RURAL ECONOMY

Non-Timber Values in Canadian Forests:
An Assessment of Uses, Techniques and Data Availability

W. Adamowicz
Project Report 92-02

PROJECT REPORT

Department of Rural Economy
Faculty of Agriculture and Forestry
University of Alberta
Edmonton, Canada

DRAFT: FEBRUARY 16, 1992

Non-Timber Values in Canadian Forests: An Assessment of Uses, Techniques and Data Availability

W. Adamowicz
Project Report 92-02

The author is Associate Professor, Department of Rural Economy, University of Alberta, Edmonton.

Non-Timber Values in Canadian Forests:
An Assessment of Uses, Techniques and Data Availability

Executive Summary

In 1989 the Canadian forest industry shipped nearly $50 billion of forest products, generated over $3.5 billion in government revenues, and accounted for $19.5 billion of Canada's trade surplus (Forestry Canada, 1991). The forest provides the products which are used to generate trade surpluses and employment in the forest industry. However, the value of the forest itself goes well beyond the generation of this economic activity. The forest also provides other goods and services. These goods and services, so-called non-timber goods and services, also have value and are important to Canadians and the world. Wildlife habitat, wilderness, recreational spaces, and a vast array of other services are provided by the forest and are not typically traded on markets.

The purpose of this paper is to define non-timber values, examine the use of these values in decision making and planning, explain the common methods used to measure non-timber values, and provide an assessment of the availability of non-timber information and the state of the art in non-timber valuation techniques in Canada. Several approaches to valuing non-timber services are examined and critically assessed. There are a host of techniques and each has its own set of limitations. The contingent valuation, travel cost and hedonic price approaches are reviewed. One of the most difficult problems in non-timber valuation is the development of a technique that reliably estimates non-use values such as existence values and bequest values. These values undoubtedly exist, but their measurement is problematic. Other limitations of non-timber valuation techniques are addressed including the treatment of irreversible changes.

Appendix 2 contains a summary of non-timber activities and values by Province for Canada. These data were collected to provide a baseline data set of non-timber activities and values. They were also collected to identify gaps in existing data sets and identify research needs. The data on non-timber activities (fishing, camping, etc.) are provided as indicators of the quantity of non-timber related activities.

There are a number of "gaps" in the non-timber value database. First and foremost is the lack of non-market value information for most services provided by the forest. Some consumptive values (hunting, fishing) have been collected on a national basis. There are very few measures of non-

consumptive values or non-use values. Typically, the studies measuring non-consumptive and/or non-use values are small scale, regional efforts. There must be more research in the area of evaluating the tradeoffs between various mixes of services provided by the forest. These studies should try to concentrate on a larger geographical level than previous valuation efforts. Site specific valuation efforts are useful for site specific management (stocking lakes, changing local regulations, etc) but they are limited in their usefulness in national management of forests.

A second major gap in the non-market valuation area is a measurement of the impact of changes in the physical environment on the non-market values. Only a few studies have been performed in Canada. Information on the impact of environmental changes is essential to evaluate decisions on harvesting approaches, buffer zones, etc.

Collection of the bio-physical information also revealed a number of gaps. Most gaps are due to definitional difficulties. "Old Growth Forest" is difficult to define and a variety of definitions exist. Differing definitions of parks, wilderness areas, recreation areas and historic sites makes the calculation of the areas in each of the designations difficult.

Additional effort should proceed on two fronts. First, non-market valuation studies should be extended so that they can be incorporated into national level planning. These non-market values should include baseline estimates as well as estimates of the values associated with environment change. Second, consistent definitions of items such as old growth forests would aid in the collection of data on the bio-physical elements.

In the current political and social environment there is considerable support for exercises which attempt to reflect the true worth of environmental services. Non-timber valuation is one such exercise. There is no doubt that values for environmental services will vary across individuals or jurisdictions nor is there any doubt that values will change over time, just as they do for market goods. The task of non-timber valuation is to try to capture the tradeoff between market goods and environmental services in an attempt to reflect the demand for these services. Such information should be useful to policy makers and resource managers alike.

Non-Timber Values in Canadian Forests
An Assessment of Data Availability, Techniques and Future Needs

W. L. Adamowicz

1. INTRODUCTION

In 1989 the Canadian forest industry shipped nearly $50 billion of forest products, generated over $3.5 billion in government revenues, and accounted for $19.5 billion of Canada's trade surplus (Forestry Canada, 1991). The forest provides the products which are used to generate trade surpluses and employment in the forest industry. However, the value of the forest itself goes well beyond the generation of this economic activity. The forest also provides other goods and services. These goods and services, so-called non-timber goods and services, also have value and are important to Canadians and the world. Wildlife habitat, wilderness, recreational spaces, and a vast array of other services are provided by the forest and are not typically traded on markets.

The values generated by the forest through both timber products (timber values) and other products (non-timber values) jointly form the value of the forest as a whole. In an attempt to describe Canada's forest resources, accurate inventories of the timber values and the non-timber values should be maintained. Furthermore, the uses of the forest often involve trade-offs between certain timber and non-timber values. The relationship between the production of fibre based goods and non-timber goods of the forest should also be examined.

The purpose of this paper is to define non-timber values, examine the use of these values in decision making and planning, explain the common methods used to measure non-timber values, and provide an assessment of the availability of non-timber information and the state of the art in non-timber valuation techniques in Canada. Presented in a series of appendices are some statistics on the use of forest resources for non-timber activities and some measures of value for these activities. These appendices are a first attempt to generate an inventory of non-timber uses of forest resources and the values associated with them.

2. NON-TIMBER GOODS AND SERVICES DEFINED

Timber products derived from forest land are relatively easy to define and measure. Measurements of annual allowable cut, area harvested, and area of productive forest land are available in The State of Forestry in Canada (Forestry Canada, 1991). Non-timber goods and services, however, are more difficult to define and quantify. The simplest definition of non-timber goods is the set of all products of the forest other than timber products. Non-timber goods include wildlife species, non-commercial plants, and a variety of other biota. Non-timber goods, however, are typically not the focus of valuation exercises. While markets exist for timber products and corresponding values are generated, non-timber goods are typically not traded on markets and values for these goods do not exist[1]. The value concepts which are applied deal with the services provided by the non-timber products. For example, a moose can be considered a non-timber good, however, the moose is a component of a set of services provided by the forest. The moose affects recreational hunting values (increased populations may increase the value of the recreational hunting experience) and it affects values experienced by campers and hikers. The non-timber good is an element of the services provided by the forest. These services, or the service flows from the forest, are the focus of valuation approaches. The non-timber (and timber) goods are components of the service flow provided by the forest environment. The remainder of this paper will address the non-timber valuation problem from the perspective of non-timber services[2]. The paper will concentrate on non-timber services which are also non-market in nature.

Non-timber services fall into three broad categories: User Services, Non-user Services and Environmental Control Services. **User services** are the services provided by forest land which support activities by individuals in the forest. Outdoor recreation, birdwatching, hunting, fishing, and hiking are examples of user services. Both the quantity and quality elements of these recreational experiences are important components of non-timber value. The resource base provides a venue for the activity and the attributes of the natural environment result in different level of quality.

Non-user services include a broad spectrum of items. Forest land may provide habitat for endangered species or it may be designated as a wilderness area. There is an apparent strong demand for

---

[1] Some non-timber goods are traded in a market and do have market values. Examples include commercially trapped animal species and commercial fishing. These elements, however, are not the focus of this paper and they tend to be relatively minor in the overall scheme of non-timber goods and services.

[2] In some cases non-timber goods are traded on markets or used in production or consumption of other goods. Examples include berry production, mushrooms and other products of the forest which are not timber products. These goods, however, are either traded on markets or are comparable to similar goods traded on markets and their values are observable through these markets.

these aspects of forest ecosystems yet this demand need not be accompanied by activity within the region. In fact, an individual may never visit a forest but they still may wish to see public forest land used for these purposes. Non-user services include maintenance of old growth forests, natural history, biodiversity, and endangered species.

Forest resources also play a role in flood control, soil erosion control, waste assimilation, water quality and quantity regulation and climate control. These are the **Environmental Control Services** of a forest. Changes to the forest land base may result in changes to these aspects of a forest ecosystem. The impact of changing environmental control services may be realized at many different levels in the economy. Changes in water quantity and quality may affect production costs in other industries (agriculture for example) or they may affect costs of water treatment by municipalities. Changes to the level of flood control provided by forest resources may result in higher risks of injury and property damage. The environmental control services of a forest arise from the linkages between the forest ecosystem and other systems, both human and natural. Some of these linkages are local (flood control) while others are global (climate control).

Given these three types of services generated by forest resources the next step is to define the value of these services. As mentioned above, non-timber values commonly fall into the category of non-market values. These are values that are not typically captured in private markets and must be measured using alternative techniques. The concept of value itself, however, is a debatable and contentious subject. In the next sections some of the issues surrounding concepts of value are described. In particular the following issues will be examined:

(a) the need for monetary evaluation of these services,
(b) the meaning of value,
(c) a description of the services being valued, and,
(d) the methods of determining these values.

3. THE NEED FOR MONETARY VALUATION

The initial reason for valuation of non-timber services was to include the benefits of these resources in economic analysis so that development decisions could include both market and non-market goods and services. For example, benefit cost analysis is an economic tool that is designed to evaluate uses of resources. The theoretical basis for benefit cost analysis is the concept of efficiency in resource use. In

a broad sense, benefit cost analysis attempts to determine if resources are being employed in their "highest value and best use." Decisions to proceed with resource development may be based on the benefits and the opportunity costs (benefits foregone or displaced) of the development. In these cases the values of both timber and non-timber services of forest land can be evaluated on the common base of monetary units.

Economic principles may prove useful in a number of resource use and management decisions. For example, in cases of land allocation for harvesting the benefits arising from the forest land with the harvesting operation versus the benefits without harvesting can be evaluated to determine which land use delivers the higher value. Both the harvesting option and the no harvesting option will contain non-timber values at different levels. The harvesting option will also include timber values. Land use decisions may be aided by this form of evaluation if all relevant values are identified. Economic models which incorporate water quality, forest recreation, and amenity values into forest rotation decisions have been developed (Bowes and Krutilla, 1985; Englin, 1990). Non-timber values may be incorporated into rotation length decisions, harvesting technique decisions, and other forest operation decisions. These values may also be used to develop guidelines for forest operations in forest management agreements.

Economic analysis can also identify the beneficiaries under each scenario. Decision makers are provided with information on the distributional impacts of resource use. This distributional information is a necessary element for public decision making.

A second reason for the valuation of the benefits of environmental amenities is to determine compensation in cases of loss or damage. Legal battles are currently underway in cases where firms or individuals are liable for damages to environmental assets. Environmental damage assessment may include the objective measurement of the impact of these damages in order to determine compensation amounts and identify beneficiaries. It is noteworthy that the techniques discussed below, particularly the travel cost and contingent valuation approaches, have been accepted as evidence in court cases in Canada and the U.S. and both techniques are sanctioned by the U.S. Water Resources Council as credible damage assessment or valuation methods.

Other types of environmental/economic analysis also require non-market value estimates. Two such approaches are "Environmental Asset Valuation" (sometimes referred to as Natural Resource Accounting) and "Full Cost Accounting". Environmental Asset Valuation has become popular with a variety of agencies. It even received mention in Canada's Green Plan (1991). This technique attempts to value a nation's natural resource and environmental assets. Some of these assets have market values (ie.

the trees in a forest) while others do not (ie. the value of the forest as a recreation space). Without non-market value estimates a critical component of the asset value is ignored. A quote from Repetto et al (1988) illustrates the need for Natural Resource Accounting, "*A country could exhaust its minerals, cut down its forests, erode its soils, pollute its aquifers and hunt its wildlife and fisheries to extinction, but measured income would not be affected as these assets disappear.*"

Full Cost Accounting introduces the idea that the current prices of certain resource uses do not reflect their true cost. To economists this is commonly called the difference between private and social costs. The consumption of gasoline is a typical example. Gasoline price reflects the cost of extraction, processing and transportation but it may not reflect the costs of pollution, greenhouse gas effects and seepage from underground storage tanks. The costs of these latter impacts are typically non-market in nature and require non-market valuation techniques to be measured.

Finally, the quantification of non-timber services and their values will identify the regional distribution of these services and the regional economic impacts of non-timber resources. There are regional community effects associated with non-timber services just as there are regional effects associated with timber harvesting and processing. The employment and expenditure aspects of non-timber services are different from the value of non-timber services. Individuals may incur costs (food, lodging, etc.) while participating in a non-timber use of the forest. However, while these expenditures are important from a regional economy standpoint, they are not measures of the value of the non-timber service. Nevertheless, the regional economic impacts of non-timber assets may be important as elements of regional and community development.

4. WHAT IS VALUE[3]?

The concept of "value" is often quite controversial. The concepts of value in the environmental literature range from individual values to "intrinsic" values or values in nature independent of humans. Value to an economist is a somewhat narrower notion. It is the maximum amount an individual is willing to exchange for the good or service from the set of resources the individual controls or the minimum

---

[3] