bias.

Doubts have arisen regarding whether consumers really know the worth of nonmarket goods since they lack market experience and information. Even if consumers do know a good's value, uncertainty surrounds whether that answer will be given in a survey. Sources of data error include hypothetical bias protest responses, starting point bias in bidding questions, and strategic gamesmanship. A considerable volume of literature describes empirical tests attempting to verify the existence of these biases, and ways developed for reducing bias.

To minimize hypothetical bias, the situation presented must be as realistic and credible as possible and be described carefully and unambiguously. Visual aids such as photos, maps and drawings of the proposed changes all help to make the questioning more understandable. A survey is less hypothetical if it is limited to those who are currently involved in the activity.

Questions which ask for compensation demanded responses appear more hypothetical than willingness to pay surveys. Consumers are simply not accustomed to receiving compensation for loss of a

---

[2] An explanation of the formula is provided in Roger Reid, Mike Stone and Fran Rothman, 1985, Report of the British Columbia Survey of Wildlife Activities for 1983, Victoria, B.C.: Economic and Social Analysis Section, B.C. Ministry of Environment.

[3] For a more complete discussion see F.L. Filion, 1980, "Human Surveys in Wildlife Management" in Wildlife Management Techniques Manual, S.D. Schemnitz, ed., Washington, D.C.: The Wildlife Society.

public good, making it difficult for them to answer such a hypothetical question accurately. Some even refuse to sell. For these reasons, CVM techniques often rely on scenarios of willingness to pay to avert a loss, However, it is clear that this measure does not completely reflect the magnitude of consumer surplus. Probably the best approach available to date is to measure willingness to pay empirically, and use a conversion factor for estimating compensation demanded. Knetsch (pers. comm.) recommends a factor of four for converting willingness to pay data to compensation demanded. This figure is the disparity generally found between the two measures, although the range is wide.

A major consideration in describing the hypothetical situation is specifying what the payment will be used for. The intent is to select a payment system which does not create protest manifested in the form of a zero bid. A general tax is the form of payment least likely to prompt objections about paying for wilderness preservation. However, it is important to specify that the money will go into a special fund used specifically for providing or maintaining the amenity. The most neutral approach for recreationists is to consider the payment as additional travel costs for getting to the site. Direct trip expenses are already generally conceived as a valid method of paying for forest recreation (Walsh et al., 1984, p.180). Alternatively, respondents can be told that payment will be in the form of an entrance fee to use the site.

Responses of a zero bid attributable to a protest against the payment mechanism, the concept, or even the interview, should not be included in the value estimates. A cross check can determine whether a zero bid reflects the resource value or is caused by a protest. This can be done by asking why the bid is zero. Reasons such as not receiving any benefits, or limited income constraining the ability to pay legitimately reflect the value of the resource. Those responses reflecting a belief in the right to free access to a public resource, or rejection of being taxed should be omitted from the analysis. The U.S. Water Resources Council (1983, p.81) recommends that if protest bids consist of more than 15 percent of responses, the hypothetical situation presented in the questionaire should be restructured.

Biases can also stem for the bidding game style of questioning. Respondents may be influenced by the starting point of the bid, or they may become bored if the bidding process covers too lengthy a range.

This sort of bias can be reduced by randomly using different starting bids (Hyrnan, 1981, p.240). Experience also suggests that more clearly defined changes in environmental attributes produce a lower probability of starting point bias (Schulze et al., 1981, p.166). However, recent investigations by Knetsch (pers. comm.) and Rowe et al. (1980) reveal that starting point bias can have a significant influence on results.

One promising technique for avoiding starting point bias is that used by Bishop et al. (1983). Instead of converging on a precise value through repeated questioning, it collects willingness to pay or compensation demanded responses by asking only one question of each individual. A typical interview entails a single question phrased something like: "Would you accept $25 to forego a day of wilderness hiking?" The close-ended question simply collects a yes or no answer. Although several respondents are queried about the same value, the entire study collects data on a range of values. Cash offers, real or hypothetical, range from a minimum low of one dollar to a maximum value at which almost all recreationists within the sample would be willing to sell. Results from the survey are tabulated to determine probabilities of each offer being accepted or rejected. Close-ended questioning is also believed to elicit more reliable responses because it is more likely to be asking for information which consumers can provide accurately.

Interviews also need to be designed to minimize responses involving strategic gamesmanship. Since the payment is hypothetical, respondents have no need to give correct answers. Incentive to give a false willingness to pay may arise if respondents feel such behaviour will affect management or political decisions. The motive may be reduced by leaving participants uncertain as to how their bids will affect decisions, or by telling them they will pay an average bid, not their own (Schulze et al., 1981, p.162). Checking for strategic bias involves examining a frequency distribution of the results for a clustering of high and low bids. If clustering is not evident, it can be assumed that strategic bias is not a significant factor in the results (Walsh et al., 1982, p.23). Investigations into the existence of strategic bias have found that individuals do not act strategically enough to significantly affect results (Schulze et al., 1981, p.156).

In general, biases of any kind are believed not to have significant influence on well-designed CVM studies. Further checks of CVM studies against actual market behaviour show that CVM produces repiicable results (Walsh et al., 1982, p.24). Though not completely accurate, most observers feel that CVM estimates approximate true values well enough to make it a technique useful for public decision making (Bishop et al., 1984, p.6).

More elaborate CVM techniques incorporate refinements which attempt to make it easier for respondents to place a value on something they are not accustomed to considering in terms of money. One of the more promising techniques, tradeoff analysis, asks consumers to choose between hypothetical packages of goods. However, it is not yet developed to a point where it can be used as a part of environmental assessment (Hyman, 1981, p.247).[4]

Travel Cost Method (TCM). The Travel Cost Method is often preferred for estimating consumer surplus for outdoor recreation. Conceptually it is more attractive because it is based on actual market behaviour rather than hypothetical answers to questions. A surrogate is used to measure recreation values. Consumers unwittingly reveal what they are willing to pay to recreate when they travel to a site. Since outdoor recreation activities are normally free, and consumers must travel to the site to participate, the "price" for the experience is the travel costs.

The difficulty with TCM is actually measuring total travel costs as perceived by the consumers. It is generally agreed that the components of consumer surplus include transportation costs, travelling time, utility of the journey, and site entrance fees. Direct travel costs are for the round-trip to the site. They include air and ferry fare. Car expenses are the variable costs, most easily estimated using standard costs per kilometer which are converted into a per passenger rate.

---

[4]For elaboration on tradeoff analysis and other contingent valuation techniques still in the development stages, see Eric Hyman, 1981, "The Valuation of Extramarket Benefits and Costs in Environmental Impact Assessment" EIA Review, 2(3): 227-258, and John Sinden and Albert Worrell, 1979, Unpriced Values. Decisions without Market Prices , New York: John Wiley, chapter 14.

Multi-purpose or multi-destination trips create complications. Not all of the travel costs can be charged to the single recreation experience. Clawson and Knetsch (1966, p.74) present a simple, intuitive solution. They assumed one-way trips of less than 500 miles were soley for recreation at the single site. Longer trips had a proportion of their costs charged to recreation, depending upon the length of the trip. The proportion of costs attributed to recreation ranged from 80 percent for 500 to 1000 miles one-way travel, to 33 percent for over 2500 miles. A more precise method was tested by Haspel and Johnson (1982). They divided total round trip distance by the number of major stops travellers reported. This produced the mileage costs attributable to the visit to the park. With this estimate, they found their TCM results to be nearly identical to value estimates measured by CVM.

Several different ways have also arisen for determining the value of travel time, Evidence suggests that consumers value commuting travel time at one-third their wage rate (Mendelsohn and Brown, 1983, p.613). Travel time for children can be valued at one-fourth the adult rate, or one-twelfth the wage rate (U.S. Water Resources Council, 1983, p.78). This value may be reduced somewhat to compensate for the greater utility of recreation travel time. Travel utility, or benefits from the journey itself, such as sightseeing, are difficult to estimate and often disregarded. A more conservative approach is to consider travel time in terms of income foregone (Haspel and Johnson, 1982). Under this assumption, the retired, students, unemployed and weekend travelers have zero value for their time. The personal wage rate is used for those who are self-employed or travelling on unpaid vacation time. In general, no evidence yet clearly indicates how large the time opportunity cost allowance should be. Nevertheless, there is near concensus in the literature that including some allowance for travel time results in more accurate estimates of consumer surplus (Sorg and Loomis, 1984, p.3).

TCM still tends to undervalue actual consumer surplus for three reasons. For one, it ignores those who travel to the site on foot or bicycle, unless their travel time is accounted for. Secondly, it undervalues those who choose to live close to the recreation area, paying instead higher housing rents, or commuting further to work. Thirdly, it does not measure the maximum willingness to pay, but only one possible value of willingness to pay for enjoying the site.

The TCM is most useful in B.C. for current use patterns at specific sites. On site interviews or trailhead registers can collect information about trip origins, number of destinations, number of passengers per vehicle and the length of the wilderness vacations. Data is best collected over an entire year to overcome seasonal variations in use. To calculate travel costs, visits to the site are subdivided into zones of origin. These may be individual cities, or regions throughout which travel costs and time required to get to the recreation area are similar. The average per person travel costs for each origin zone are then calculated. The annual number of visits from each zone of origin is also estimated. Typically, the number of visits declines as the cost per visit increases. The exact relationship for a set of data can be expressed mathematically, or plotted graphically to form a demand curve as in figure 1. The area under the demand curve is the total consumer surplus gained from recreation at the site. It can be converted to a unit-day value per individual by dividing the total annual consumer surplus by the annual number of visitor days,

If conditions are similar, data from several sites may be extrapolated to estimate benefits under hypothetical management regimes. In B.C. however, since the population distribution is highly concentrated and few sites of recreational consequence have close substitutes, the opportunities for using similar sites are limited, if at all. Use of TCM is further restricted in that it cannot measure compensation demanded for loss of an opportunity.

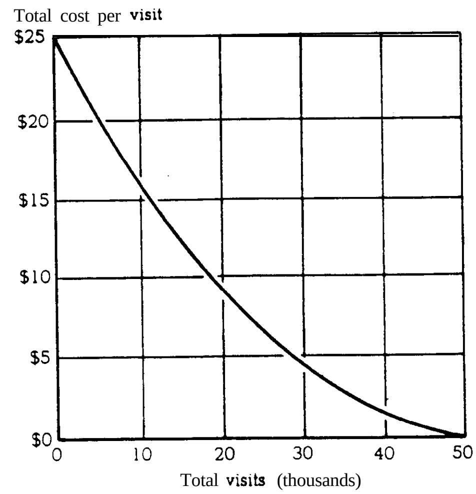


Figure 1. Number of visits and cost per visit at a hypothetical recreation area (Clawson and Knetsch, 1966, p.51).

Unit Value. Roth CVM and TCM have been used to derive standard unit values for various recreation activities. This is the simplest and least expensive way of estimating outdoor recreation benefits for alternative management regimes. Unit values are usually expressed in dollars per day of a specific recreation activity. They are most applicable to measuring discrete recreation activities once use and demand for a site have been determined. As yet, no unit values have been developed in Canada for wilderness recreation. In the U.S., recommended unit values have been provided by the Forest Service for dispersed recreation, wilderness recreation, big game hunting and cold water fishing (USDA Forest Service, 1980). Their main drawback is that accuracy is compromised since the unit values reflect an average site rather than a specific site. They cannot take into account unique qualities and recreation opportunities of a particular site, nor the availability of substitutes.

