The Economic Valuation of Selected Canadian Non-timber Resources: An Examination of Valuation Methods and A Review of Results

H.W. Harshaw

A PAPER SUBMITTED IN PARTIAL FULFILMENT OF THE REQUIREMENTS FOR THE DEGREE OF DOCTOR OF PHILOSOPHY

In

THE FACULTY OF GRADUATE STUDIES
Faculty of Forestry
Department of Forest Resources Management

THE UNIVERSITY OF BRITISH COLUMBIA
November 2000

INTRODUCTION

Traditionally in North America, the management of forested lands has been primarily concerned with the effective and efficient harvest of timber values. However, there has been a shift in forest management to a more holistic paradigm that recognizes the value of non-timber forest amenities (Prins *et al.*, 1990). These amenities include outdoor recreation, aesthetics, the harvest of botanical forest products such as mushrooms and salal, the maintenance of wildlife populations, the sequestration of carbon, spiritual values, the harvest of medicinal products, and the maintenance of biodiversity.

The emphasis of this paper is the economic valuation of Canadian non-timber forest resources. However, this review is not limited to this jurisdiction; relevant studies of non-timber resources in the US Pacific Northwest are included, as this region offers many similarities to British Columbia. The studies and reports that are reviewed are divided into wildlife, recreation, old growth/wilderness preservation, First Nation values, economic impact (costs) of non-timber value protection, and other (which includes medicines, botanical, water, marshes, aesthetics, soil, and carbon sequestration).

Non-timber resources can be considered to be those goods, services and amenities obtained from forested areas that derive their worth independent of the economic value of merchantable timber in that same area. As non-timber resources typically have no defined market value (although, some non-timber values have become exchanged in markets, such as salal and mushrooms), or because the price assigned to a non-timber value may not reflect its economic value, the valuation of non-timber values is difficult.

The importance of including non-timber values in valuation considerations is not just a matter of efficiency, but of equity as well (Adamowicz *et al.*, 1991): for example, the satisfaction and utility that people derive from wildlife ought to be taken into account in economic trade-off analysis. A problem that forest managers and decision makers face is balancing the costs and benefits of timber and non-timber values. This problem is further exacerbated by the fact that many non-timber values are not market-traded and subsequently are unpriced (McKenney & Sarkar, 1994). Condon and White (1994) cite five additional reasons for the importance of non-timber resource valuation:

- it allows compensation to be determined for environmental damage;
- non-timber values are unique and difficult to supplement with technology;
- the increase in demand for non-timber resources has been a result of society placing increased importance on amenity services;
- valuation allows for the identification of distribution and impacts of non-timber resources; and
- the valuation of non-timber resources allows for their inclusion in national accounts, such as gross national product.

Some social benefits (*e.g.* employment, quality of life) are related to economic benefits, consequently these social benefits can quantified through economic valuation and may be included in policy discussions. Many of the authors reviewed in this paper have suggested that the role of non-market valuation plays in of non-timber resources in natural resources policy decision-making is increasing. In light of this observation, the relatively few number of studies that estimate the economic value of non-timber resources illustrates the need for more work in this area.

TYPES OF VALUE

The term value is employed in many ways in discussions of economic evaluations of non-timber resources, including use value and non-use values. It is useful to clarify the meanings of the different types of value, as the term can have distinct meanings. The working definitions and discussions of non-market values offered here are derived from Condon & White (1994), Sarker and McKenney (1992), Adamowicz *et al.* (1991), and Klemperer (1996).

USE VALUES

Use value is the benefit a user obtains, either directly or indirectly, from participation in an activity. *Consumptive use* can be considered participation in activities that utilize and possibly deplete environmental resources*; non-consumptive uses* are those uses or activities that do not affect the resource.

NON-USE VALUES

Non-use values include amenities such as scenery, open spaces, and recreation that contribute to external benefits, or 'positive side-effects' that are provided by a resource. Examples of external benefits include increases in productivity, well being, health, longevity, and feelings of tranquility and peace; a decrease in stress was also identified as an external benefit within this category (Klemperer, 1996). *Existence value* are those benefits that are derived from the knowledge that non-timber amenities and resources (*e.g.* wildlife, old growth forests) will continue to exist despite the fact that the amenity or resource may never be used, seen or visited. *Bequest value* is the worth that is assigned to preserving a resource for the use of future generations. The benefits or values that a person derives from the knowledge that an option exists for the future use of a non-timber resource is referred to as *option value*; *quasi-option value* has been defined as "the value of the opportunity for obtaining better information by delaying a decision that may cause irreversible changes" (Sarker & McKenney, 1992, p. 6). Often, people place value on a resource that they have never used or plan to use, but derive benefit from pictures, descriptions and other representations of the resource; this type of value is referred to as *vicarious value*. A schematic representation of these values is presented in figure 1.

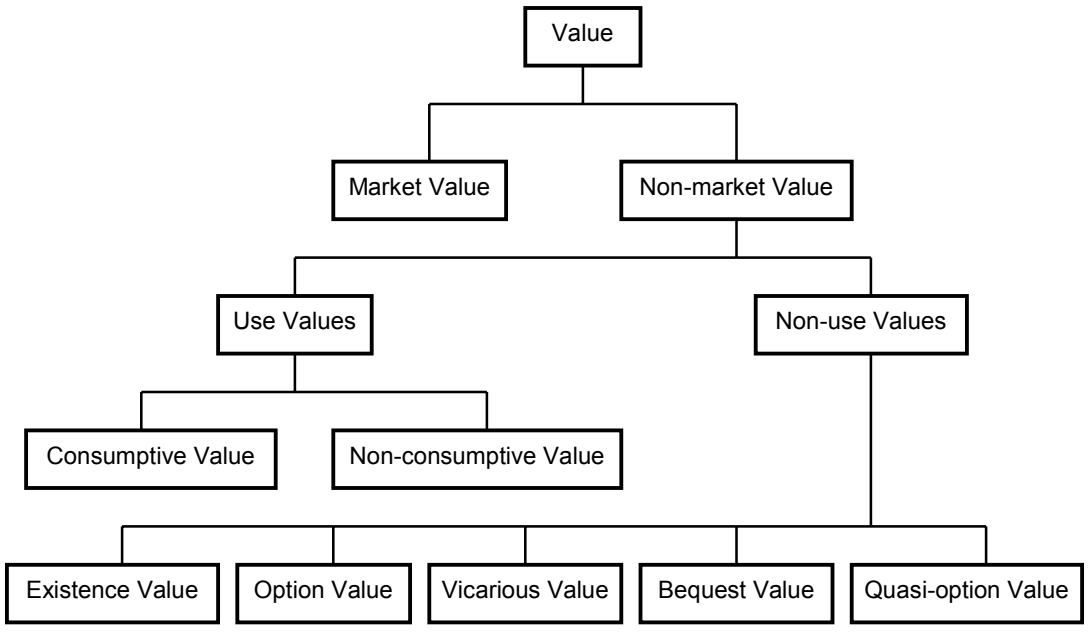

Figure 1. Valuation Methods (Sarker & McKenney, 1992, p. 6). While this figure classifies *use value* and *consumptive value* as non-market values, they may also be considered as market values

The manner in which economic values are derived can have a direct effect on the worth that is calculated; these economic values may be presented as either marginal or average values. Average value can be considered the average revenue that is generated per unit. Marginal value, or the value equal to the change in total value, is the revenue that is generated from the production of additional units; the marginal value is generally lower than the average value. Traditional economic valuations of forested landscapes have been determined by characteristics that include the location of the forest resource and the species composition of the trees. However, forested landscapes do have economic value outside of timber utilization; indeed, some BC residents have indicated that that they would be willing to incur financial costs to increase the area of protected land in BC.

VALUATION METHODS

The methods employed for the economic valuation of non-timber resources include direct methods, which determine the value a person is willing to pay for the service or good being valued through a survey instrument. Indirect methods are also used to gauge the value of non-timber resources; these methods employ the observation of user behaviour to derive valuation estimates. The following review of valuation methods has been informed by Condon and White (1994), Sarker and McKenney (1992), Klemperer (1996), and Gregory (1987). Figure 2 illustrates some of the non-market valuation methods that can be used.

INDIRECT VALUATION TECHNIQUES

The *travel cost method* is an indirect valuation technique that was developed to model actual recreation behaviour. This method estimates value based on the assumption that the price paid to travel to a site is the implicit value of that site. While no fee may be imposed on the use of a (recreation) resource, there are costs associated with accessing that resource that include the cost in fuel and mechanical maintenance of a vehicle, and the time spent travelling (if time is not considered in a travel cost study, the overall benefits may be underestimated); the travel cost method uses these costs as variables to determine the value of a resource. However, the travel cost method is limited in that it is only capable of measuring single destination trips, and it assumes that travel is a means, rather than an end in itself.

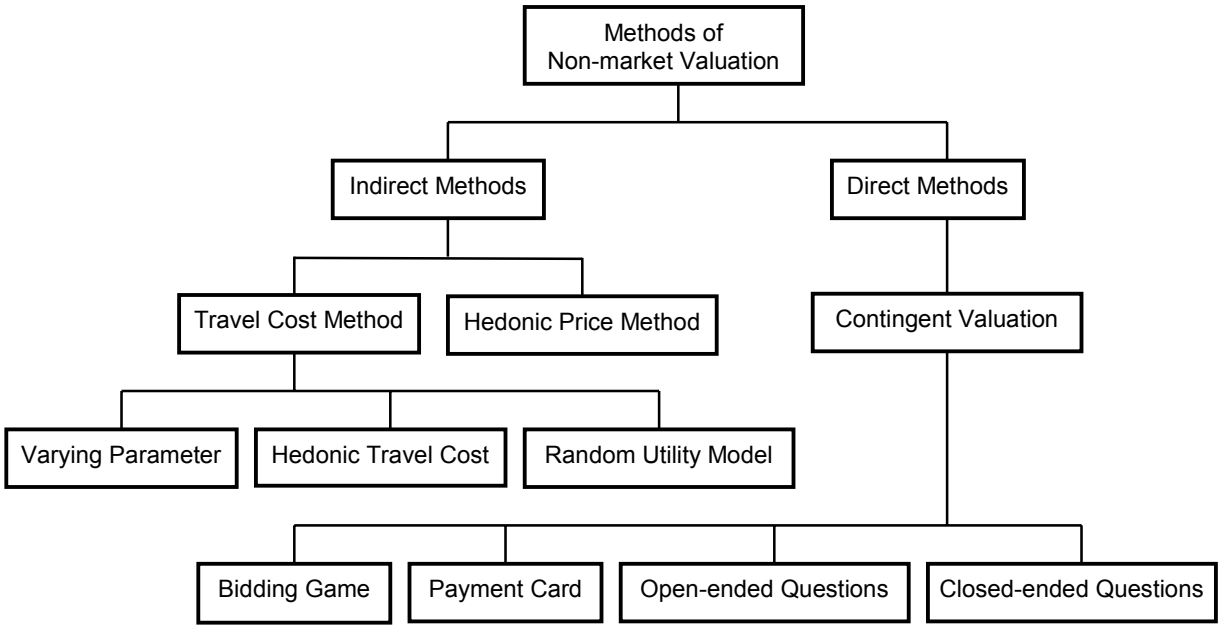

Figure 2. Non-market Valuation Methods (adapted from Sarker & McKenney, 1992).

A *varying parameter travel cost method* attempts to consider a site's characteristics, the costs to visit that site, and relevant socio-economic considerations that may constrain site selection by the users. The hypothesis that frames this method is that travel cost estimates may vary due to the quality of the characteristics of a site.

The *random utility model* is able to model demand functions for multiple sites and allows for the provision that some sites may have no consumption; this model can be used to interpret how recreation users make their choices of recreation participation at a particular site. Four assumptions shape this method:

- the time horizon is dynamic and is not fixed to a season' s start date as in the travel cost method;
- multiple trips are deemed to be made independent of each other;
- the utility that visitors derive from a visit to a particular site has been weighed by those visitors against other recreational opportunities; and
- the choice of location by visitors is determined by both deterministic and stochastic elements.

The complexity of this model might serve to limit its use.

A variation of the travel cost method that is used often is the *hedonic travel cost method.* This method is well suited for evaluating recreational quality, as changes made to a recreation site's characteristics can be valued. The hedonic travel cost method is predicated on the assumption that people will pay more to visit a site that has a higher level of quality. Recreation policy makers may find the hedonic travel cost method useful, as they can control site attributes to test recreation quality. This method also assumes that people originating in the same zone will have the same socio-economic profile and will travel the same distance; the validity of these two assumptions is debatable.

DIRECT VALUATION TECHNIQUES

Contingent valuation is a direct means of capturing consumer surplus through the elicitation of a *willingness to pay* value for the preservation of a resource or opportunity in a simulated market. This method can employs a number of techniques to elicit valuation responses including a bidding 'game', the use of a payment card, open-ended questions, and closed-ended questions.

Another value that can be elicited by contingent valuation is a *willingness to accept value*. A willingness to accept value provides an estimate of the amount of money an individual would have to be compensated to forgo an opportunity; this value estimate is predicated on the notion that the payment is equal to the benefits that a person would incur through the pursuit of that opportunity.

While economic theory would suggest that willingness to pay and willingness to accept values should be similar, it has been demonstrated that willingness to accept values can be three to four times higher than willingness to pay values (Klemperer, 1996). A respondent's willingness to pay value may be constrained by their level of income, while a willingness to accept value is not. Another suggestion to explain this discrepancy proposed by Hanemann (1989; cited in Condon & White, 1994) holds that the degree of "substitutability" of the valued goods compared to another good's utility function are responsible for the differences between willingness to accept and willingness to pay.

Contingent valuation is the only method that can be used to estimate non-use values. The extra-market values of respondents are elicited through the creation of an hypothetical market; three parameters are must be provided to the respondents:

- the institutional and structural regulatory frameworks that govern the availability of the non-timber values being examined;
- the method of payment; and
- any provisions that were made for environmental improvement.

It has been suggested that contingent valuation may be prone to an embedding effect, as the value being measured may be part of a larger group of resources; furthermore, the results may not be accurate due to respondent behaviour. Respondent behaviour may include strategic bidding which can be a result of vehicle bias (techniques discussed below) - this tends to undervalue the resource being measured. An additional respondent behaviour that can affect the results of contingent valuation is the possibility that respondents might make a bid that reflects a sense of moral satisfaction from the prevention of the loss of a resource, instead of the actual economic value of the resource being measured.

Many techniques can be employed to solicit value using the contingent valuation approach; these include *iterative bidding*, the use of a *payment card*, *open-ended questioning*, and *dichotomous-choice questioning*. The iterative bidding technique involves presenting the respondent with a price for the resource being measured and asking them to raise or lower this bid until they are comfortable with the price; however, this technique can be prone to starting point bias.

Instead of employing bidding, the payment card technique assigns a hypothetical household income to a respondent, who is then asked to place an economic value on a resource. The respondent's value must take the household income and cost of living into account.

The open-ended questioning technique asks respondents to state the maximum amount that they are willing to pay for an item; however it ought to be noted that the value that is elicited may not reflect an accurate value of the resource being measured. In order to avoid starting point bias, the dichotomous choice technique can be employed: respondents are asked to either

accept or reject a monetary value that is assigned to a resource; there is no need for an interviewer which makes this technique suitable for use in questionnaires.

ECONOMIC IMPACT STUDIES

Some studies that are reviewed in this paper employ economic impact (gross expenditure) methods of economic valuation; it should be mentioned that there are some inherent problems with this valuation method. Economic impact measures the effects of a particular investment on the rest of the economy, and is a relatively coarse indicator. This technique can have a multiplier effect, since it projects the cost and benefits of a particular investment onto other sectors that may be affected by the investment in terms of the creation of jobs and income. Since it is a coarse economic indicator, economic impact does not allow for regional variation of impact, nor does it address resource depletion or degradation. For example, an increase of tourism activity in one area may be at the expense of another area; similarly, the economic activity that is generated by fighting a forest fire would be captured by economic impact, but this measure does not account for the revenue that is lost as a result of a damaged or depleted timber resource. Another example of economic impact valuation is gross domestic product (GDP). Klemperer (1993) suggests that national well being can sometimes overstated by GDP, as damage to the environment is not taken into account.

Consumer welfare studies, such as the Gross Progress Indicator (GPI), offer alternatives to economic impact studies. While GDP has historically increased, GPI levels have been falling since the 1970's (Klemperer, 1993). GPI not only measures the direct benefits of an investment – the costs associated with environmental damage, resource depletion, declining capital stock, increased income inequities, and unemployment are also taken into account. Consumer welfare studies typically are not as coarse as economic impact methods.

VALUATION ESTIMATES OF NON-TIMBER RESOURCES REVEWS

WILDLIFE

Over the years, Canadians have placed an increasing importance on the maintenance of wildlife resources. However, the economic value of wildlife has been undervalued, as there is no

market for wildlife. As a result, it has been argued wildlife has not been properly considered in economic trade-off analysis. The studies reviewed in this section address this problem.

Adamowicz *et al.* (1991) have identified wildlife value components that can be considered the economic evaluation of the value of wildlife. These components were tested in a framework that was used in a case study of Alberta residents. The authors note that recreationist expenditures may not adequately capture the value of wildlife, as valuations based on expenditures do not account for local use (*i.e.* low expenditures) and associated values. The preservation value of wildlife, using a contingent valuation method (CVM) was estimated to be $80.92/Alberta household; the aggregated value of non-use benefits was calculated as $67.7 million/year. The weighted average value of derived benefits of Alberta recreational hunters was calculated as $165.9/hunter, which amounts to $53 million/year. Benefits derived from non-consumptive activities were valued at $162.90/participant, for a total value of $64.5 million. The total annual value of Alberta wildlife was calculated by the authors as $185.2 million. The present value of the services provided by Alberta wildlife, calculated at a 5% market rate, is $3.7 billion (Adamowicz *et al.*, 1991).

A case study of a caribou management program in Alberta that increased caribou populations and wilderness areas through habitat enhancement but decreased recreation choice and employment was used to examined the variation of valuation estimates based on an elicitation approach. The elicitation approach that was employed were a choice experiment model (stated preference) that offered more than two alternatives in conjunction with a CVM. A linear contingent valuation measure estimated the value of the program as $142.82, while the same valuation method using a quadratic form estimated the value as $140.86 (Adamowicz *et al.,* 1998).

The economic importance of birds was demonstrated by Clark (1987) in an effort to justify and support conservation efforts in Pembroke, Ontario through the employment of a benefit-cost analysis and the travel cost method (TCM). The model that Clark used in this study calculated long distance traveler eligibility costs at 50% of actual costs, as any travel to Pembroke for bird viewing was likely part of a multi-destination trip. By calculating the direct benefits of preserving a unique roosting site for swallows, and the associated marketing the opportunities shared by 10 000 people, the net worth of associated bird viewing was valued at $520 000. The benefit-cost ratio was estimated as 3.8:1.

A survey of recreation participants in wildlife-related activities (e.g. hunters, bird watchers, and photographers), conducted to identify the value that Canadians place on wildlife, estimated that the actual participant expenditures for wildlife-related recreation activities are calculated as $4.2 billion (Jacquemot *et al.,* 1986). These authors calculated the value of the consumer surplus as $779 million, though they suggested that this figure was undervalued. Based on a 10% discount rate, the estimated capitalized value of wildlife-related recreation activities was $7.8 billion. The Gross Production generated from wildlife-related recreation activities was valued as $8.7 billion. The impact on gross domestic product (GDP) at market prices was calculated as $5.2 billion, while the consideration of factor costs gave an estimate of $4.5 billion. Additionally the expenditure contribution to personal income was valued at $3 billion, $2 billion was contributed to government income, and 184 860 jobs were supported (Jacquemot *et al.,* 1986).

Jacquemot *et al.* (1987) suggest that human derived benefits from wild birds include the provision of eggs and meat for First Nation peoples and numerous recreation activities for Canadians as a whole. The authors demonstrate the economic importance of wild birds through an examination of bird-related recreation activities. This examination estimated that 84% of Canadians have had some sort of interaction with bird-related recreation activities (including hunting, bird watching and photography); however, this number may be reflective of respondents including movie/television viewing and visits to museums and zoos as recreation activities. A willingness to pay (WTP) model estimated that the gross value of bird-related recreational activities as $2.3 billion (all figures were calculated in 1981 dollars). Expenditures for activities accounted for $1.9 billion, while the net economic benefit was calculated at $347 million – this benefit was distributed relatively evenly among hunters and non-hunters. Based on a 5% discount rate, the capitalized value of direct economic benefits derived from bird-related recreational activities was estimated as $6.9 billion. The authors conclude that bird-related expenditures contribute $4 billion to Canada's Gross Business Production and $2.410 million to Canada's GDP. In addition, bird-related recreation activities provided 86 000 jobs, and contributed $868 million in revenue through direct and indirect taxes to the Canadian economy.

The conflict between timber interests in the Pacific Northwest and the active protection of the Northern Spotted Owl (an indicator species for old growth habitat) has been one of the more contentious public debates in recent years. Ruben *et al.* (1991) compared the economic costs

of owl protection (reduced harvest levels and subsequent labour cuts) against the economic benefits of protecting the spotted owl. The authors then examined how much Washington State residents would be willing to pay to protect the spotted owl, and adjusted the WTP model for West Coast and National populations. Their data suggests that the spotted owl is valuable to people and provides some benefits, including an existence value. Recreation, option, bequest and commercial values were identified by the authors as contributing goods for economic value. The authors note that the short term costs of spotted owl protection may be high, but conclude that US residents are willing to pay for the protection of the owl at levels that would cover the costs associated with lost revenues and jobs from a decreased harvest (Ruben *et al.* 1991).

RECREATION

The application of user fees to recreation areas is one means that has been employed to supplement government budgets in the provision of services that recreation participants desire, or require, for the pursuit of their various activities. In an examination of the economic value of camping in the Rocky-Clearwater Forest (a managed recreation area that collects fees for use of basic amenities), Boxall, McFarlane & Gartrell (1996) hypothesize that the camping area's benefits to users exceed the economic value of user fees. This study also sought to provide better estimates of recreation benefits, and examined data collection systems that can be used to determining the economic benefits of forest recreation. Among the suggestions for improvements that could be made to better inform management planning and development that were made by the authors was the adoption and implementation of geographic information systems (GIS) technology. A zonal travel cost method (TCM), in association with the utilization of truncated count estimators with aggregated data were used to estimate recreation values (consumer surplus estimates elicited through this approach may be higher than estimates derived from untruncated models). The authors determined the recreation value of the area to be $52.77/trip, which when aggregated for total number of trips to the site derived a total annual benefit of $750 000.

In an examination of recreational moose hunting in Alberta to assess the impacts of alternative timber harvesting practices on non-market recreational values, a CVM yielded a valuation estimate of WTP for the improvement of moose populations of $69.93, and an expected value of $85.59 (Boxall, Adamowicz, Williams & Louviere, 1996). The choice experiment model employed in this study calculated the value of moose population improvement as $3.46, a

significantly lower value considering that the same sample group was used. Three possibilities for this discrepancy were considered: a flawed contingency valuation method instrument, compliance bias in the sample, and the omission of substitution possibilities by respondents. The authors conclude that it is likely that the discrepancy was due to respondents not considering substitution possibilities.

A ten year review and analysis of forest, range and recreation resources in BC that focuses on historical and future supply and demand trends of these resources attempted to address the implications of possible resource scarcity or surplus (BCMoF, 1994). This analysis found that the economic benefits of outdoor recreation in BC provincial forests was valued at $3 billion for 1993, expenditures for that year contributed $2.4 billion (88% from BC residents) to BC's economy, and the net economic value was calculated as $867 million (84% from BC residents). The economic value for doubling designated wilderness areas in 1993 was also examined, and estimated to be $160 million (76% of this value was attributed to existence and bequest values, while the remaining 24% was attributed to option or use values). Total actual expenditures for outdoor recreation on Crown lands (which includes use in national, provincial and regional parks) was calculated at $4 billion/year (80% from BC residents), and the annual net value was estimated as $1.5 billion (BC residents accounted for 74%). Non-resident outdoor recreation expenditures in the province were valued at $780 million (BCMoF, 1994).

A study of environmental quality change on Bighorn sheep hunting suggested two underlying problems of recreation management in Alberta. The first problem was that competing land interests caused inter-governmental agency conflicts that led to the creation of conflicting or convoluted policy directions. The second problem was that recreation had traditionally been accorded low benefit-cost values, despite favorable valuation efforts (Coynen & Adamowicz, 1990). To address these problems, the authors developed a methodology that examined the economic effects of changes to environmental quality on recreation demand for Bighorn sheep hunting in Alberta. The model indicated that increases in sheep populations, decreases in crowding, and decreases in travel costs would result in a more attractive hunting site. The values of recreational Bighorn sheep hunting sites were estimated in terms of consumer surplus and welfare analysis. The net benefit of hunting site quality that would result from a 10% increase in Bighorn Sheep populations was calculated as $7 790/season; a 10% increase in crowding reduced the benefits received by hunters by $9 113/season; a 10% increase in travel costs would impose a cost in welfare loss of $21 949. The total annual welfare losses to

Bighorn sheep hunters due to hunting site closure ranged from $3 715 to $27 728 depending on site location.

Non-market economical impacts of fire to wilderness have been examined in a study of backcountry canoe recreationists in Manitoba (Englin *et al.*, 1996). In this study, forest fire damage was used as an attribute to estimate a random utility model, which was paired with a TCM to estimate the welfare losses from fire damage (as the forest will regenerate, welfare losses will decrease over time). The authors concluded that returning burned areas to pre-burned states results in aggregate welfare gains of $6 626.43 - $7 529.63 dependant upon location. In a second scenario that assumed that two entire canoe routes were completely burned, the authors indicated aggregate welfare losses of $390.88 - $13 725.79 depending on location. The present value of total per trip losses due to fire, at a discount rate of 4%, was calculated as $577. To account for forest renewal after a fire, the authors calculated present welfare losses from a ten-year-old fire as $15.46/trip (Englin *et al.*, 1996).

The effects of currency exchange rate between the United States and Canada on backcountry recreation trips made to four adjacent wilderness parks in Central Canada have been examined by Englin *et al.* (1998). The authors' employment of a utility theoretic model yielded a calculation of consumer surplus in the range of $107/day to $766/day depending on the remoteness of the park. Generally, as the value of the Canadian dollar comes close to the value of the American dollar, American visits to Canadian parks decline; although this trend does not apply to the two remote parks included in the study, as it is believed that there are no substitutes for the experiences provided by these parks. The American welfare effects of currency rate change range from $134.95/season for a $0.05 change in exchange rate to $800/season if the two currencies are at par. The authors also note that trips to the most remote park are valued at more than $700/day.

In a study of the importance of wildlife to Canadians, Fillion *et al.* (1994) indicate that Canadians place a high importance on wildlife, and that this importance is reflected in economic contributions by Canadians who participate in wildlife-related recreation activities. The authors suggest that a failure to value the environment and its related biological goods and services has resulted in the unsustainable use of natural resources. The study's purpose was to determine the direct and indirect benefits of wildlife-related recreation activities and wildlife resources. Direct benefits resulting from the enjoyment received from wildlife but not paid for by

participants accounted for $0.7 billion, while actual expenditures accounted for $5.6 billion (non-consumptive use = 43.6%; hunting = 21.3%; and other = 35.1%). The economic results from these expenditures in indirect benefits to the Canadian economy include $10.2 billion in Gross Business Production ($14.6 billion including fishing-related benefits); $7.0 billion ($10.2 billion including fishing-related benefits) in GDP; $3.1 billion ($4.6 billion including fishing-related benefits) in taxation revenue; $3.8 billion ($5.4 billion including fishing-related benefits) in personal income; and employed 126 440 people. The inclusion of American tourist expenditures resulted in slightly higher figures for the indicators: total expenditures are estimated at $9 billion; Gross Business Production is calculated at $15.8 billion; GDP is estimated as $11.0 billion; tax revenue is valued at $4.9 billion; personal income increases to $5.9 billion; and the number of sustained jobs is calculated as 203 135. The estimated value of the net economic value of wildlife-related recreation activities, based on discount rates of 5% and 10% is $7-$14 billion. Direct and indirect benefits, the distribution of net economic values by wildlife-related recreation activities, and the present value of future direct benefits are calculated for the 10 provinces. Compared to the 1981 study, 1991 expenditures increased 32.9%; government revenue increased 64.5%; GDP contributions increased 35%; and personal incomes derived from expenditures increased 26% (these comparisons have not been adjusted for inflation).

Conflicts over landuse in BC have demonstrated the need for analytical techniques to assist in conflict resolution.

Recreation data derived from estimates of user days from survey data and WTP values recommended by the U.S. Forest Service was used to examine the conflict between logging and wilderness preservation in the Stein River watershed in BC (Gunton, 1991). The author noted that as WTP values can vary depending on site characteristics and location, and that resultant estimated values might over/under-estimate actual values related to the Stein River watershed. Net present values for the wilderness recreation option were calculated as $3.3 million at a 10% discount rate, and a WTP value was estimated as $1.0 million. The author suggested that the range of values calculated for the logging option outweighed the values of the wilderness recreation option (Gunton, 1991).

An examination of the economic effects of preserving wildlife habitat on forest values (both timber and non-timber) in the Pacific Northwest was conducted to anticipate the creation of

critical habitat areas (areas protected in order to preserve habitat for endangered species) for salmon (Haynes *et al.*, 1992). The direct net economic costs of such critical habitat designation on range, timber, recreation, and mineral values managed by the U.S. National Forest Service were included in this study, and it was assumed that Forest Service programs could be restored in these areas through mitigation. Real price appreciation rates (net of inflation) of 0.6%/year for range prices, 0.3%/year for recreation prices, and 2.0%/year for mineral prices were included to reflect the increasing scarcity of these resources; timber assessment had a real price appreciation of 3.2%/year. The total net cost, in present value terms, of the first scenario at a 4% interest rate were calculated as $10.3 million for range; $480.8 million for timber, $2.030 billion for recreation, and $72.8 million for minerals; at a 9% interest rate, the values are estimated as $8.1 million for range, $3.804 billion for timber, $1.6037 billion for recreation, and $56.9 million for minerals. The total net cost, in present value terms, of the second scenario at a 4% interest rate were calculated as $19.3 million for range, $1.8 million for timber, $15.2-19.1 million for recreation, and $87.3 million for minerals; at a 9% interest rate the values are estimated at $15.7 million for range, $1.4 million for timber, $12.0-15.1 million for recreation, and $68.2 million for minerals. The authors estimated that the economic impact of the preservation of salmon habitat would be felt most at the local level, but will be largely insignificant at the national level. Job losses to range-related employment are estimated to be19-74 (income loss = $185 025-$740 100); recreation job losses 29-3 800 (income loss = $420 000-$58.3 million); timber job losses 299-2 971 (income loss = $10 million - $148.2 million); lower figures indicate the mitigation scenario. The authors concluded that the benefits of preserving critical habitat outweigh the costs for recreation and minerals; the case of timber is unclear; and the costs of mitigation for range values outweigh the benefits of protection (Haynes *et al.*, 1992).

The economic impacts of timber harvesting operations on the quality of outdoor recreation experiences have been were examined by in a study that employed a variation of the contingent valuation method (CVM) to measure the changes in the value of road access, game populations, hunter congestion, and travel costs for big game hunters due to timber harvesting activities (Morton *et al*. 1995). The model was applied to a Forest Management License Area in northwestern Saskatchewan. The authors proposed that this information could contribute to the development of integrated resource management plans that consider societal benefits. The results indicate that in some cases, positive changes in hunting attributes were overshadowed by the presence of forestry operations. The marginal value of access for deer hunters was

calculated as $7.93, while the value for moose hunters was $32.15. The marginal value of game populations was calculated as $46.03 for deer hunters and $150.36 for moose hunters. The marginal value of congestion was calculated as -$32.25 for deer hunters, and -$82.92 for moose hunters. Using a discount rate of 5%, the capitalized value for deer and moose hunters for increasing game populations and access while keeping congestion levels low is calculated as $380 000 at the mean and $270 000 at the median.

An heightened emphasis on integrated resource management has increased information needs for non-timber values and for the determination of market pricing of non-timber values. Sarker and Surry (1998) have suggested that the TCM can be used for an indicator as it can derive consistent, policy relevant benefit estimates. High demand for hunting, when matched with declining budgets for forest resource management in Ontario led to the consideration of raising user fees. The authors calculated the benefits of moose hunting in the range of $175.00 - $210.00 per trip, which was comparable to a study of moose hunting in Newfoundland. In addition, Sarker and Surry (1998) recommended that the management practices of timber harvesting should take into account the maximization of overall forest benefits including other non-timber value opportunities.

In order to overcome some of the limitations of traditional travel cost and discrete choice methods in the modeling of recreation site choice and participation, a multivariate recreation demand model was been developed that could account for the frequency and choice among alternative recreation sites through the employment of a mixed Multinomial-Poisson hurdle distribution (Yen & Adamowicz, 1994). The model can evaluate site choice as a function of travel costs; site attributes and trip frequency evaluated as a function of travel costs, site attributes, and individual characteristics. Recreational hunting of Bighorn sheep in ten sites in Alberta was used to test the model. The Multinomial-Poisson hurdle distribution estimated that a 10% increase in travel cost would result in a welfare loss of $2.82/trip, or a total welfare loss of $157.70 for the sample; a 10% increase in congestion would result in a welfare loss of $1.54/trip, or a total welfare loss of $638.42 for the sample; and a 10% increase in sheep population would result in a welfare gain of $1.45/trip, or $622.84 for the sample. Welfare losses due to site closures were also calculated, and indicated that the closure of sites with the easiest access, and sites that provided *wilderness* hunting experiences lead to the highest losses in welfare.

Recreation site choice and valuation by wilderness canoeists in a Manitoba Provincial Park were examined based on the influence of forest characteristics, levels of development, and recreation management features (Boxall, Watson & Englin, 1996). The employment of a random utility model enabled the authors to estimate the direct valuation of forest attributes. Landscape attributes were rated as the most important site attributes to recreationists, while the presence of cottages and motorboats are identified as detracting from recreationists' experiences. This study's results indicated that Jack pine value to recreationists range from $0.241/ha/trip to less than $0.001/ha/trip. Increasing the number of black spruce trees resulted in welfare losses of $0.020/ha/trip to $0.002/ha/trip. The addition of cottage developments resulted in welfare losses of $1.745 - $4.752/trip depending on location; and the removal of existing cottages resulted in welfare gains of $0.557 - $0.733/trip depending on location. Two methods were used to estimate welfare losses from severe forest fires: one calculated loss as $2.905 - $343/trip depending on location; the other calculated loss as $5.878 - $21.761/trip depending on location. Jack pine and white spruce were valued by recreationists, while black spruce and aspen were not.

The economic contributions of provincial parks in British Columbia was examined in a study that included estimates of both market and consumer surplus benefits of parks for 1993 (Coopers & Lybrand Consulting, 1995). Seven percent of the provincial landbase (6.5 million ha) is held in 407 provincial parks and 131 ecological reserves, though these reserves are not considered in the study). During the period of 1984-1995 the number of people visiting BC Parks increased by 4.9%/year, the authors propose that BC Parks are instrumental in attracting tourists to BC and as a sustainable resource can provide long-term benefits. The total direct benefits of BC Parks was calculated at $430 million ($390 million is attributed to visitor expenditures). BC Parks contributed an estimated $400 million to the provincial GDP. 9 300 jobs were sustained through park use (5 300 through direct expenditures). Provincial tax revenue from BC Park use was calculated as $40 million, while federal tax revenue was estimated to be $129 million. While Vancouver and Victoria account for three-quarters of the Provincial population, the two cities only represent 20% of park expenditures and park-generated income. Non-residents of BC accounted for 38% of visitor's expenditures. Net social benefits of consumer surplus values were calculated using a method that assigned a user value to 19 different recreation activities which were then matched to a weighted activity profile (the weighted mean value was $32/day); the resulting net consumer surplus was calculated as $670 million.

The increase in outdoor recreation participation has led to an increase in the demand for overnight campsites at organized campgrounds. Recreational use at Earl Rowe Park in Ontario was examined to determine the demand for, and price of the provision of campsites (Nautiyal & Chowdhary, 1975). The authors argue that the average cost of park authorities is the marginal cost to society, and that basing campsite price on average cost will maximize net social welfare. Four experience types were identified for park users, which denoted temporal use of park facilities; these experience types were applied to determine the demand for campsite use based in the net benefit resulting from each campsite, and form the basis for the creation of a discriminatory fee schedule. Based on the capital costs of construction for new campsites, the opportunity cost of the park's total area, and an 8% discount rate, the optimal number of campsites was determined to be 368 for Earl Rowe Park. The authors suggested the implementation of a discriminatory fee schedule that proposed a $6.00/site/day fee for peak periods, $2.50/site/day for the next busiest period, and $0.50/site/day, and no fee for off-peak periods. The authors acknowledge that the adoption of such a fee schedule would result in a decrease in park revenue, but argue that such a fee schedule is more equitable than existing fee structures and result in the maximization of social welfare. Revenues based on the existing fee of $2.50/site/ day were calculated at $ 69 942.50, while revenues derived from the discriminatory fee schedule were calculated at $59 000 (Nautiyal & Chowdhary, 1975).

OLD GROWTH/WILDERNESS PRESERVATION

Provincial government initiatives in BC, reflecting an increase in the public's recognition of the value of the environment, have changed the management philosophy of forested lands from one of timber management to one of managing for multiple use. In managing for multiple use, stakeholders are given equal status, regardless of their economic contribution; such initiatives have led to uncertainty in the manner in which land use is allocated within British Columbia (Ells *et al.* 1997). The authors identify the uncertainty inherent in management decisions and describe the socioeconomic impacts of such decisions on Vancouver Island. Based on estimated recreation and recreation options value of 111.11 million/year, the average recreation value is given as $33/ha/year; intensive land use is predicted to produce only 50% of attainable benefits, and protected areas are predicted to provide only 40% of benefits received from integrated resource management. Based on a WTP for a doubling and tripling of wilderness area from a 5% base of $136 and $168/household, the authors estimate that the WTP of Vancouver Island residents to increase protected areas to 15% is $32/year, or $26.69/ha.

A study to determine the feasibility of a US conservation policy to protect the northern spotted owl (an indictor species for old growth habitat), found that survey respondents, who indicated that the benefits of preservation outweigh its costs, supported conservation policy (Hagen *et al.*, 1992). This study estimated a threshold price range for WTP for preservation of old growth for northern spotted owl habitat as $3.39 - $ 13.56. Though the benefits of preservation are distributed over a whole nation and the costs are geographically concentrated, the authors have suggested that economic support to affected timber-dependant communities be a consideration in the determination of costs. However, job loss due to the implementation of the preservation policy is not considered, as the central economic issue of the study was the highest-valued use of the affected lands.

A study of aboriginal and non-aboriginal values of wilderness protection in Saskatchewan suggests that, generally, aboriginal people value wilderness protection for non-use values such as existence and option values (Kulshreshtha & Loewen, 1997). Environmental health and the availability of wilderness for future generations were among the reasons for aboriginal respondents supporting preservation of wilderness. Non-aboriginal respondents saw wilderness protection as a use value that supported commercial aspects of preservation such as tourism, recreation and option values. The authors calculated WTP for both aboriginal and non-aboriginal respondents, which, when compared to the average incomes for each group, raise interesting sociological issues. Non-aboriginal respondents had an annual average income of $46 000 and a WTP of $60.89; aboriginal respondents had an average annual income of $17 154 and a WTP of $80.00. Respondents who had membership in an environmentally oriented society or organization had a WTP that was twice that of non-membership holding respondents. The study estimates that the economic value of Saskatchewan wilderness preservation is $422 million, or roughly $100.00/ha. The authors note that WTP remains constant regardless of the size of the wilderness area being protected, which they suggest reflects the marginal economic value of preserving Saskatchewan's wilderness (Kulshreshtha & Loewen, 1997).

The opportunity cost of growth preservation and the calculation of land value were examined In order to determine, from an economic standpoint, the optimal stock of old growth that should be preserved for non-timber benefits (Ludwig & Conrad, 1991). This determination was made using the following assumptions: future prices and costs for old growth timber harvest were known, the model derives a rule for the termination of harvest activity that depends on the net

present value of old growth when cut, the present value of synchronized second growth and the remaining non-timber benefits. Based on these assumptions, the total opportunity cost of preserving one hectare of old growth coastal cedar is calculated at $51 958, while the present value under an optimal rotation was only 3.38% of that value; the authors conclude that the value of a timber stand appears to be a key component. As the opportunity costs vary across species and across British Columbia, the authors suggest that those areas with lower opportunity costs might be the best candidates for preservation (Ludwig & Conrad, 1991).

The valuation of wilderness areas in Ontario was studied so that the effects of information and embedding on contingent valuation results could be determined (embedding refers to a value assigned to a good that is part of a larger good) (Macdonald & McKenney, 1996). WTP values for wilderness estimated for a 5% increase in Canadian wilderness were $53.53/year; a 2-3% increase in Ontario Provincial Parks yielded WTP values that ranged from $32.07/year - $38.52/year; and a 10% increase in the size of Lake Superior Provincial Park yielded a WTP value of $21.59/year - $28.36/year. These results suggest that the valuation of wilderness varies with jurisdiction. While the embedding effect was perceived to be minimal for the group of respondents who were provided with low levels of background information, the authors noted that more fluctuation in values occurred in this group. This group's valuation of wilderness also varied with jurisdiction, WTP values for a 5% increase in Canadian wilderness was estimated as $162.81/year; for a 2-3% increase in Ontario parks as $89.83/year - $108.66/year; and for a 10% increase in Lake Superior Provincial Park as $45.28/year - $73.89/year. The majority of respondents indicated that they felt it was their duty to protect the natural environment. Respondents who had visited Lake Superior Provincial Park indicated a WTP of $9.00 higher than respondents who had not.

An investigation of the economic feasibility of increasing BC's protected areas through the protection of areas of old growth forest examined two proposals: protection of old growth in the Valhalla area of BC; and BC's Protected Areas Strategy, which seeks to increase protected areas of the province to 12% of the land base (van Kooten, 1995). The author employed multiple accounts analysis to determine objectives for management strategies for old growth that are not measurable by the same standard, such as ecological, social and economic values. The purpose of multiple account analysis is to identify the costs of management strategies that would be borne by the public. The author argues that the benefits of old growth protection must be weighed against average timber values (coast = $20 108.00/ha; interior = $8 556.00/ha). A

value of old growth protection is presented as $444 - $1 803/ha, depending on the size of the protected area (based on a discounted WTP model). The author concluded that it is not economically efficient to preserve all old growth in BC, and that it cannot be economically justified to preserve 12% of wilderness in BC; the suggestion is made that more wilderness could be accessed for protection in the interior than on the coast.

ECONOMIC IMPACTS (COSTS) OF NON-TIMBER VALUE PROTECTION

While focusing on the economic impact of reduced annual allowable cut (AAC) in BC due to government policy and timber supply, Binkley *et al.* (1994) also provide insight to the potential ramifications of a reduced timber supply in BC due to land being set aside in protected areas or reserves as a result of increased public awareness and concern for the environment. Amendments made in 1992 to the BC *Forests Act* calling for the consideration of non-timber values have been the cause of uncertainty regarding future AAC levels. Economic assessment is considered using three models: an input-output model predicts that a 10% reduction in AAC would result in a reduction of 31 570 jobs and $1.9 billion in GDP; a policy simulation model predicted that an AAC reduction of 25% (from 1991 levels) would result in the reduction of GDP by 8.5% by the year 2001. The general equilibrium model developed for this study includes nine sectors, five of which represent the forest industry – wages were assumed to be fixed. The model predicts reductions in employment of 2.4%, and in GDP of 2.6% for a 10% reduction on AAC; for a 25% reduction in AAC, reductions in employment and GDP are estimated as 6% (92 000 jobs) and 6.5% ($4.9 billion) respectively. A general lack of economic diversity in British Columbia communities involved in forestry activities indicates that the effects of a reduced AAC will have the most destabilizing effects on the local level, though larger population centers will also be affected. The authors propose that policies regarding AAC determinations ought to consider non-timber values in order that economic trade-offs can be better understood (Binkley *et al.,* 1994).

The effects of implementing a proposal suggested by the Valhalla Society to increase protected areas in British Columbia from 5.2% to 13.1% was been examined by the Natural Resources Management Program of Simon Fraser University (1990). This report based its recommendations on the costs of wilderness protection to the timber industry and does not account for the valuation of non-market non-timber values. Despite this approach, the report concluded that an enlargement of protected areas is possible while maintaining a productive

forest industry. The report notes that wilderness tourism, tourism employment, and the importance of non-timber values to Canadians is increasing. The Valhalla proposal would affect 6.5% of existing timber supply areas (TSAs) and tree farm licenses (TFLs), and 6.2% of the provincial landbase. Annual allowable cut (AAC) impacts were calculated as 0%-5.3% depending on forest region for a provincial average of 3.5%. This study also concluded that other impacts to the forest industry included a loss in direct jobs of 2 554, and $52.9 million in lost government revenue, $23.8 million of which was attributed to stumpage losses. The report proposed that the losses to the timber industry could be offset by restocking not-satisfactorily re-stocked (NSR) lands, improving timber utilization, and encouraging value-added manufacturing and improving wood processing efficiency.

FIRST NATION VALUES

The effect of natural resource decisions and management on indigenous peoples has come to be recognized as a significant issue. Important aspects of this issue are the cultural differences and resultant differing interpretations of value. Adamowicz *et al.* (1988) employ a multi-disciplinary perspective that questions the applicability of non-market valuation techniques for eliciting the natural resource preferences of indigenous peoples, as the underlying assumptions of these techniques may not be transferable. The authors identify three difficulties contributing to the potential failure of nonmarket valuation methods: eliciting individual valuation responses, which may arise from difficulty in determining substitutes between goods, concepts of property rights, and derived satisfaction from the accumulation of goods and services; aggregating responses over indigenous peoples, such as differences in social structure and demographic effects; and combining indigenous and non-indigenous responses stemming from differing measures of social welfare (currency, political structures, and income) (Adamowicz *et al.*, 1988). Obstacles in inferential approaches for nonmarket valuation, such as difficulties in data collection, the ability to measure only use values, and inflexibility in discerning differences in preferences have limited valuation efforts using contingency valuation models. The authors suggest that value structures are dynamic over time and that historical conflict over natural resources between Euro-American cultures and indigenous peoples may have directly influenced cultural interpretations of value.

The lower Liard Valley (an area that contains between 15-30% of North West Territory's merchantable timber) has had a long history of interest in the development of commercial timber operations. Beckley and Hirsch (1997) have suggested that information on subsistence and

non-industrial forest uses will allow for resource management that is (socially) responsible, and may allow for the effects of land-use change on communities to be examined. The authors propose that a direct relationship between the Native people who live in the area and the forest landscape exists, and that changes in one affect the other in the Lower Liard Valley. The local economy exists primarily in services and natural resources, though high unemployment levels and low incomes indicate that subsistence activities play a large role in community stability. Replacement value and incomes for forest resources are determined, though the authors note that estimates may be overly conservative. Three categories of non-industrial forest use were examined: *country food*, which refers to locally produced food harvested from the land, and has remained at relatively constant levels for 35 years; *trapping*, which has not declined; and *non-animal forest products* such as traditional medicines, crafts, fire wood, and wood used for local construction. The authors used commercially available produce to estimate the value of harvested foods. The replacement value for meat, furs, non-animal forest products, and moose-hide crafts is estimated at $1 470 401.77 for Fort Liard and $265 763.21 for Nahanni Butte (based on subsistence only). The contribution of food, firewood, all crafts, and Martin pelts to average income-in-kind was $10 796, or 33% for residents of Fort Liard, and $10 630.52, or 32% for residents of Nahanni Butte. The authors note that these forest uses provide a total income-in-kind between $950 000 and $1 700 000 to residents of these two communities. In both communities, more than half of in kind income derived from fish and game is shared or given away to other community members. A discussion on the limitations of applying replacement value studies in cultural contexts notes that replacement value studies may not address the underlying cultural contributions of non-industrial and subsistence forest use. The authors also note that as financial compensation is not the primary motivation for a person's forest activity, replacement values do not account or provide for the total welfare of an individual (extra-market benefits). Beckley and Hirsch (1997) caution against using replacement value results to assess a level of forest dependence, as the results do not take into account the distribution effects of forest resources. With respect to the introduction of commercial forestry to the area, the suggestion is made that communities ought to be given the choice of the mix of market and subsistence economies which best suits them. The authors conclude by cautioning that the bush represents a social safety net, and forest resources provide sustenance and self-respect, values that ought to be considered in resource management decisions (Beckley & Hirsch, 1997).

The contributions of waterfowl (specifically geese, ducks, and loons) to the subsistence economies of Canada's northern Cree societies have been investigated by Scott (1987). While the economic valuation of waterfowl is possible, other contributions to social well being, native spirituality, and the maintenance of traditional culture and lifestyle are elusive in economic terms. The author suggests that while a quantitative estimation of these values is not available, their importance should not be discounted. The 200 000 kg of waterfowl harvested by 8 communities in the study area suggests the heaviest subsistence reliance on waterfowl in North America (other studies have indicated that half of Quebec's Cree population's income is derived from food acquired from forested landscapes). Based on per capita consumption of meat, fowl and fish, a replacement cost of $6000 is calculated for a household of 6; waterfowl's contribution is estimated to be 29-44% for coastal communities, and 4-10% for inland communities. Waterfowl are considered to be an efficient choice for harvest, as their calorie contribution exceeds the caloric expenditure of hunting.

OTHER NON-TIMBER RESOURCES

Botanical Products

Non-timber forest products in BC are classified as either "*special forest products*" (regulated under the *Forests Act* and *Special Forest Products Regulations)*, or "*unregulated botanical forest products*" (which will be regulated under the *Forest Practices Code*). Data on most botanical products is scarce due to lack of regulation, an implication of which is the inability of the Provincial Government to accrue any income from the harvest of botanical products on Crown land. A study completed by de Geus (1995) suggested that the need for regulation might have been stimulated by the need for ecological research (especially concerning Pine Mushrooms and Western Yew bark) and by the potential for provincial income. Currently in BC, 221 botanical products are recognized. The harvest of mushrooms for predominantly export markets was 125 290 kg in 1993, which paid $3 880 000 to harvesters. While BC does not keep statistics on the harvest of mushrooms, reliable data from a comparable jurisdiction (the US Pacific Northwest) indicate that 1.8 million kg of edible mushrooms were harvested in 1992, with $20.3 million paid to harvesters. The gross value of mushroom harvesting in the US Pacific Northwest is estimated at $41.1 million. Unregulated botanical forest products are divided into seven categories: floral and greenery products, medicinal and pharmaceutical products, wild berries and fruits, herbs and vegetable products, native landscaping plants, craft products (bark, wood, leaves, roots), and miscellaneous botanical forest products (honey, syrup, smoke

woods); data and records are sparse or non-existent for these products as well. The unregulated nature of the harvest of botanical forest products raises important issues including the sustainability of the resources, multiple forest resource use, potential (and lost) revenue to government, social and economic factors, health and safety of harvesters, and the necessity of interagency cooperation. Among the recommendations made in the study is that an attempt be made to better regulate and control botanical forest products in order to allow for sustainability and provincial revenue generation (de Geus, 1995).

Water and Wetlands

Degradation of water quality due to bacterial contamination has highlighted the need for more information on beach recreation in Ontario. In order to determine how beach users value water quality improvement, study participants were asked to estimate their annual recreation expenditures; this figure was calculated as $1 560 (3.7% of reported income), though the authors of the study suggest that this figure does not represent outdoor recreation expenditures which are estimated to be lower (Ecologistics Limited, 1990). Study participants indicated that they would double their travel time for a beach that had “very good” water quality and that rate of use would triple due to water quality improvement. Using a contingency valuation method, the authors calculated a WTP (based on payment through taxes) for the assurance of good water quality as $62 (the median payment was $30), and for the prevention of very poor water quality at beaches as $52 (median payment was $20). Using regression analysis, the authors suggest that the mention of increasing taxes as a collection vehicle resulted in a downward WTP bias of $30; and that for every $10 000 increase in income there is an increase in WTP of $7.67. The WTP value for water quality degradation prevention is estimated to be depressed by $45 due to the proposed collection method; for every $10 000 increase in income there is an increase in WTP of $5.35. Study participants indicated that the economic value of improving the water quality at beaches from existing conditions to “very good” conditions was between $60-$70, while the household loss due to a deterioration in water quality from existing conditions was between $40-$50. A beach with a “fair” water quality would generate a total annual consumer surplus of $132 975/year; an improvement in water quality to a rating of “good” would be valued at an additional $19 700 (Ecologics Limited, 1990).

Agricultural, residential, and industrial interests and market driven valuations have largely defined wetland use and value. It has been suggested that these uses have contributed to the degradation of wetland quality, and consequently the quantity of viable wetlands. In an

examination of the recreational use and value of wetlands, Kreutzwiser (1981a) determined the significance of wetlands through economic valuation in order that non-consumptive wetland use can be quantified and considered in landuse decision making. Recreation activities in the study area include nature viewing, appreciation, and photography, fishing, hunting and canoeing; these activities attracted 17 000 users. As winter recreation activities were not included in the valuation, the overall recreational significance is understated. A modified TCM was used to estimate consumer surplus for wetland use, which yielded a value of $34.85, and a total consumer surplus of $196 361 for primary users; consumer surplus values for secondary recreation users of wetlands was calculated at $22 049, from which the recreational value of wetlands of $213 000 was derived. Recreation user expenditures contributed $250 000, $120 000 of which was spent locally. The author also estimates that $225 000 in local business income was generated by recreational use of the Long Point marsh (Kreutzwiser, 1981a).

In another study, Kreutzwiser (1981b) further examined the recreational value of lakeshore marshes and suggested that recreational values have traditionally been ignored in lakeshore marsh decisions regarding agriculture and residential use. The recreational value of two lakeshore marshes in Ontario, Long Point and Point Pelee were measured, and the socio-economic values of marshes as recreational resources were considered. The author suggested that recreational users of marshes often exhibit some degree of activity specialization. A modified TCM was used to determine recreational value of these lakeshore marshes. Consumer surplus values of recreation in Long Point are calculated at $34.85 and $46.03 for Point Pelee based on primary users only. The total consumer surplus value, including secondary user contributions are calculated as $213 000 for Long Point and $1 664 000 for Point Pelee. Long Point recreation user spending contributed $119 000 to the study area, while Point Pelee recreation users contributed $1 025 000 to the study area. Based in a multiplier effect, local business income generated by Long Point recreation users was $225 000, and $1 928 000 by Point Pelee recreation users. These figures do not account for costs associated with providing the recreational experience, nor the environmental costs of marsh use (Kreutzwiser, 1981b).

Tourism

Twynam and Robinson (1987), in a presentation of two surveys that described the socio-demographics of tourists to Northern Ontario, sought to determine the demand for ecotourism opportunities. The authors raised three issues which affect both timber and tourist management

in Northern Ontario: though the area has traditionally been reliant on the timber industry, changing public attitudes are calling for a change in timber harvest practices that reflect the growing concern for ecosystem management within the context of a biocentric paradigm; in order to achieve sustainability of forest land (in terms of economic, social and environmental sustainability), integrated resource management ought to be more widely adopted; and that in light of the previous issues, ecotourism can be seen as an alternative land use in timber-dependant regions that can contribute to sustainability. Six market segmentation profiles are developed in the study, though only three, *enthusiast*, *adventurer*, and *naturalist* are considered well suited for the Northern Ontario ecotourism market. The authors argue that ecotourism is often turned to by timber-dependant communities as a last resort – only after traditional resource-based activities have been exhausted; on its own, ecotourism is unlikely to provide the necessary economic inputs for community stability. The development of ecotourism is best considered as a means of diversifying local economies and as an instrument for economic development. In order that ecotourism be successful, the authors suggest that it not be treated as an add-on to current forest management, but as an essential part of integrated resource management; it is recommended that ecotourism works best when developed in a regional setting, not in isolated communities.

Soil Quality

The economic impact of timber harvesting and silviculture on soil quality and productivity was examined by White (1991), whose results suggest that soil disturbance can affect future harvest levels, and can have long-term impacts on site productivity. Viewed in this light, the role of soil as a non-timber value that directly affects future timber values is reviewed in terms of rehabilitation costs. It has been estimated that the effect of timber harvesting on site productivity is 10%/ha; productivity losses occur in soil quality due to displacement and compaction of soil, erosion, and scarification. Soil rehabilitation costs were estimated by to be $2 500 - $ 4 000/ha (White, 1991).

Carbon Sequestration

The economic value of the role of forests in carbon sequestration has been an area that has received increased attention in recent years. The increase of atmospheric concentrations of greenhouse gases has contributed to climate change, and what has been termed the greenhouse effect, or global warming. The contribution of CO_2 to this process has been documented and attributed to, among other factors, a decrease in the Earth's biomass. In this

context, the practice of forestry, through the removal of trees, can be considered a contributing factor to this problem. The roles of forests in the carbon cycle are well documented; forests act as a carbon sink, and through photosynthesis, CO_2 is "fixed", or sequestered. Forests also emit CO_2 through biomass decay. The role of forests in the sequestration of carbon is an important one, and can be considered an amenity value (Pohjola, 1999; Solberg, 1998; Haines *et al.*, 1994; and Hoen & Solberg, 1994).

Methods of increasing carbon sequestration in the United States, and the market related impacts of forest policy options have been examined so that the intersectoral and intertemporal market effects that result from the dynamics of forest policy and of supply and demand can be identified (Haynes *et al.*, 1994). A number of scenarios were developed by the authors that address forest area, forest inventory, harvest, and pricing concerns; the welfare effects of mitigation strategies are also investigated. These scenarios were then compared against baseline projections of timber markets through to the year 2040. The alternative scenarios that were developed and their impacts were discussed and include the planting of marginal agricultural land, an increase in the practice and use of recycling, a reduction of harvesting levels, and the development of alternative biomass assumptions (various combinations of these scenarios are also developed). The results of this study indicate that the impacts on forest inventory and harvest are highest in the *planting scenario*, which was funded at US$220 million/year for 10 years and a decrease in US stumpage rates resulted in a decline of Canadian timber exports to the US) – these market impacts grow as the timber matures. The *low National Forest harvest scenario*, with the assumption of a decreased timber harvest level of 1 billion cubic feet by the year 2000, predicted a rise in US stumpage and a subsequent increase in Canadian timber exports to the US of 21% by the year 2040 – these market impacts decrease with a lower harvest (Haynes *et al.*, 1994).

In order to build on previous attempts to model the economy wide effects of reducing emissions, a study that acknowledged the possibility that carbon emissions may be decreased by increasing the carbon sink compared the economic effects of setting emission limits based on gross and net emissions using a computable general equilibrium model (Pohjola, 1999). While carbon taxes on fossil fuels are often calculated based on carbon content, the author suggests that it is not efficient to do the same for wood. The model employed in this study takes intersectoral interactions into account when estimating the economic effects of environmental and energy policy measures. Assuming the year 2010 to be the year that CO_2 emissions are to

be stabilized to 1990 levels, a 2% overall economic growth rate, and a net increase in emissions (due to decreased biomass), a reference policy scenario was developed. Based on this reference scenario, nine emission tax rates, welfare loss, and reduction in GDP are presented. Using sensitivity analysis, the author suggests that it would be more advantageous for the Finnish economy to set emission limits to net emissions than to gross emissions, except in the case of no tax exemptions. However, Pohjola noted that using gross emission limits is more advantageous for the pulp and paper and wood processing industries. In the case of welfare loss, net emission limits were the most advantageous; while in the case of GDP, gross emission limits are favoured. The author concludes that the welfare loss of reducing gross emissions by 2010 are 5.9 billion FIM (Finnish monetary unit), and 5.6 FIM for a net reduction of CO_2 emissions (Pohjola, 1999).

In a review article Solberg (1998) examined studies of the economical effects of global change, and studies of economic analysis of the effects of forestry measures on carbon balance and noted that the cost analysis of carbon sequestration and substitution of fossil fuels is limited, and that studies of per unit costs of carbon sequestration do not discount sequestration benefits. Based on scenarios generated by the use of four general equilibrium circulation models of climate, the author suggested that an expansion of net primary productivity of global forests would benefit consumers, but would be detrimental to timber producing areas – specifically, the net present value, based on a 4% discount rate, is calculated as US$10.7 - 15.9 billion. Solberg (1998) acknowledged the uncertainty of this calculation, in addition to some omissions of the study, such as fire outbreak, ecosystem dynamics, and the impacts of climate change on non-timber values that could have been addressed. In Scandinavian countries, where the majority of this research was done, it has been found that the marginal cost of reducing CO_2 emissions is equal to the carbon tax if markets are functioning well (Solberg, 1998). In Norway, a tax of US$49/ton of CO_2, at a real interest rate of 3%, has resulted in a net economic value of carbon sequestration in biomass that is five times that of the net stumpage value. Future research priorities are identified. The author concludes that the role of forestry in climate change and carbon sequestration is an important one, although the inclusion of other industrial sectors is necessary in order that a complete understanding of this problem can be fostered (Solberg, 1998).

LITERATURE CITED

Adamowicz, W., P. Boxall, M. Williams, and J. Louviere (1998) Stated preference approaches for measuring passive use values: Choice experiments and contingent valuation. *American Journal of Agricultural Economics* 80(1): 64-75

Adamowicz, W.L., J. Asafu-Adjaye, P.C. Boxall, and W.E. Phillips (1991) Components of the economic value of wildlife: An Alberta case study. *Canadian Field Naturalist* 105(3): 423-429.

Adamowicz, W., T. Beckley, D.H. MacDonald, L. Just, M. Luckert, E. Murray, and W. Phillips (1988) In search of forest resource values of indigenous peoples: are nonmarket valuation techniques applicable? *Society and Natural Resources* 11: 51-66.

Beckley, T.M. and B.H. Hirsch (1997) *Subsistence and Non-industrial Forest Use in the Lower Liard Valley*. Natural Resources Canada, Canadian Forest Service, Northern Forestry Centre, Edmonton, AB. Information Report NOR-X-352.

Binkley, C.S., M. Percy, W.A. Thompson, and I.B. Vertinsky (1994) A general equilibrium analysis of the economic impact of a reduction in harvest levels in British Columbia. *Forestry Chronicle* 70(4): 449-454.

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

Boxall, P.C., B.L. McFarlane, and M. Gartrell (1996) An aggregate travel cost approach to valuing forest recreation at managed sites. *Forestry Chronicle* 72(6): 615-621.

Boxall, P.C., D.O. Watson, and J. Englin (1996) Backcountry recreationists' valuation of forest and park management features in wilderness parks of the western Canadian Shield. *Canadian Journal of Forest Research* 26(6): 282-290.

British Columbia Ministry of Forests (1994) *Forest, Range and Recreation Resource Analysis, 1994*. Crown Publications, Inc., Victoria.

Condon, B. and W.A. White (1994) *Valuation of Nontimber Forest Resources: An overview*. *Natural Resources Canada*, Canadian Forest Service, Northwest Reg., Northern Forestry Centre, Edmonton, AB. Information Report NOR-X-339. 16pp.

Coopers and Lybrand Consulting (1995) *Economic Benefits of British Columbia Parks: Report for the British Columbia Ministry of Environment, Lands & Parks, April, 1995*. URL: http://www.env.gov.bc.ca/publications/index.html.

Clark, W.R. (1987) Economics and marketing of 'Canada's Capistrano'. In: A.W. Diamond and F.L. Filion (eds).*The value of birds: Proceedings of a workshop held during the 19th World Conference of the I.C.B.P. in June 1986 at Queen's University, Kingston, Ontario*. Page Bros., Norfolk, England. pp. 31-48.

Condon, B. and W.A. White (1994) *Valuation of Nontimber Forest Resources: An overview*. Natural Resources Canada, Canadian Forest Service, Northwest Region, Northern Forestry Centre, Edmonton, AB. Information Report NOR-X-339.16pp.

Coyne, A. and W. Adamowicz (1990) *Economic Effects of Environmental Quality Change on Recreation Demand*. University of Alberta, Faculty of Agriculture and Forestry, Department of Rural Economy, Rural Economy Project Report 90-02. 59pp.

de Geus, P.M.J. (1995) *Botanical Forest Products in British Columbia: An overview.* Integrated Resources Policy Branch, British Columbia Ministry of Forests. 51pp.

Ecologistics Limited (1990) *Benefits to Beach Users from Water Quality Improvements*. Research Advisory Committee Project no. 374C. Ontario Ministry of Environment. Queen's Printer for Ontario. 63pp. + appendices.

Ells, A., E. Bulte, and C.G. van Kooten (1997) Uncertainty and forest land use allocation in British Columbia: Vague priorities and imprecise coefficients. *Forest Science* 43(4):509-520.

Englin, J., P. Boxall, and D Watson (1998) Modeling recreation demand in a Poisson system of equations: An analysis of the impact of international exchange rates. *American Journal of Agricultural Economics* 80(2):255-263.

Englin, J., P.C. Boxall, K. Chakraborty, and D.O. Watson (1996) Valuing the impacts of forest fires on backcountry forest recreation. *Forest Science* 42(4): 450-455.

Filion, F.L., A. Jacquemot, E. DuWoks, R. Reid, P. Boxall, P. Bouchard, P.A. Gray, and A Bath (1994) *The importance of wildlife to Canadians: The economic significance of wildlife-related recreational activities in 1991*. Canadian Wildlife Service, Environment Canada 46pp.

Gregory, G.R. (1987) Nontimber products: Production, measurement, and assessment. In: *Resource Economics for Foresters*. John Wiley & Sons, New York. pp. 329-356.

Gunton, T. (1991) *Economic evaluation of forest land use tradeoffs*. Forest Economics and Policy Analysis Research Unit Working Paper 157, University of British Columbia, Vancouver, British Columbia. 40 pp.

Hagen, D.A., J.W. Vincent, and P.G. Welle (1992) Benefits of preserving old-growth forests and the spotted owl. *Contemporary Policy Issues* 10(2): 13-26.

Haynes, R.W., R.J. Alig and E. Moore (1994) *Alternative Simulations of Forestry Scenarios Involving Carbon Sequestration Options: Investigation of impacts on regional and national timber markets*. General Technical Report PNW-GTR-335. US Department of Agriculture, Forest Service, Pacific Northwest Research Station. Portland, OR. 66 p.

Haynes, R.W., N.A. Bolon, and D.T. Hormaechea (1992) *The Economic Impact on the Forest Sector of Critical Habitat Delineation for Salmon in the Columbia and Snake River Basin*. General Technical Report PNW-GTR-307. Portland, OR: USDA Forest Service, Pacific Northwest Research Station. 33pp.

Hoen, H.F. and B. Solberg (1994) Potential and economic efficiency of carbon sequestration in forest biomass through silvicultural management. *Forest Science* 40(3): 429-451.

Jacquemot, A. and F.L. Filion (1987) The economic significance of birds in Canada. In: A.W. Diamond and F.L. Filion (eds)*The value of birds: Proceedings of a workshop held during the 19th World Conference of the I.C.B.P*. in June 1986 at Queen's University, Kingston, Ontario. Page Bros., Norfolk, England. pp.15-21.

Jacquemot, A., R. Reid, and F.L. Filion (1986) *The Importance of Wildlife to Canadians: The recreational economic significance of wildlife*. *Canadian Wildlife Service*, Environment Canada 76pp.

Klemperer, W.D. (1996) Valuing nonmarket forest options. In: *Forest Resource Economics and Finance*. McGraw-Hill, Inc., New York. pp. 418-447

Kreutzwiser, R. (1981a) The economic significance of the Long Point Marsh, Lake Erie, as a recreational Resource. *Journal of Great Lakes Research* 7(2): 105-110.

Kreutzwiser, R. (1981b) Recreational values of lakeshore marshes. In: *Proceedings of the Ontario Wetlands Conference: Hosted by the Federation of Ontario Naturalists and the Department of Applied Geography, Ryerson Polytechnical Institute, September 18-19, Toronto, ON*. pp. 48-57.

Kulshreshtha, S.N. and K.G. Loewen (1997) Value of wilderness protection in Saskatchewan: A case study of existence values. *Journal of Sustainable Forestry* 5(1/2): 207-216.

Ludwig, D. and J. Conrad (1991) *Opportunity Cost of Preservation of Old Growth and the Present Value of Silviculture*. Forest Economics and Policy Analysis Research Unit Working Paper 165, University of British Columbia, Vancouver, British Columbia. 15 pp.

Macdonald, H., and D. McKenney (1996) Varying levels of information and the embedding problem in contingent valuation: The case of Canadian wilderness. *Canadian Journal of Forest Research*, 26(7):1295-1303.

McKenney, D. and R. Sarkar (1994) An overview of non-wood valuation efforts in Ontario. *Forestry Chronicle* 70(1): 47-54.

Morton, K.M., W.L. Adamowicz, and P.C. Boxall (1995) Economic effects of environmental quality change on recreational hunting in northwestern Saskatchewan: A contingent behaviour analysis. *Canadian Journal of Forest Research* 25(6): 912-920.

Nautiyal, J.C. and R.L. Chowdhary (1975) A suggested basis for pricing campsites: Demand estimation in an Ontario park. *Journal of Leisure Research* 7(2): 95-107.

Pohjola, J. (1999) Economy-wide effects of reducing CO_2 emissions: A comparison between net and gross emissions. *Journal of Forest Economics* 5(1): 139-168.

Prins, R., W. Adamowicz, and W. Phillips (1990) *Non-timber Values and Forest Resources: An annotated bibliography*. University of Alberta, Faculty of Agriculture and Forestry, Department of Rural Economy, Rural Economy Project Report 90-03.

Rubin, J., G. Helfand, and J. Loomis (1991) A benefit-cost analysis of the Northern Spotted Owl: Results from a contingent valuation survey. *Journal of Forestry* 89(12): 25-30.

Sarker, R. and Y. Surry (1998) Economic value of big game hunting: The case of moose hunting in Ontario. *Journal of Forestry Economics*. 4(1): 29-60.

Sarker, R. and D.W. McKenney (1992) *Measuring Unpriced Values: An economic perspective and annotated bibliography for Ontario*. Forestry Canada, Ontario Region, Sault Ste. Marie, ON Information Report O-X-422. 32pp.

Scott, C.H. (1987) The socio-economic significance of waterfowl among Canada's Aboriginal Cree: Native use and local management. In: A.W. Diamond and F.L. Filion (eds)*The value of birds: Proceedings of a workshop held during the 19th World Conference of the I.C.B.P.* in June 1986 at Queen's University, Kingston, Ontario. Page Bros., Norfolk, England. pp. 49-62.

Simon Fraser University. Natural Resources Management Program (1990) *Wilderness and Forestry: Assessing the cost of comprehensive wilderness protection in British Columbia*. Burnaby, BC: SFU. 136pp.

Solberg, B. (1998) Economic aspects of forestry and climate change. *Commonwealth Forestry Review* 77(3): 229-233.

Twynam, G.D. and D.W. Robinson (1997) *A Market Segmentation Analysis of Desired Ecotourism Opportunities*. Natural Resources Canada, Canadian Forest Service, Great Lakes Forestry Centre, Sault Ste. Marie, ON. NODA/NFP Technical Report TR-34. 52pp.

van Kooten, G.C. (1995) Economics of protecting wilderness areas and old-growth timber in British Columbia. *Forestry Chronicle* 71(1): 52-58.

White, W.A. (1991) Economics and sustainable forest development: The case of soil degradation. *Forestry Chronicle* 67(1): 19-22.

Yen, S.T. and W.L. Adamowicz. (1994) Participation, trip frequency and site choice: A Multinomial-Poisson hurdle model of recreation demand. *Canadian Journal of Agricultural Economics* 42(1):65-76.