The U.S. Water Resources Council has attempted to refine application of unit values by basing them on a numerical rating of site quality. The benefits from a day of recreation are assigned contingent upon the site's quality rating. Two recreation categories, generalized for activities at sites with highly developed facilities, and specialized for low density pursuits requiring special skills, are assessed with five criteria:

a. types of activities

b. availability of recreational alternatives

c. carrying capacity

d. accessibility

e. environmental quality

These site quality rating criteria are restrictive in that they base value on facilities rather than resource attraction. Even with this refinement, the U.S. Water Resources Council limits reliance on unit value based estimates to projects of low recreational significance. For illustrative purposes, a compilation of user-day values for a variety of forest recreation activites are given in Appendix A.

2.2.2 *Forecasting Demand*

Net present value estimates for recreation require forecasts of both the magnitude of future recreation use of the area, and changes in the consumer surplus of the activity. Demand forecasts can never be absolute. Validity is enhanced if they include explicitly stated assumptions and give a range and probability of outcomes.

A variety of techniques are available for forecasting wilderness recreation demand. Probably the most effective in terms of reliability and usefulness for evaluating alternative resource uses, is a blend of methods. This would include considering the projections of relevant factors, surveying expert opinions in the field, and describing the influences of various managment regimes? In addition, due to the atypical nature of outdoor recreation, it is important that forecasts consider the influence of supply.

Forecasting Techniques. Recreation forecasts are frequently estimated by extrapolating trends. Recreation demand is linked to four major variables (Clawson, 1985, p.75). These are population, income,

[5] For a review of futures forecasting techniques see James Bright, ed., 1968, Technological Forecasting for Industry and Government New Jersey: Prentice-Hall; Marvin Cetron, 1969, Technological Forecasting New York: Gordon and Breach; and Joseph Martino, ed., 1972, An Introduction to Technological Forecasting London: Gordon and Breach.

transportation facilities and leisure time. An increase in any one factor usually causes a rise in demand for outdoor recreation.

The resulting shift in the demand curve can be divided into movement along the vertical and horizontal axes (see figure 1). Movement along the vertical axis reflects a change in price or the willingness of consumers to pay for a unit of recreation activity. The demand for recreation is income elastic and thereby characterized by increasing faster than increases in per capita income. These conditions apply if there are no close substitutes for a wilderness recreation opportunity. The Economic Council of Canada (1978, p.78) estimates the income elasticity of demand for recreation to be 2.1 percent. This when combined with the annual increase in per capita gross national product, produces a factor for the annual increase in the value of a recreation user-day. In cost-benefit studies, these estimates are often used with sensitivity analyses. Krutilla and Fisher (1975, p.130) recommend annual rates of increase in user-day values of 4, 5 and 6 percent, Knetsch and Fleming (1977, p.48) used 3, 4 and 6 percent

A change in quantity, or the number of recreationists causes the demand curve to shift along the horizontal axis. Population changes directly affect magnitudes of site use. More useful projections involving population trend analysis consider the characteristics of wilderness recreationists. Hendee et al. (1978, p.304-307) in a survey of the literature found wilderness users to be different, on average, from the general population. Backcountry recreationists tend to be young, highly educated, city residents, earning moderately high incomes in professional or technical occupations. By incorporating projections for these pertinent characteristics, recreation use may be forecasted more accurately. For instance, rather than the rate of change of the overall population, it is the change in the number of 20 to 40 year olds which is most significant.

Projections of site use need truncating when they reach carrying capacity, the upper limit of recreational use an outdoor area can accommodate. That limit is based upon several constraints which are ultimately defined by what the users perceive as acceptable. If recreationists are seeking wilderness, then carrying capacity is the maximum number of people the area can sustain while still providing a wilderness experience.

The two salient factors influencing carrying capacity are the resilience of the environment to human use and the frequency of encounters with other parties. In general, the two groups can be characterized as those who are sensitive to use levels and those who are tolerant of high use conditions (Graefe et al., 1984, p.414-415). Those less tolerant of crowded conditions are generally experienced and frequent participants of specialized non-motorized sports. They travel in small groups and seek wilderness, nature and solitude. Conversely, more tolerant recreationists are less experienced, participate in larger groups and tend to prefer motorized, thrill sports in developed areas.

Carrying capacity is, then, somewhat a matter of personal preferance. Key to the concept is determining what kind of social and environmental conditions management is aiming to provide (Hendee et al., 1977, p.186). This is a judgemental decision rather than an absolute measure and is dependant upon management objectives.

When carrying capacity is surpassed by demand, the value of a user-day can be expected to increase (Porter, 1982). Under constrained supply, if only those who are willing to pay the highest gain entry, recreation values increase. This effect is enhanced as the continuing reduction in substitutable supply also raises the value of recreation to each consumer.

Another factor influencing recreation demand is transportation costs. Wilderness recreation is an atypical commodity since its lack of mobility causes the consumer to travel to it. Demand is also nonmarket in nature; there is usually no fee for using a trail or river. Thus a prime determinant of demand is the price of the experience in terms of what it costs to travel to it. The key elements affecting travel costs are the availability and the proximity of the recreation facilities and opportunities. (Knetsch, 1974, p.13).

Recreation use may also be affected by some variables which previously had little influence (Kaiser and Moeller, 1980, p.29). Evolving social and cultural roles may cause the typical wilderness recreator profile to be rewritten. As more adults choose to remain childless, and the elderly become increasingly aware of fitness, the average age of backpackers may increase. Changes in technology, have repeatedly opened new recreation pursuits or made others accessible to more people. The cost of access is still another factor to consider. Prices for energy and thus transportation will influence the accessibility of outdoor sports to many.

Perhaps the most effective way to consider such a range of influences and possibilities is by integrating them into futures scenarios. The scenario outlines a logical set of circumstances which might evolve from specific assumptions. The technique is useful for estimating demand for hypothetical alternatives for individual sites. The effects of various management regimes on such demand determinants as site aesthetics, facility construction and marketing strategies can be detailed.

Scenario based forecasts are further enhanced if they involve expert concensus. Delphi techniques provide a means for canvassing expert opinions and improving upon them with brainstorming techniques by providing iterative feedback.

Many of these considerations have been incorporated into general forecasts for outdoor recreation in the United States. Clawson (1985, p.91) predicts that recreational use of national and state parks and national forests will increase over the next 25 years at 4 percent annually, with the per capita rate increasing at 2 to 3 percent annually.

2.3 Measuring Aesthetic Values

The existence of aesthetic values is often demonstrated in the market They are reflected in the higher prices houses and property command when they have a view. Some forested land may also produce scenic values. When those who benefit from wildland beauty are not recreationists, whose consumer surplus for an undisturbed landscape are included in recreation measures, then scenic values are an additional component of wilderness preservation benefits. The instances where scenic values are apt to be most significant are when the land is viewed by residents or highway travellers.

To date, bidding games have almost exclusively been used to measure willingness to pay to avoid aesthetic damage to an outdoor environment. Randall et al. (1974, p.147), using photos to supplement their description of development impacts, concluded that the techniques produced statistically reliable estimates of the substantial benefits from abating environmental disturbance. Further studies by Brookshire et al. (1976) and Rowe et al. (1980), were able to replicate the earlier results.

Nevertheless, the same considerations for using CVM to measure recreation benefits also apply here. When a loss is being experienced, as in a view being marred by logging, compensation demanded is the more appropriate measure. As well, close-ended questioning will alleviate some of the problems with bias inherent in bidding game surveys.

2.4 Measuring Preservation Values

Until recently, cost-benefit analysts regarded preservation values as true intangibles, beyond estimation. Several techniques have been proposed for accounting of wilderness preservation values in cost-benefit analysis. One technique, described by Krutilla and Fisher (1975) and expanded upon by Porter (1982) involves using a discount rate which reflects the social time preference. A discount rate for wilderness preservation which is lower than the marginal rate of capital productivity normally used in cost-benefit analysis, will better reflect the future value to society of preserving wilderness areas. The problem with such a technique is that no theory nor empirical evidence yet exists which gives insights about what that discount rate ought to be (Porter, 1982, p.73). Furthermore, values reflected in discount rates are obscured.

Relatively recently, CVM techniques have been applied to measuring preservation values. One of the first attempts, (Brookshire et al., 1983, p.14) concluded that conceptually sound empirical estimates are possible for preservation values. However, these values are probably only indicative, rather than precise.

For goods less likely to be involved in market transactions, an individual's capacity to price them becomes exceedingly poor (Rolston, 1985, p. 35). Nevertheless, preservation values should be added to recreation and aesthetic values to determine the total economic value of wilderness to society. Studies measuring willingness to pay for wilderness preservation in Colorado (Walsh et al., 1982) and wildlife preservation in B.C. (Reid et al., 1985) have found that preservation values constitute a considerable component of the total value of wilderness and wildlife.

As with measures of recreation and aesthetics, CVM techniques and their considerations also apply to preservation values. Importantly, these values can be held by nonusers as well as direct users of the resource. Therefore, surveys should sample the entire population of the group to which these values accrue, such as the citizens of the province.

2.5 Conclusion

The three components of wilderness benefits can be estimated by inferring market values of consumer surplus. Aesthetic and preservation values are best measured using contingent valuation methods. Recreation benefits can be derived from unit day values, CVM or TCM. Of these, CVM is perhaps most adaptable to B.C. resource allocation decisions.

The CVM and TCM measures of the same intangible generally produce consistent values (Peterson and Randall, 1984, p.84). However, comparison of the inferred results with actual market measures has revealed discrepancies. Investigations by Bishop and Heberlein (1979) and Brookshire et al. (1982) found that imputed estimates were at least fifty percent lower than actual market transaction prices. Nevertheless, Brookshire et al. (1982, p.175) conclude, "this level of accuracy is certainly preferable to no information for the decision-making process." When intangibles are difficult to measure precisely, analysis may be better used to determine the breakeven or threshold point for a project. Threshold analysis determines what minimum values would have to be derived from preservation to make development untenable (Hyman, 1981, p.250). This may be the most valid way of comparing a forest harvesting alternative with total wilderness preservation.

3. APPLYING COST-BENEFIT ANALYSIS TO THE WEST COAST TRAIL

3.1 Introduction

Between Port Renfrew and Bamfield on the west coast of Vancouver Island lie 72 kilometers of wind-swept and wave-pounded sand and cliffs. Inland the forest ranges from ancient cedars to struggling scrub. It has yet to be penetrated by roads. Instead, weaving in and out of the rain forests, and along the beaches runs a trail. Built originally in 1912 for sailors shipwrecked along the treacherous coast, it is now a holiday destination for backpackers. During the five or six days it takes to hike from one roadhead to the other, recreationists pass through unlogged portions of Tree Farm Licenses owned by MacMillan Bloedel Ltd. (MB) and British Columbia Forest Products (BCFP). Exactly how the terrain is to be divided between recreationists and forestry companies is yet to be resolved despite fifteen years of negotiations.

The West Coast Trail is typical of many forest land use conflicts in B.C. Forest harvesting tenures exist where a quality recreational experience is contingent upon a pristine wilderness environment. Decisions regarding how to manage the land are difficult because the magnitude of social welfare accruing from alternative land uses is not immediately obvious. For these reasons, the West Coast Trail area was chosen as a case study to demonstrate and assess the use of cost-benefit analysis as an analytical tool for resource allocation decisions. The West Coast Trail analysis demonstrates one way in which cost-benefit techniques can measure values from nonmarket outdoor recreation activities.

3.1 .I *Background*

Much of the land surrounding the West Coast Trail was put into two Tree Farm Licenses (TFLs) in 1955. TFL 44 is managed by MacMillan Bloedel and TFL 46 by BC Forest Products. Prior to the timber allocations the land had been under a recreation reserve for 21 years. The reserve was lifted in 1947 when the provincial government concluded the region was too remote for recreation (Sierra Club of Western Canada, 1980, p.14). By the 1970s, logging began to penetrate the area, and so did backpackers. In response to the mushrooming demand for hiking the coast, Parks Canada in 1970 included the West Coast Trail when it created Pacific Rim National Park. Yet the drawing of the park boundaries to enclose the trail was left to a later date.

The last fifteen years have seen the Sierra Club advocate one boundary location on behalf of recreation&s and conservationists and the Council of Forest Industries counter with recommendation for a smaller park. A compromise line was erected around the trail which, for management purposes, has been considered the park boundary for the last several years. Its ratification awaits Parks Canada's final decision and an agreement among the provincial and federal governments and the logging companies on the value of the licenses held by the companies (Bryan Price, pers. comm.).

The proposed park corridor is less than one-half kilometer wide in places. Pacific Rim National Park Superintendent, Roger Wilson (1984, p.2) maintains that this buffer is not adequate to protect trail users from logging disturbances. The noise of harvesting, for instance, will intrude at times upon backpackers. Even more detrimental to the hike's wilderness nature will be the increased access logging roads create. Wherever less than a kilometer wide strip of forest is left, trails can easily be pushed to the beach (Sierra Club of Western Canada, 1980, p.88). Backpackers out for a week would have their wilderness experience interrupted by day visitors. "The rare and unusual would be replaced by the commonplace, " concludes the Sierra Club. For this reason, they propose the park be a minimum of 2.5 kilometers wide.

3.1.2 *The Alternatives Considered*

In light of the history it seemed appropriate for this study to consider three alternative uses of the coastal strip of forest between Port Renfrew and Bamfield. The alternative uses examined were Wilderness, Multiple Use and Logging. The area considered for each alternative consists of a strip, 2.5 kilometers wide from the shoreline, running the length of the West Coast Trail. In places the currently proposed Pacific Rim National Park boundary extends further inland than this strip. This additional area, except for the Hobiton Valley, is also a part of the study area. The boundaries of the TFLs, the proposed park and the study area are shown in figure 2.

1) Wilderness: Resource use under the Wilderness alternative involves wilderness recreation with no timber harvesting within the study area. The Wilderness option is the solution recommended by the Sierra Club.

2) Multiple Use: This alternative includes both timber and recreation use. The extent of each is based upon the currently proposed park boundary. Logging would proceed to the park boundary, which in places is within 2.5 km of the coast. The disturbances logging creates when it is in such close proximity to a trail would convert hiking the West Coast Trail from a wilderness experience to one of dispersed recreation.

3) Logging: The timber harvesting alternative involves cutting all merchantable timber in the study area thereby precluding any backpacking recreation on the West Coast Trail. The Logging alternative was further divided into two subcategories. A portion of the land within the proposed park boundary is not TFL, but instead Crown Grant to individual owners. The Log All option assumes this land would be logged and measures the net timber benefits accrued. The Log Part option assumes the owners never intend to log their land, but are instead holding it to preserve its natural characteristics.

Figure . Map of the study area.

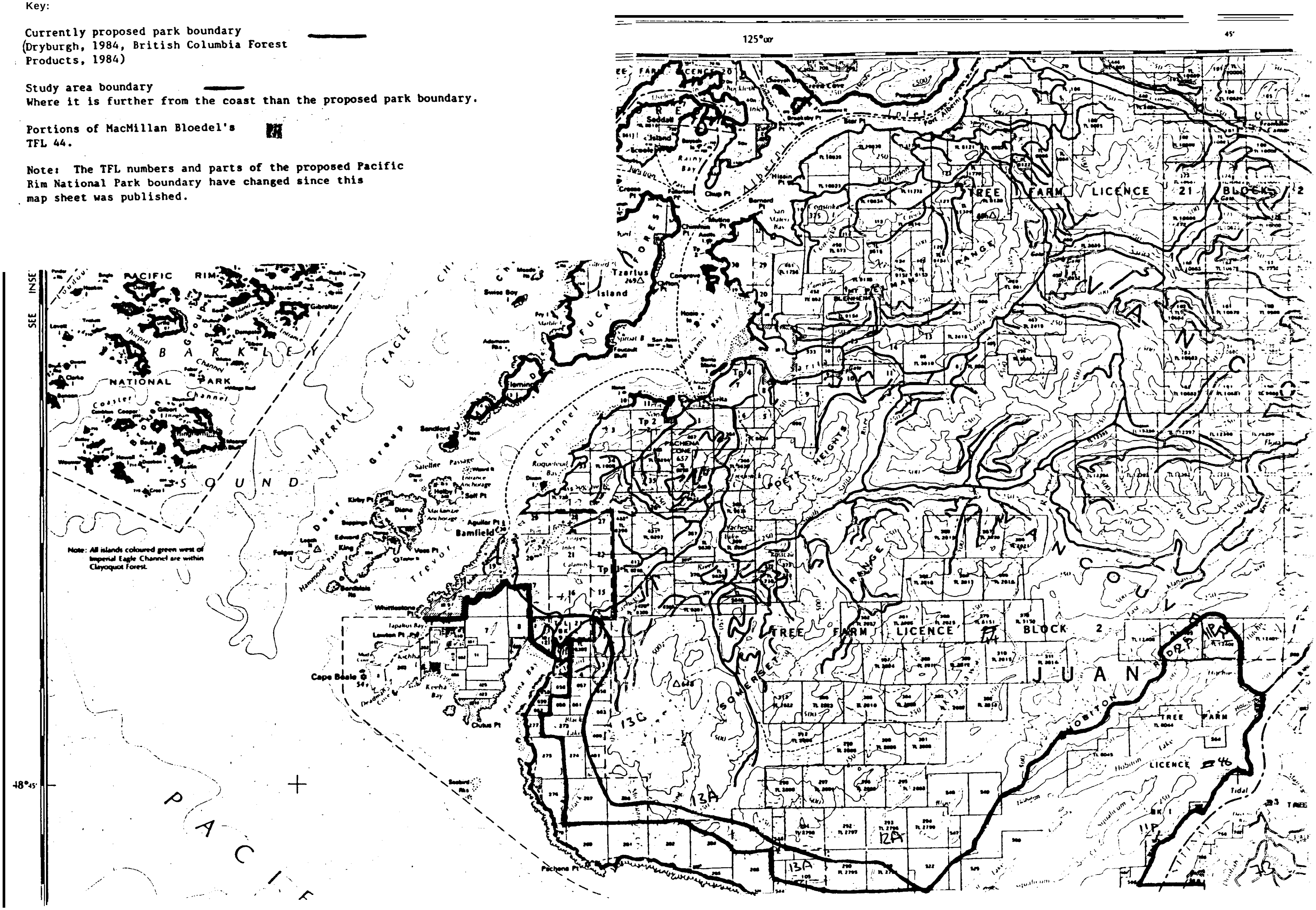
Key:

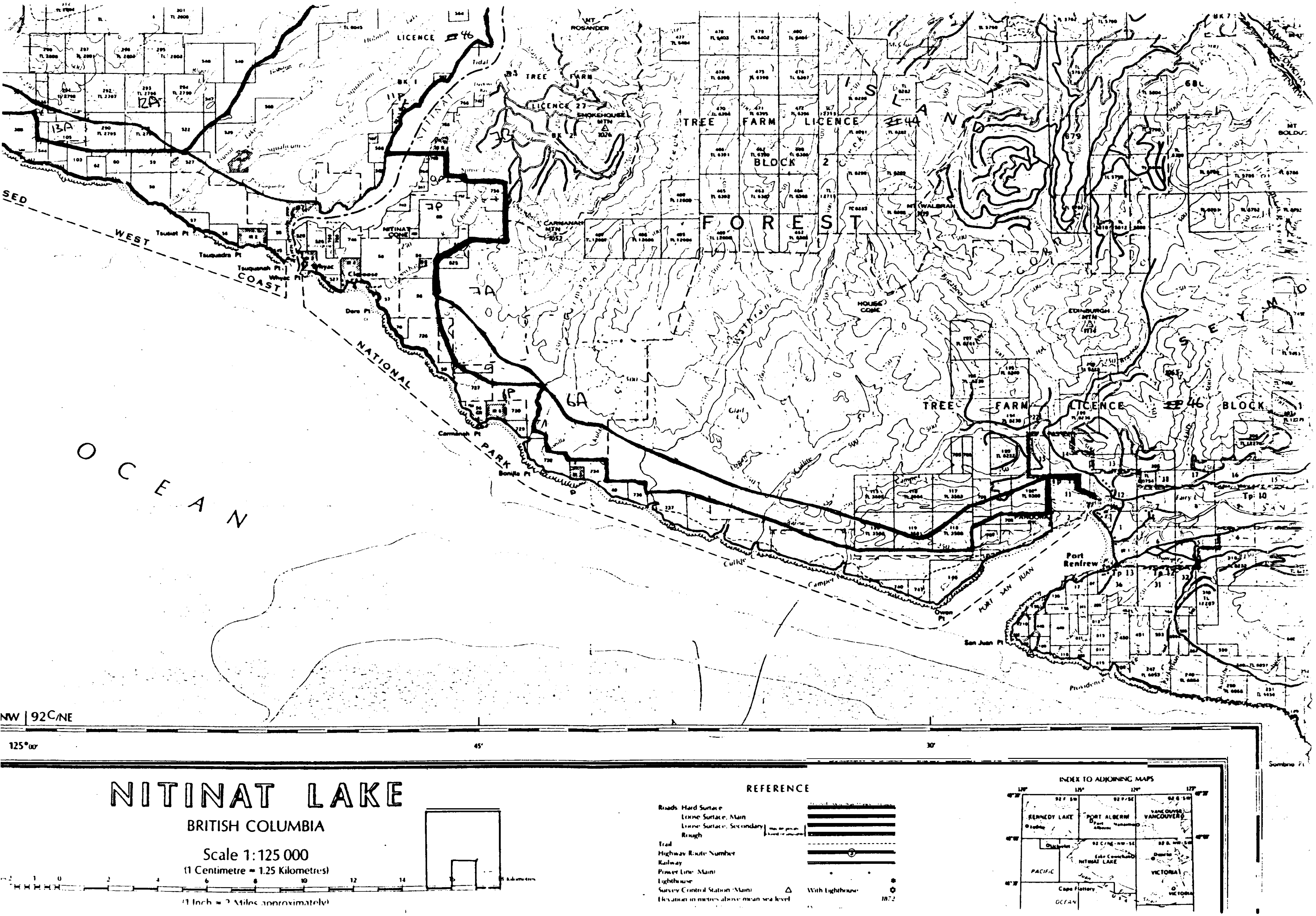
Currently proposed park boundary
(Dryburgh, 1984, British Columbia Forest Products, 1984)

Study area boundary
Where it is further from the coast than the proposed park boundary.

Portions of MacMillan Bloedel's TFL 44.

Note: The TFL numbers and parts of the proposed Pacific Rim National Park boundary have changed since this map sheet was published.




NITINAT LAKE
BRITISH COLUMBIA
Scale 1:125 000
(1 Centimetre = 1.25 Kilometres)
(1 Inch = 2 Miles approximately)
REFERENCE
Roads: Hard Surface
Loose Surface, Main
Loose Surface, Secondary
Rough
Trail
Highway Route Number
Railway
Power Line: Main
Lighthouse
Survey Control Station (Main)
With Lighthouse
Elevation in metres above mean sea level
INDEX TO ADJOINING MAPS
KENNEDY LAKE
PORT ALBERNI
VANCOUVER
NITINAT LAKE
VICTORIA
PACIFIC
OCEAN
Cape Flattery
NW | 92C/NE
125°00'
45'
30'
OCEAN
WEST COAST
NATIONAL PARK
TREE FARM LICENCE 44
BLOCK 2
FOREST
ISLAND
TREE FARM LICENCE 46 BLOCK
TREE FARM LICENCE 27
LICENCE 46
MT ROSANDER
SMOKEHOUSE MTN
CARMANAH MTN
MT WALBRAN
NITINAT CONE
HOUSE CONE
EDINBURGH MTN
MT BOLDUC
Tsusiat Pt
Tsuquadra Pt
Tsuquanah Pt
Whyac Pt
Dare Pt
Carmanah Pt
Bonilla Pt
Owen Pt
San Juan Pt
Port Renfrew
PORT SAN JUAN
Sombrio Pt
Tp 10
Tp 13
12A
13A
7P
7A
6A
6P

3.2 Valuing the Resources

3.2.1 *Tangible Costs and Benefits*

The equations used to calculate the tangible benefits and costs for both timber and recreation are described below. For each equation the rationale behind the variables used in the calculations is outlined. along with how the values for the variables were derived. Those values are listed in appendix B, table B.5. The stream of tangible benefits and costs, and total net present value were calculated with SIMCON (Steer and Peterman, 1985), a canned computer program used for running simulation models written in FORTRAN.

1) Timber Benefits: The total benefits from timber harvesting were calculated using the following equation:

$$TBT = \Sigma \frac{((WD*VOL)+STUMP)}{(1+R(I))**TIME}$$

where TBT = net present value of total timber benefits from year 1 to 50.

WD = wage differential between forestry and other sectors expressed in dollars per m^3 wood volume.

VOL = scaled volume of timber harvested annually from area.

STUMP = annual stumpage on timber harvested.

R(I) = social discount rate.

TIME = year for which benefits are calculated.

R(I). A discount rate of 8 percent was used for the base case calculations. Sensitivity analysis was also done using a 10 percent discount rate. These rates are based upon the recommendations of Loose (1977, p.71).

TIME. Throughout the analysis, benefits, costs and net present values were calculated over 50 years. This time frame was considered appropriate for two reasons. Both forestry companies estimate they have about 50 years of mature timber left to harvest on their TFLs. Secondly, after 50 years, costs and benefits, when discounted take on negligible values. For this study it was assumed that one-fiftieth of the forest area, volume and value would be harvested each year.

Market imperfections, such as the power of labour unions, could result in forest sector wages being higher than their social opportunity cost. If this is true, shadow prices reflecting social opportunity costs should be used in place of nominal wages. This has been done in other studies (Meares Island Planning Team, 1983; B.C. Ministry of Environment and Ministry of Forests, 1983) by including as a benefit the difference between forest sector wages and the opportunity cost of labour as defined by the average wage rate in other sectors. Whether this assumption is valid is open to debate. The wage differential can be viewed as a market imperfection existing only during the short-term and not of consequence in the 50 year time frame of this analysis. Some suggest that the higher wages reflect the higher amount of risk, stress and time spent injured from the job. These intangible costs can be considered equal to the income differential. For these reasons no wage differential was used in the base case. A sensitivity analysis was done under the assumption that a wage differential was part of the net benefits from forestry. It took the difference between direct forestry jobs and all manufacturing sector wages as the differential.

The WD between forestry and the manufacturing sectors was calculated by taking average percent differentials over six years, 1979 to 1984, based on average weekly earnings for B.C. employees in the sectors as reported by Statistics Canada. The result was a 13 percent differential between forestry and manufacturing wages. Using June 1983 weekly earnings and the 1977 to 1981 average of 1.75 person years per 1000 m^3 harvested in coastal B.C. (B.C. Ministry of Forests, 1985), a wage differential value of $6.66 per cubic meter was calculated.

The volumes of accessible merchantable mature timber on TFL land within the park boundary were available by species in compartment summary form from MacMillan Bloedel (Tydeman, pers. comm.) and BC Forest Products (1984). Their volume data was also used to extrapolate timber volumes on land outside this area. An average of 527 m^3/ha was assumed for coastal areas, and 681 m^3/ha for inland areas outside the proposed boundary. By comparison, the Vancouver Region average is 660 m^3/ha (Jones, 1983). The volume per hectare averages are further broken down by species in appendix B, table B.l.

STUMP. The stumpage that forestry companies pay to the crown for timber harvested is an estimate of the net benefits from logging and milling (B.C. Ministry of Lands, Parks and Housing, 1983, p.3-4). Stumpage rates vary since they are derived from the market price for logs, which fluctuates considerably. To allow for the cyclical nature of log prices, a ten year average of stumpage rates is commonly used for calculating net benefits from timber harvesting. The rates for each species were available as Vancouver Region averages, and in recent years, coastal region averages, from Ministry of Forests Annual Reports for 1974 to 1983184. Only stumpage rates for the last four years were available for Cypress. As with all monetary values used in this study, stumpage figures were converted to 1983 Canadian dollars using the Gross National Expenditure price index supplied by Statistics Canada. To calculate the total annual stumpage gained from each alternative involving forestry, the average stumpage prices for each species (listed in appendix B, table B.2) were multiplied by the volume cut annually.

2) Timber Costs: The total costs of timber harvesting were calculated using the equation:

$$TCT = \Sigma \frac{(SILV*HA)}{(1+R(I))**TIME}$$

where TCT = net present value of total timber costs from year 1 to 50.

SILV = average silvilculture costs per hectare.

HA= number of hectares logged annually.

R(I) = social discount rate.

TIME = year for which costs are calculated.

Stumpage rates published in the Ministry of Forests annual report are net of most harvesting costs but do not include deductions for the costs of site preparation, planting, brushing and weeding. TFL holders are required to reforest land after logging and may deduct their expenses from stumpage paid under Section 88 of the Forest Act. The inclusion of silvicultural treatments as a forestry cost in net present value calculations is disputable. It can be argued that they are an investment in future timber, and not a cost of harvesting existing timber. If the costs are considered, they therefore should be balanced against future timber revenues. An alternative view states that the cost of harvesting timber ought to include its replacement cost. Society has already decreed, through regulation, that reforestation costs are to be charged against the current harvest. For this reason, the study included silvicultural treatments in forest harvesting cost calculations.

To estimate silviculture costs, the average cost per hectare for each activity in the Vancouver Forest Region were taken from Jones' (1983) compilation. The proportion of logged land to receive each treatment was determined in various ways. MacMillan Bloedel plants 82 percent of the land they log on TFL 44 (Dryburgh, 1984). Their rate was applied to the entire study area. Over the last three years the B.C. Ministry of Forests has recorded in their annual reports the amount of land receiving various site preparation treatments in the Vancouver Region. For each treatment, the degree to which it is used was calculated as a percentage of the total area surveyed and these rates assumed for the study area. Brushing and weeding rates were similarily calculated from annual report data as a proportion of the total area planted. The rates of each silviculture activity are given in appendix B, table B.3. They total up to an average cost of $1106 per hectare. This study assumed that the intensity of silviculture activity would not change over the 50 year period of analysis. This may be a conservative estimate given the trend in recent years to plant, site prepare and remove brush on more land.

<u>HA.</u> The area of land on TFLs within the park boundary has been measured by the forestry companies (Tydeman, pers. comm., BC Forest Products, 1984). Land area elsewhere was measured with a planimeter. All land excluding lakes, was included for timber inventory purposes, regardless of its status. The only excepted areas were Indian Reserves. It was assumed that the average silviculture costs would apply to one-fiftieth of the area each year.

3) Recreation Benefits: The following equation was used to calculate tangible recreation benefits:

$$TRB = \frac{\Sigma(UD*(1+UI)**TIME)*(CD*(1+WI)**TIME)}{(1+R(I))**TIME}$$

where TRB = net present value of total recreation benefits from year 1 to 50.

UD = number of user-days annually.

UI = annual compounded rate of increase in demand for user-days.

CD = value of a user-day based on compensation demanded criteria.

WI = annual compounded rate of increase in the value of a user-day.

R(I) = social discount rate.

TIME = year for which benefits calculated.

The number of annual user-days on the West Coast Trail was estimated from data supplied by Parks Canada. Their trail information and registration center is open at the Bamfield trailhead from early May to the end of September. The trek's ruggedness causes most hikers to attempt it during these months and most take time to register. Based on estimates from Howie Hambleton (pers. comm.) the number of days spent on the trail was determined from the traveller's destination. A further 25 percent was added to registration center tallies for those hikers who did not register and 15 percent added for those who did the trail during the months when the center was closed. An average of 1981 to 1984 annual totals was used for this study. For their values see appendix B, table B.4. Since trail use varies considerably from year to year, probably more due to weather conditions than anything else, an average of the last few year's use was deemed the most appropriate starting point for user-days.

It was assumed that demand for recreation on the trail would be the same for the Wilderness and Multiple Use alternatives, although the type of use might vary. With the Multiple Use alternative, day visitors might displace those seeking a lengthier wilderness experience. Reliance upon the assumption that overall demand would not be affected by the nature of recreation was also necessitated by the lack of use projections for dispersed recreation.

UI. Knetsch and Fleming (1977, p.47) assume that demand for wilderness in eastern B.C. over the long run will at least be equal to the rate of population growth. Projections of B.C.'s population predict it will increase from 2.74 million in 1981 to 4.36 million by the year 2002 (Parks Canada, 1983, p.4). This 2.35 percent annual rate of increase was used for the value of UI.

That figure is probably conservative. The increasing growth in tourism should be considered as a component of UI, since in 1981, 45 percent of the people hiking the trail were from outside the province (Sierra Club of Western Canada, factsheet, p.3). Canada and especially B.C.. are looking towards substantial increases in tourism (Parks Canada, 1983, p.2). That rate of increase will no doubt affect UI, but was not included in this calculation.

CD. According to Krutilla and Fischer (1975, p.35), "The willingness to pay on the part of nondestructive users represents the lower bound value of the resource when allocated to such a purpose." In this instance, however, willingness to pay is not the most appropriate measure of recreation benefits (Jack Knetsch, pers. comm.). Instead, the compensation demanded by recreationists better reflects the resource's value. This takes account of the facts that logging would take away the opportunity already existing for wilderness backpacking, and that the West Coast Trail area was designated as a recreation reserve several decades before the TFLs were established.

No compensation demanded values are available for wilderness hiking experience. However Knetsch (1984, p.7) has found that studies measuring both willingness to pay and compensation demanded for other forms of outdoor recreation result in compensation demanded being 2.3 to 4.2 times higher than willingness to pay. A mean of these results, 3.3 was the factor used to derive compensation demanded values for this analysis from willingness to pay data.

Willingness to pay figures for deriving the compensation demanded values for a day of recreating on the West Coast Trail were taken from figures suggested by the Water Resources Council and used in the

United States 1980 Resource Planning Analysis (US Department of Agriculture Forest Service, 1984, p. B-53). The drawback with using these estimates is that they fail to take into account the role of substitutes and the uniqueness of a specific site, However, when neither time nor resources are available to carry out actual willingness to pay or travel cost measures for an area, then standard values will do.

Different values for compensation demanded were used for the two alternatives involving recreation. It was assumed that increased road access and other logging disturbances in the Multiple Use alternative would make the hiking experience one of dispersed recreation, worth $16.96 per day in 1983 Canadian dollars. Dispersed recreation tends to be day-use activities in an undeveloped area and in conjunction with a road or trail. With wilderness recreation, the imprint of man's activity is substantially less noticeable (US Department of Agriculture Forest Service, 1984, p.Glossary-3). The Wilderness alternative provides more of a wilderness backpacking experience worth $45.44 per day.

WI. Recreation is a superior good, meaning the amount of money users are willing to spend on it increases with increasing per capita income. As well, the income elasticity of demand for recreation is 2.1 percent (Economic Council of Canada, 1978, p.78). Using this factor, and a per capita GNP factor of 3 percent annual increase (Knetsch and Fleming, 1977, p.48) produces an increase in compensation demanded value of recreation of 6 percent annually. This value was taken as the base case. A sensitivity analysis was done using a 4 percent rate of increase.

4) Recreation Costs: The equation used to estimate the discounted costs of recreation over the next 50 years is as follows:

$$TCR = \Sigma \frac{(BUCK)}{(1+R(I))**TIME}$$

where TCR = net present value of total recreation costs from year 1 to 50.

BUCK = annual costs of trail maintenance and public information.

R(I) = social discount rate.

TIME = year for which costs are calculated.

Parks Canada admits their bookkeeping is such that it is difficult to arrive at a costs figure for operating the trail (Hambleton, pers. comm.). However a rough estimate by Hambleton came up with $90,000 in labour and $50,000 in materials purchased annually for a total of $140,000 to operate the West Coast Trail.

5) Other Tangible Costs and Benefits: Some additional measures of costs and benefits could have been added to these equations but were omitted because they were not applicable or data were unobtainable within the time and resource constraints of this analysis.

Under certain circumstances it may be appropriate to include additional costs for timber extraction. Under Section 88 of the Forest Act, certain road costs are also deducted from gross stumpage. Since this rarely applies to coastal TFLs and seemed unlikely to occur on TFLs 44 and 46 (Robert Pope, pers. comm.), these costs were assumed to be zero.

The rental fee charged by the crown to TFL and TL holders has been considered a net benefit in other cost-benefit analyses (B.C. Ministry of Environment and Ministry of Forests, 1983, p.39). It amounts to $0.45 per cubic meter annual allowable cut for TFLs and $1.25 per hectare for TLs. More appropriate, however is to assume this rental fee covers the government management costs for forestry. These include variable costs borne by the Forest Service for timber management and silviculture on the site, involving activities such as checking harvesting plans and monitoring silviculture operations. This assumption was used here and neither Ministry of Forests management costs nor rental fees were included in the net present value calculation of timber.

It would also be reasonable to include with recreation costs the price to retrain and relocate forestry workers displaced by a reduction in the annual allowable cut. Similarly, if logging were to preclude operation of the trail, costs might be incurred to retrain and relocate trail maintenance and information staff. The magnitude of these costs depends upon the economy and job opportunities in the regions where the displaced workers live, and no attempt was made to estimate these factors in this study. Displacing forestry workers has, however, been taken into account by including wage differential benefits in one of the sensitivity analyses.

Lastly, carrying capacity is integral to calculating demand when valuing a resource such as wilderness. As Knetsch and Fleming (1977, p.46) note, "Large numbers of people are incompatible with maximum enjoyment of the recreational experience and lead to diminution of benefits." Wilderness areas are especially subject to crowding constraints. Unfortunately, Parks Canada at this point has no estimate of the carrying capacity of the West Coast Trail. However they do acknowledge the need for measures of carrying capacity and intend to obtain them when the agency has the authority to regulate trail use (Hambleton, pers. comm.).

3.2.2 *Intangible Benefits*

In addition to the measures of benefits listed above, there are several other net benefits from timber harvesting and recreation for which economics has less successfully afixed a meaningful figure.

The alternatives which include timber harvesting also have benefits from the long-term harvesting rights the TFL and TL licenses themselves convey. Since this good is rarely traded in the market place, no cost-benefit analysis in B.C. has attempted to place a value on its worth (BC Ministry of Lands, Parks & Housing, 1983, p.39, Meares Island Planning Team, 1983, p.60).

Preservation values, until recently, have also escaped measurement. Initial attempts have been made to estimate preservation values for wilderness in Colorado (Walsh et al., 1982) and wildlife in B.C. (Reid et at., 1985). As yet, no studies have attempted measurement of preservation values associated with wilderness or outdoor recreation in B.C. Nevertheless, all three components of preservation value, option, existence and bequest, are likely to comprise a significant portion of the benefits derived from the Wilderness option, and to a lesser extent from the Multiple Use alternative. However, these benefits are not included in the empirical results of this analysis.

3.3 Results

For each alternative the discounted costs of both resources were subtracted from their discounted benefits to arrive at a total net present value. Table 1 presents the net present value for each alternative and each sensitivity analysis.

With the set of variables chosen for the base case, timber harvesting had the lowest net present value at $10.31 million (1983 $) for logging the entire TFL and TL area, or $15.07 million if Crown Grant land is logged as well. Maintaining the currently proposed park boundary, the Multiple Use alternative, produces a slightly higher net present value of $25.22 million. The value of the Wilderness alternative, preserving the entire area for recreation with no logging, has a net present value of $74.06 million. The wilderness value is nearly three times higher than the next best alternative.

All the sensitivity analyses result in the Wilderness management option ranking highest, with a net present value at least twice that of the next highest alternative. However, theranking of the other two resource use options varies. At a ten percent discount rate, maintaining the park boundary has the second highest net present value. With a compensation demanded increase rate of 4 percent, or a wage differential of $6.66, the timber harvesting option ranks second, but only if all Crown Grant land is logged.

For the purposes of choosing the optimum resource use alternative, the sensitivity analyses do not affect the results. In all cases, the net present value of the Wilderness alternative is considerably higher than the others.

TABLE 1

Net Present Value of the Alternatives

Variables	Alternative			
	Wilderness	Multiple Use	Log Part	Log All
	million 1983 $			
BASE CASE Discount Rate 8% Wage Differential 0 Rate of Increase in Compensation Demanded 6 %	74.06	25.22	10.31	15.07
SENSITIVITY ANALYSES Discount Rate 10%	46.91	15.55	8.36	12.21
Wage Differential Benefit	74.06	25.14	20.38	30.03
Lower Recreation Demand	45.83	14.69	10.31	15.07

3.4 Conclusion

A cost-benefit analysis of resource use alternatives for the West Coast Trail area provides an indication of the worth of several options for timber and recreation use. Despite many values in the costs and benefits equations being only approximate, the analysis demonstrates which management regime garners the highest net benefit to society. Importantly, sensitivity analyses of different assumptions show that they do not affect the net present value ranking of the alternatives.

The analysis reveals that preserving for wilderness recreation a 2.5 kilometer wide coastal strip from Port Renfrew to Bamfield is the most efficient use of the land's resources. The Wilderness alternative produces a net present value three times higher than the other two alternatives. The empirical results do not include intangible preservation benefits associated with the Wilderness alternative. Based on this study, then, the most desirable resource management alternative is to preserve the area as wilderness.

4. CONCLUSION

Cost-benefit analysis is capable of improving the evaluation of land use alternatives in B.C. A review of the literature reveals that well developed techniques are available for inferring wilderness and recreation values. Furthermore, a case study of the West Coast Trail demonstrates that CBA produces a clear and nearly comprehensive comparison of alternative resource management regimes involving wilderness recreation and forest harvesting. Nevertheless, CBA is most effective when used judiciously since incorrect application of the technique can lead to erroneous conclusions. This difficulty necessitates basing cost-benefit procedures on generally accepted guidelines. This concluding chapter elaborates on the suitability of CBA in evaluating alternative land uses, discussing its strengths and limitations. Specific recommendations are also made for enabling routine incorporation of CBA to measure outdoor recreation and wilderness preservation values in B.C.

4.1 An Appraisal of Cost-Benefit Analysis

In many ways, cost-benefit analysis is a superior evaluative tool. The conceptual framework of CBA is grounded in welfare economic theory which has repeatedly been scrutinized and refined. The development of CBA has entailed extending its application to a broad range of evaluation problems. Over the last several decades, a body of literature has assembled documenting the testing and validation of various analytical procedures. Significantly, for land allocation decision making, considerable attention has been directed towards applying CBA to evaluate divers resource uses including timber harvesting and outdoor recreation.

These efforts have resulted in what is likely the best framework for integrating disparate values. Relative to other assessment techniques involving numerical analysis, CBA is able to derive values more objectively. The technique aims to place values on goods which reflect, through market place behaviour, the values of all people, rather than a select few. Other methods which attempt to use a common measurement unit for diverse values tend to rely on numerical weightings provided by a few analysts, or with help from a select public group. Additionally, their units of measure often have no relevance outside the analytical framework. Using money as a common unit of measure facilitates understanding of the results by both decision makers and lay public. In this way, the net benefits to society from recreation along the West Coast Trail were easily compared to those from logging.

These strengths make CBA an attractive tool for evaluating land use alternatives. However, its use in decision-making needs to be guarded. The complexity of calculations and technical procedures in cost-benefit studies are usually difficult for decision makers and the public to fully comprehend. There is a tendancy for decision makers to note only the final numerical result without considering all that is implied in that dollar value. Considerable danger lies in concealing value judgements. This problem is exacerbated by the theoretical disagreements surrounding certain procedures such as selection of the appropriate discount rate, and the choice of willingness to pay or compensation demanded measures of recreation value. One of the most important value judgements CBA makes is that concerning the distribution of costs and benefits (Lea, 1985). To ameliorate the problem of hidden assumptions concerning values and procedures, they can be tested using sensitivity analysis to elucidate their effects on the final result For the West Coast Trail study, this was done with three variables, yet none were found to affect the net present value ranking of land use options. Wherever assumptions are significant, however, the implications should be presented with the results.

The precision of cost-benefit results is also limited by the uncertainty surrounding measures of some goods. The calculation of net logging benefits is most quickly derived from stumpage rates. The values, being based on Vancouver log market prices, may be artificially low since the market does not operate under perfect conditions. Uncertainty invariably exists with the valuation of nonmarket goods. For many recreational activities, imputation techniques and values have been devised and found to be sufficiently reliable. Still, these techniques have yet to be adapted or applied to B.C. Less attention has been paid to the wilderness values of preservation and aesthetics. There is less certainty in measuring these because of the difficulty in comparing them to market goods. Consumers lack the experience to form good judgements regarding their dollar value. Willingness to pay for them is also influenced by the ability to pay, causing insufficient attention to be given to the values of the poor. These features cause the accuracy of cost-benefit assessment of nonmarket goods to often be suspect. When nonmarket values altogether elude attempts at quantification, they are not included in the net present value calculation. As a result, intangible values are often ignored by decision makers.

Several steps can be taken to address the difficulties of including nonmarket goods in cost-benefit analysis of alternative land uses. For one, research can be directed to ascertaining the worth of unpriced environmental amenities. Secondly, where these amenities are not included in net present value calculations, their presence can be brought to the attention of the decision makers in conjunction with the final results. Lastly, cost-benefit evaluation can be used as a threshold analysis rather than an attempt to determine the precise worth of each alternative. The relative net present values of West Coast Trail management alternatives do not vary within a considerable range of uncertainty. Within the framework of EIA and land use decison making, great precision is neither demanded nor expected. Cost-benefit methods are certainly adequate enough to determine the relative benefits of various alternatives.

Acknowledging the presence of intangible values is especially critical where preservation values are concerned. Many forest land allocation conflicts, including the West Coast Trail, involve a land use entailing the preservation of amenities which would be irreversibly destroyed by resource development or extraction. When CBA is unable to measure preservation values, decision makers should be advised of the implications. Specifically, the advice of Arrow and Fisher (1974, p.317) is appropriate: "If we are uncertain about the payoff to investment in development, we should err on the side of under-investment, rather than over-investment, since development is irreversible." Keeping future options open is the recommended strategy.

A further constraint of CBA is that it requires more data and time to perform than many other evaluative techniques. Nevertheless, B.C. land use decisions often involve resource values of such magnitude that, in comparison, the cost of undertaking a cost-benefit study is insignificant, This is certainly true for the West Coast Trail where the net present value of alternative uses ranges from $15 million to $74 million (1983 $). The need for reliable and clear analysis is made critical by the fact that many of these land use decisions involve irreversible options. Each conflict however, is best assessed on its own merits as to the need and benefits derived from using CBA as an analytical tool. Importantly, effective land use decisions will rely on more than just a cost-benefit analysis. The technique ought to be one of a package of tools for evaluating options (Lea, 1985, p.161; McAllister, 1980, p.278; Whitney and Maclaren, 1985, p.26). These are ideally used strategically, as part of an iterative process which draws upon appropriate techniques as the situation requires. Of the methods, CBA is perhaps the one most effectual in assessing situations which are not clearly defined by simpler and less costly techniques.

A reliable set of analytical techniques alone will not guarantee good decisions. Evaluation needs to be part of a comprehensive and multifaceted EIA program, enabling effective and efficient decison making. Ideally, implementation of CBA occurs within the framework of a good planning process, derived from the principles of EIA. All elements of the process, including technical analysis, ought to be combined with full public involvement to ensure planning and decisions meet citizen requirements.[1]

4.2 Recommendations

The findings of this study lead to several recommendations for the cost-benefit assessment of forest land use alternatives in B.C. involving wilderness and recreation. Basic to these, CBA is optimally incorporated into a comprehensive EIA process designed for evaluating forest land use options.

Within this framework CBA is best applied in a consistent way, using generally accepted techniques and assumptions. A set of guidelines will enable technical specialists to quickly and easily carry out

---

[1]For discussion of the elements constituting a good public involvement process see A.P. Grima, 1985, "Participatory Rites: Integrating Public Involvement in Environmental Impact Assessment" in Environmental Impact Assessment: The Canadian Experience, J.B.R. Whitney and V.W. [illegible]s. [illegible], Toronto: Institute for Environmental Studies, University of Toronto; and Barry Sadler ed., 1979, Involvement and Environment, Proceedings of the Canadian Conference on Public Participation, Vols 1 and 2, Edmonton: Environment Council of Alberta.

reliable cost-benefit studies. Most appropriate would be guidelines which elaborate on those already published by the B.C. Environment and Land Use Committee Secretariat (Loose, 1977) and include the level of detail given in chapter 2 of this study for handling a variety of evaluative situtations. Guidelines should also recommend under what circumstances it is appropriate to conduct a CBA.

In addition, background data ought to be acquired for facilitating cost-benefit analysis in B.C. The valuation of options involving recreation requires projections of recreation demand. As well, accepted values need to be established for nonmarket environmental amenities such as outdoor recreation, scenic qualities, and wilderness preservation. A series of CVM surveys would be the most suitable means of collecting this information.

Lastly, in light of the difficulty with measuring many wilderness values, where that is an alternative land use, CBA is preferably employed to derive threshold analysis, rather than to determine absolute values. Even when applied this way, CBA has considerable promise for improving the quality of land use decisions in B.C.

REFERENCES

Arrow, K.J. and Fisher, A.C. 1974. "Environmental Preservation, Uncertainty, and Irreversibility" Quarterlv Journal of Economics. 88: 312-319.

Association of British Columbia Professional Foresters. 1985. Economic Benefits of Timber and Productive Forest Land In British Columbia. Vancouver: Association of B.C. Professional Foresters.

Bell, Frederick. 1981. Recreational Benefits for the Atchafalava River Basin. Washington, D.C.: US Department of Interior, Fish and Wildlife Service.

Bianchi, Dennis. 1969. The Economic Value of Streams for Fishing. Louisville, Kentucky: Water Resources Institute, University of Kentucky.

Bishop, Richard and Heberlein, Thomas. 1979. "Measuring Values of Extramarket Goods: Are Indirect Measures Biased?" American Journal of Agricultural Economics 65(5): 926-930.

Bishop, Richard; Heberlein, Thomas and Kealy, Mary Jo. 1983. "Contingent Valuation of Environmental Assets: Comparisons with a Simulated Market" Natural Resources Journal 23: 619-633.

Bloodoff, Peter. 1981. "An Assessment of the Lower Mainland Crown Land Planning Process' Vancouver: MA Thesis, University of British Columbia School of Community and Regional Planning.

Bowes, Michael and Loomis, John. 1980. "A Note on the use of Travel Cost Models with Unequal Zonal Populations Land Economics 56(4): 465-470.

Bright' James, ed. 1968. Technological Forecasting for Industry and Government. New Jersey: Prentice-Hall.

British Columbia Environment and Land Use Act, R.S.B.C. 1979, c.110.

British Columbia Forest Act, R.S.B.C. 1979, c. 140.

British Columbia Forest Products. 1984. Management and Working Plan No.1 Maauinna Tree Farm License No.46 Folio No.1 1984-1988. Vancouver: British Columbia Forest Products.

British Columbia Ministry of Environment and Ministry of Forests. 1983. Reservation of Old Growth Timber for the Protection of Wildlife Habitat on Northern Vancouver Island . Victoria: British Columbia Ministry of Environment and Ministry of Forests.

British Columbia Ministry of Forests. 1974 to 1984. Ministry of Forests Annual Report Victoria: Queen's Printer.

British Columbia Ministry of Forests. 1984. "Local Resource Use Planning". Resource Planning Manual. Victoria: Resource Planning Section, Planning and Inventory Branch.

British Columbia Ministry of Forests. 1985. Fraser Timber Supply Area Options Report Vancouver: Vancouver Region B.C. Forest Service.

British Columbia Ministry of Lands, Parks and Housing. 1983. Ministry of Lands, Parks and Housing Approach to Calculating Opportunity Costs of Forest Industrial Values in Ecological Reserves. Occasional Paper No. 1. Victoria: Lands Program Branch, British Columbia Ministry of Lands, Parks and Housing.

Brookshire, David; Eubanks, Larry and Alan Randall. 1983. 'Estimating Option Prices and Existence Values for Wildlife Resources" Land Economics 59(1): 1-15.

Brookshire, David; Ives, Berry and Schulze, William. 1976. "The Valuation of Aesthetic Preferences" Journal of Environmental Economics and Management 3(4): 325-346.

Brookshire, David; Thayer, Mark; Schulze, William and d'Arge, Mark. 1982. "Valuing Public Goods: A Comparison of Survey and Hedonic Approaches" American Economic Review 72(1): 165-177.

Brown, Gardner and Hammack, Judd. 1972. "A Preliminary Investigation of the Economics of Migratory Waterfowl" in Natural Environments: Studies in Theoretical and Applied Analysis. John Krutilla, ed. Baltimore, Md.: John Hopkins.

. Brown, Gardner and Plummer, Mark. 1979. "Recreation Valuation" (Appendix A.5) An Economic Analysis of Nontimber Uses of Forestland in the Pacific Northwest Pullman, Wash.: Forest Policy Project, Washington State University.

Brown, William; Larson, D.M.; Johnston, R.S. and Wahle, R.J. 1976. Improved Economic Evaluation of Commercially and Sport Caught Salmon and Steelhead of the Columbia River. Corvallis, Ore.: Oregon State University.

Brown, William; Nawas, Farid and Stevens, Joe. 1973. The Oregon Big Game Resource: An Economic Evaluation. Corvallis, Ore.: Agricultural Experiment Station, Oregon State University.

Brown, William; Sorhus, Colin and Gibbs, Kenneth. 1980. Estimated Expenditure by Sport Anglers and Net Economic Values of Salmon and Steelhead for Specified Fisheries in the Pacific Northwest. Corvallis, Ore.: Department of Economics, Oregon State University.

Buckley, Jane; Lavallee, Andre and Liivamae, Maret. eds. 1980. Land Use in Canada. Report of the Interdepartmental Task Force on Land-Use Policy. Ottawa: Lands Directorate, Environment Canada.

Cetron, Marvin. 1969. Technological Forecasting:. New York: Gordon and Breach.

Clawson, Marion. 1985. "Outdoor Recreation: Twenty-five years of history, Twenty-five years of projection" Leisure Sciences 7(1): 73-99.

Clawson, Marion and Knetsch, Jack. 1966. Economics of Outdoor Recreation. Baltimore: John Hopkins.

Crutchfield, James A. and Schelle, Kurt 1979. An Economic Analysis of Washington Ocean Recreational Salmon Fishing With Particular Emphasis on the Role Played by the Charter Vessel Industry. Seattle, Wash: Department of Economics, University of Washington.

Dryburgh, J.G. 1984. Management and Working Plan No.1 1985-1989. "Alberni" Tree Farm Licence No.44.Albemi: MacMillan Bloedel Ltd.

Economic Council of Canada. 1978. Annual Review. Ottawa: Supply and Services Canada.

Filion, F.L. 1980. "Human Surveys in Wildlife Management" in Wildlife Management Techniques Manual. S.D. Schmenitz, ed. Washington, D.C.: The Wildlife Society.

Fisher, Warren. 1982. "Travel Cost and Contingent Value Estimates Explored." Washington, D.C.: Eastern Economics Association.

Forest Research Council of British Columbia. 1983. "Second Annual Report for the year ending March 31.1983." Richmond: Forest Research Council of British Columbia.

Gibbs, Kenneth. 1974. "Evaluation of Outdoor Recreational Resources: A Note." Land Economics 50(3): 309-311.

Gold, Andrew. 1974. "Design with Nature: A Critique" American Institute of Planners Journal 40(4): 284-286.

Gordon, Douglas. 1970. An Economic Analysis of Project Number F18R15 Idaho Sport Fisheries. Boise, Idaho: Idaho Cooperative Fishery Unit, Idaho Department of Fish and Game.

Graefe, Alan R.; Vaske, Jerry J. and Kuss, Fred R. 1984. "Social Carrying Capacity: An Integration and Synthesis of Twenty Years of Research" Leisure Sciences 6(4): 395-431.

Grima, A.P. 1985. "Participatory Rites: Integrating Public Involvement in Environmental Impact Assessment" in Environmental Impact Assessment: The Canadian Experience. J.B.R. Whitney and V.W. Maclaren, eds. Toronto: Institute for Environmental Studies, University of Toronto.

Grubb, Herbert and Goodwin, James. 1968. Economic Evaluation of Water Oriented Recreation in the Preliminary Texas Water Plan. Dallas, Texas: Texas Water Development Board.

Hambleton, Howie. Chief, Visitor Services, Pacific Rim National Park, Ucluelet. pers. comm. March 18, 1985.

Hansen, Christopher. 1977. A Report on the Value of Wildlife. Ogden, Utah: US Dept. of Agriculture, Forest Service, Intermountain Region.

Haspel, Abraham and Johnson, Reed. 1982. "Multiple Destination Trip Bias in Recreation Benefit Estimation" Land Economics 58(3): 364-372.

Hendee, John; Stankey, George and Lucas, Robert 1978. Wilderness Management MP No. 1365. Washington D.C.: US Dept of Agriculture, Forest Service.

Holecek, Donald. 1980. "Recreation Evaluation Has Become Feasible" Journal of Forestry. 78(1): 21-22.

Hyman, Eric. 1981. "The Valuation of Extramarket Benefits and Costs in Environmental Impact Assessment" EIA Review 2(3): 227-258.

Jones, Trevor. 1983. Wilderness or Logging? Case Studies of Two Conflicts in B.C.. Vancouver: Federation of Mountain Clubs of British Columbia.

Kaiser, Fred and Moeller, George. 1980. "Trend Indicators Needed for Effective Recreation Planning - A Statistical Blueprint for the 80's." in Proceedings 1980 National Outdoor Recreation Trends Symposium. Vol. 1. USDA FS Gen. Tech. Rep. NE-57. Broomall PA: USDA Forest Service. Northeastern Forest Experiment Station. pp 26-32.

Kalter, Robert and Gosse, his. 1969. Outdoor Recreation in New York State: Proiections of Demand, Economic Value and Pricing Effects for the Period 1970-1985. Ithaca, N.Y.: Cornell University.

Keith, John; Halverson, Phil and Fumworth, Lon. 1982. Valuation of a Free Flowing River: The Salt River. Arizona. Logan, Utah: Utah State University.

King, David and Walka, Ann. 1980. A Market Analysis of Trout Fishing on Fort Apache Indian Reservation. Tucson, Arizona: School of Renewable Natural Resources, University of Arizona.

Knetsch, Jack. 1974. Outdoor Recreation and Water Resources Planning. Washington D.C.: American Geophysical Union.

Knetsch, Jack. 1984. "Legal Rules and the Basis for Evaluating Economic Losses" International Review of Law and Economics. 4: 5-13.

Knetsch, Jack. Professor, Economics Department, Simon Fraser University, Burnaby. pers. comm. March 12, 1985.

Knetsch, Jack; Brown, Richard and Hansen, William. 1976. "Estimating Expected Use and Value of Recreation Sites" in Planninn for Tourism Development: Ouantitative Approaches C. Gearing, W. Swart and T. Var, eds. Proeger, N.Y.

Knetsch, Jack and Fleming, William. 1977. "Resource Development Alternatives: An Evaluation Strategy" Annals of Regional Science. 11: 39-50.

Knetsch, Jack and Sinden, J.A. 1984. "Willingness to Pay and Compensation Demanded: Experimental Evidence of an Unexpected Disparity in Measures of Value" Ouarterlv Journal of Economics 99(3): 507-521.

Krutilla, John and Fisher, Anthony. 1975. The Economics of Natural Environments. Baltimore: John Hopkins University Press.

Lea, Anthony. 1985. "Methods and Models of Economic Impact Assessment Within the Context of Environmental Impact Assessment" in Environmental Impact Assessment: The Canadian Experience. J.B.R. Whitney and V.W. Maclaren, eds. Toronto: Institute for Environmental Studies, University of Toronto.

Loomis, John. 1979. Estimation of Recreational Benefits From Grand Gulch Primitive Area. Moab, Utah: US Dept. of Interior, Bureau of Land Management.

Loomis, John. 1982. "Use of Travel Cost Models for Evaluating Lottery Rationed Recreation: Application to Big Game Hunting" Journal of Leisure Research Second Quarter: 117-124.

Loose, Verne, ed. 1977. Guidelines for Benefit-Cost Analysis. Victoria: British Columbia Environment and Land Use Committee Secretariat.

McAllister, Donald M. 1980. Evaluation in Environmental Planning. Cambridge Mass.: MIT Press.

Manning, E.W. 1980. Issues in Canadian Land Use. Ottawa: Lands Directorate, Environment Canada.

Martino, Joseph, ed. 1972. An Introduction to Technological Forecasting. London: Gordon and Breach.

Martin, William; Gum, Russei and Smith, Arthur. 1974. The Demand for and Value of Hunting, Fishing and General Rural Outdoor Recreation in Arizona. Tucson, Arizona: Agricultural Experiment Station, University of Arizona.

Matthews, Stephen and Brown, Gardner. 1970. Economic Evaluation of the 1967 Sport Salmon Fisheries of Washington. Washington: Department of Fisheries.

Meares Island Planning Team. 1983. Meares Island Planning Options Draft Report Victoria: Ministry of Forests.

Mendelsohn, Robert and Brown, Gardner. 1983. "Revealed Preference Approaches to Valuing Outdoor Recreation" Natural Resources Journal 23(3): 607-618.

Michaleson, Edgar. 1977. "An Attempt to Quantify the Esthetics of Wild and Scenic Rivers in Idaho" in Proceedings of a Symposium of River Recreation Management and Research General Technical Report NC-28. St Paul, Minn.: US Dept of Agriculture, Forest Service, North Central Station.

Michaleson, Edgar and Gilmour, Campbell. 1978. Estimatina the Demand for Outdoor Recreation in the Sawtooth Vallev. Idaho. Moscow, Idaho: Agricultural Experiment Station, University of Idaho.

Mishan, E.J. 1971. Cost-Benefit Analvsis: An Introduction. New York: Praeger.

Parks Canada. 1983. The Future: Some Assumptions A Background Paper for the Four Mountain Parks Planning Program. No.25 Calgary: Parks Canada.

Pearse, Peter H. 1976. Timber Rights and Forest Policv in British Columbia. Victoria: Queen's Printer.

Pearse, Peter H. 1977. "Natural Resource Policies: An Economist's Critique" in Managing Canada's Renewable Resources. R. Krueger and B. Mitchell, eds. Toronto: Methuen.

Peterson, George and Randall, Alan, eds. 1984. Valuation of Wildland Resource Benefits. Boulder, Colorado: Westview Press.

Pope, Robert Appraisal Coordinator, Vancouver Forest Region, British Columbia Ministry of Forests, Bumaby. pers. comm. March 20, 1985.

Porter, Richard. 1982. "The New Approach to Wilderness Preservation through Benefit-Cost Analysis" Journal of Environmental Economics and Management 9(1): 59-80.

Price, Bryan. Manager, Park Resources Section, British Columbia Ministry of Lands, Parks and Housing, Victoria, pers. comm. March 18, 1985.

Randall, Alan; Ives, Berry and Eastman, Clyde. 1974. "Bidding Games for Valuation of Aesthetic Environmental Improvements" Journal of Environmental Economics and Management l(2): 132-149.

Reid, Roger; Stone, Mike and Rothman, Fran. 1985. Report of the British Columbia Survev of Wildlife Activities for 1983. Victoria B.C.: Economic and Social Analysis Section, B.C. Ministry of Environment.

Rolston, Holmes. 1985. "Valuing Wildlands" Environmental Ethics 7(1): 23-48.

Rowe, R.D.; d'Arge, Ralph and Brookshire, David. 1980. "An Experiment on the Economic Value of Visibility" Journal of Environmental Economics and Management 7(1): 1-19.

Sadler, Barry, ed. 1979. Involvement and Environment. Proceedings of the Canadian Conference on Public Participation, Vols 1 and 2. Edmonton: Environment Council of Alberta.

Schulze, William; d'Arge, Ralph and Brookshire, David. 1981. "Valuing Environmental Commodities: Some Recent Experiments" Land Economics 57(2): 151-172.

Sierra Club of Western Canada. 1980. The West Coast Trail. 4th ed. Vancouver: Douglas & McIntyre Ltd.

Sierra Club of Western Canada. no date Factsheet Pacific Rim National Park Phase III. Victoria: Sierra Club of Western Canada.

Sinden, John and Worrell, Albert 1979. Unpriced Values. Decisions without Market Prices New York: John Wiley.

Smith, Kerry and Kopp, Raymond. 1980. "Spatial Limits of the Travel Cost Recreational Demand Model" Land Economics 56(1): 64-72.

Sorg, Cindy and Loomis, John. 1984. "Empirical Estimates of Amenity Forest Values: A Comparative Review" General Technical Report RM-107. Fort Collins, Colorado: USDA Forest Service, Rocky Mountain Forest and Range Experiment Station.

South Moresby Resource Planning Team. 1983. South Moresbv Land Use Alternatives. Victoria: Queen's Printer.

Steer, Greg and Peterman, Randall. 1985. A Beginner's Manual for SIMCON Version 7 . Bumaby: Simon Fraser University.

Stynes, Daniel. 1980. "Methods Are Available for Estimating Recreation Benefits." Journal of Forestry 78(1): 22.

Sutherland, Ronald. 1980. A Regional Recreation Demand and Benefits Model. Corvallis, Ore.: Corvallis Environmental Research Laboratory, U.S. Environmental Protection Agency.

Tydeman, Dave. Inventory Section, Nanaimo Woodlands, MacMillan Bloedel Ltd., Nanaimo. pers. comm. March 22, 1985.

United States Department of Agriculture, Forest Service. 1980. A Recommended Renewable Resources Program – 1980 Update. FS-346. Washington, D.C.: U.S. Government Printing Office.

United States Department of Agriculture, Forest Service. 1984. Wasatch-Cache National Forest Land and Resource Management Plan. Draft Environmental Impact Statement. U.S. Government Printing Office.

United States Department of Interior, Fish and Wildlife Service. 1980. National Survev of Fishing, Hunting and Wildlife Associated with Recreation. Washington, D.C.: US Dept. of Interior.

United States Water Resources Council. 1983. Economic and Environmental Principles and Guidelines for Water and Related Land Resources Implementation Studies Washington, D.C.: Government Printing Office.

Vaughan, William and Russell, Clifford. 1982. "Valuing a fishing day: An Application of a Systematic Varying Parameter Model" Land Economics 58(4): 450-463.

Walmsley, M.E. 1976. "Biophysical Land Classification in British Columbia: The Philosophy, Techniques and Application" in Ecological (Biophysical) Land Classification in Canada. J. Thie and G. Ironside, eds. Ottawa: Lands Directorate, Environment Canada.

Walsh, Richard; Aukerman, Robert and Milton, Robert 1980a. Measuring Benefits and the Economic Value of Water in Recreation on High Countrv Reservoirs. Fort Collins, Colorado: Colorado Water Resources Research Institute, Colorado State University.

Walsh, Richard; Ericson, Ray; Arosteguy, Daniel and Hansen, Michael. 1980b. An Empirical Application of a Model for Estimating the Recreation Value of Instream Flow. Fort Collins, Colorado: Colorado Water Resources Research Institute, Colorado State University.

Walsh, Richard and Gilliam, Lynde. 1982. "Benefits of Wilderness Expansion with Excess Demand for Indian Peaks" Western Journal of Agricultural Economics 7: 1-12.

Walsh, Richard; Gillman, Richard and Loomis, John. 1982. Wilderness Resource Economics: Recreation Use and Preservation Values. Denver, Colorado: American Wilderness Alliance.

Walsh, Richard and Olienyk, John. 1981. Recreation Demand Effects of Mountain Pine Beetle Damage to -the Qualitv of Forest Recreation Resources in the Colorado Front Range. Fort Collins, Colorado: Department of Economics, Colorado State University.

Walsh, Richard; Radulaski, Olga and Lee, Li-Chen. 1984. "Value of Hiking and Cross-Country Skiing in Roaded and Nonroaded Areas of a National Forest" in IUFRO Proceedings for Economic Value Analysis of Multiple-Use Forestrv. Research Todav for Tomorrow's Forests. Corvallis, Oregon: Oregon State University.

Ward, Frank. 1982. The Demand for and Value of Recreational Use of Water in Southeastern New Mexico 1978-79. Las Cruces, New Mexico: Agricultural Experiment Station Research Report, New Mexico State University.

Weithman, Stephen and Haas, Mark. 1982. "Socioeconomic value of the Trout Fishery in Lake Taneycomo, Missouri" Transactions of the American Fisheries Society 111: 223-230.

Wennegren, Boyd; Fullerton, Herbert and Wrigley, Jim. 1973. Estimation of Qualitv and Location Values for Resident Deer Hunting in Utah. Logan, Utah: Utah Agricultural Experiment Station, Utah State University.

Whitney, J.B.R. and Maclaren, V.W. 1985. "A Framework for Assessment of EIA Methodologies" in Environmental Impact Assessment: The Canadian Experience. J.B.R. Whitney and V.M. Maclaren, eds. Toronto: Institute for Environmental Studies, University of Toronto.

Wilson, Roger. 1984. Visitor and Resource Management Issues in Pacific Rim National Park. Ucluelet: Pacific Rim National Park.

APPENDIX A - UNIT VALUES FOR FOREST RECREATION

The following is a compilation of unit **day values** for many outdoor recreation activities. They are taken from CVM and TCM studies of a variety of parks, forests and recreation areas. The results of most studies reported here are standardized to reflect a set of techniques established by a panel of economists. In these cases, adjustments were made to the final results and reported in Sorg and Loomis (1984). Standardization allows the values for a particular recreation activity to be directly compared. Differences among unit day measures are attributable more to variation in site quality and the availability of substitutes in the area, than to discrepant assumptions implicit in the measurement procedures. Also included in this compilation are some unit values recommended by U.S. government agencies.

Table A.1

Unit Values for Wilderness Recreation

Value of a Recreation User-Day 1983 $ Cnd.	Survey Details	Source
22.00 - 24.60	US Water Resources Council recommended values for low density, specialized recreation in areas throughout the United States of outstanding aesthetic quality, good access and no substitutes within two hours travel.	US Water Resources Council, 1983
11.79 - 17.69	US Forest Service recommended range for a 12 hour visitor day to a national forest.	Walsh et al., 1982
23.74	State average for wilderness and roadless area recreation in Colorado.	Walsh et al., 1981
29.39	Backpacking in Indian Peaks Wilderness Area, a large alpine site, within 105 kilometers of Denver, Colorado.	Walsh & Gilliam, 1982
16.56	Hiking at Indian Peaks.	
25.20	Hiking and backpacking in high desert, primitive areas of southern Utah.	Loomis, 1979
26.56	Visits to Ventana Wilderness, a small, nonalpine area in California, 218 kilometers from San Francisco.	Smith & Kopp, 1980
95.79	Average for four wilderness recreation areas in Oregon and Washington: Glacier Peak, Goat Rocks, Diamond Peak and Eagle Cap.	Brown & Plummer, 1979

Table A.2

Unit Values for Camping

Value of a Recreation User-Day 1983 $ Cnd.	Survey Details	Source
16.08	Developed camping near high mountain reservoirs in Colorado.	Walsh et al., 1980a
20.26	Undeveloped camping.	
1.52	Developed camping in Colorado.	Walsh & Olienyk, 1981
10.75	Semi-developed camping in Colorado.	
20.73	Camping associated with river recreation in Idaho.	Michaleson, 1977
8.68	Idaho.	Michaleson & Gilmour, 1978
8.10	Oregon and Washington.	Sutherland, 1980
14.77	Western Washington.	Brown & Plummer, 1979
34.14	Camping associated with river and lake recreation in Florida.	Gibbs, 1974
24.10	Statewide average for New York.	Kalter & Gosse, 1969

Table A.3

Unit Values for Hiking

Value of a Recreation User-Day 1983 $ Cnd.	Survey Details	Source
20.24	Hiking and backpacking in remote, high mountains in Colorado.	Walsh et al., 1980a
13.94	Hiking and backpacking along the Front Range, Colorado.	Walsh & Olienyk, 1981
33.69	Hiking in Arizona's national forests.	Martin et al., 1974
23.58	Hiking and backpacking in western Washington.	Brown & Plummer, 1979
59.29	Hiking in New York state.	Kalter & Gosse, 1969

Table A.4

Unit Values for Picnicking

Value of a Recreation User-Day 1983 $ Cnd.	Survey Details	Source
8.46	For a 4.2 hour day of picnicking along the Front Range in Colorado.	Walsh & Olienyk, 1981
16.08	Picnicking at developed and semi-developed high mountain reservoirs in Colorado.	Walsh et al., 1980a
10.04	Picnicking and other activities on day trips to California reservoirs.	Knetsch et al., 1976

Table A.5

Unit Values for Water Sports

Value of a Recreation User-Day 1983 $ Cnd.	Survey Details	Source
13.29	Recreation in general at several reservoirs in SE New Mexico.	Ward, 1982
17.36	Water recreation in Texas.	Grubb & Goodwin, 1968
26.76	Florida lake and stream recreation.	Gibbs, 1974
34.98	Swimming in New York state.	Kalter & Gosse, 1969
18.98 21.96	Rafting on western Colorado rivers. Kayaking in western Colorado.	Walsh et al., 1980b
27.21	Recreational floating in Arizona.	Keith et al., 1982
23.97 194.36	Floating non-wild and scenic rivers in Idaho. Floating the Middle Fork of the Salmon River, Idaho.	Michaleson, 1977
43.04	White water rafting, kayaking and floatingboating on the Westwater Canyon portion of the Colorado River in Utah.	Bowes & Loomis, 1980
8.14	Boating in Oregon and Washington.	Sutherland, 1980

Table A.6

Unit Values for Fishing

Value of a Recreation User-Day 1983 $ Cnd.	Survey Details	Source
70.24	Sport salmon fishing in Idaho.	Cordon, 1970
128.30	Sport salmon fishing in Washington.	Matthews & Brown, 1970
33.58	Ocean sport fishing in Washington.	Crutchfield & Schelle, 1979
50.09	Salmon and steelhead fishing in Oregon.	Brown et al., 1976
37.25	Anadromous sport fishing for 3.3 hours in Oregon.	Brown et al., 1980
44.88	Anadromous sport fishing in Washington.	
15.81	Cold water fishing in Idaho.	Walsh et al., 1980a, 1980b
12.05	A 4.6 hour day of cold water fishing in Idaho.	Walsh & Olienyk, 1981
17.82	Fishing at the Fort Apache Indian Reservation, Arizona.	King & Walka, 1980
33.36	Cold water fishing in Arizona.	Martin et al., 1974
20.33	Fishing in Utah, Idaho, western Wyoming and Nevada.	Hansen, 1977
14.99	Fishing on Idaho's high country lakes.	Cordon, 1970
19.07	Trout fishing in Idaho.	USFWS, 1980
48.91	Western Washington.	Brown & Plummer, 1979
87.52	Oregon.	

Table A.6

Unit Values for Fishing

Value of a Recreation User-Day 1983 $ Cnd.	Survey Details	Source
11.12	Kentucky.	Bianchi, 1969
25.18	Fishing at Lake Taneycomo, Missouri.	Weithman & Haas, 1982
48.30	New York state.	Kalter & Gosse, 1969
31.32	United States average for fishing.	Vaughan & Russell, 1982
21.38	United States average for trout fishing.	USFWS, 1980

Table A.7

Unit Values for Hunting

Value of a Recreation User-Day 1983 $ Cnd.	Survey Details	Source
60.96	Deer in Arizona.	Martin et al., 1974
66.25	Other big game.	
31.01	Small game.	
21.07	Waterfowl.	
25.50	Antelope in Utah.	Loomis, 1982
42.80	Deer in Utah, Idaho, Wyoming, Nevada.	Hansen, 1977
24.37	Antelope.	
47.12	Elk.	
29.05	Small game.	
41.90	Waterfowl.	
39.92	Deer in Utah.	Wennegren et al., 1973
84.22	Idaho statewide average for big game.	Brown & Plummer, 1979
55.17	Small game.	
33.51	Deer and elk in Oregon.	Brown et al., 1973
98.19	Big game in western Oregon.	Brown & Plummer, 1979
39.53	Big game, Atchafalaya River Basin, Louisiana.	Bell, 1981
20.39	Small game.	
32.09	Waterfowl.	
166.61	Deer in Pennsylvania.	Fisher, 1982
35.40	United States average for deer.	USFWS, 1980
79.18	Waterfowl in the Pacific Flyway.	Brown & Hammack, 1972

Table A.0

Unit Values for Preservation

Annual Value 1983 $ Cnd.	Survey Details	Source
52.60	Provincial average for preservation of wildlife in B.C.	Reid et al., 1985
20.53	Value per Colorado household of preserving 1.2 million acres of wilderness in the state.	Walsh et al., 1982
27.66	2.6 million acres.	
37.32	5 million acres.	
46.96	10 million acres.	

APPENDIX B - DATA FOR WEST COAST TRAIL STUDY

Table B.1

Average Timber Volumes per Hectare

Species	Average volume per hectare of mature accessible timber, m^3/ha	
	Coastal Strips	Inland Areas
Douglas Fir	62	20
Cedar	186	270
Hemlock	182	265
Balsam	79	99
Spruce	10	10
Pine	4	5
Cypress	4	12
Totals	527	681

Table B.2

Average Stumpage Prices

Species	1974 to 1983 Average Gross Stumpage Prices for the for the Vancouver Forest Region 1983 $\$/m^3$
Douglas Fir	10.68
Cedar	11.07
Hemlock	5.58
Balsam	5.96
Spruce	21.40
Pine	5.09
Cypress	33.07[1]

[1] 1980 to 1984 average.

Table B.3

Silviculture Costs

Treatment	Proportion of logged land receiving treatment (%)	Treatment Costs per hectare treated (1983 $)	Average Silviculture costs per hectare by treatment (1983 $)
Planting	82	1141.80	936.28
Brushing & Weeding	16	409.20	65.47
Broadcast Burning	46	198.00	91.08
Spot Burning	9	85.80	7.72
Bunch & Burn	2	270.60	5.41
Total			1105.96

Table B.4

Annual Number of User-days on the West Coast Trail

Year	Total Annual User-days
1981	26455
1982	34319
1983	29780
1984	28026
Average	29645

Table B.5

Values for Variables in Each Alternative

Variable	Alternative			
	Wilderness	Combination	Log Part	Log All
Discount rate	0.08 0.10	0.08 0.10	0.08 0.10	0.08 0.10
User-days	29645	29645	0	0
Pate of increase in user-days	0.0235	0.0235	0	0 ·
Compensation demanded (1983$)	45.44	16.96	0	0
Pate of increase in compensation demanded	0.06 0.04	0.06 0.04	0 0	0 0
Trail maintenance (1983$)	140000	140000	0	0
Wage Differential (1983$/m³)	0 0	0 6.66	0 6.66	0 6.66
Volume (m³)	0	74162	123511	186910
Stumpage (1983$)	0	643341	1082341	1604060
Silviculture costs (1983$)	0	1106	1106	1106
Area (ha)	0	109	216	337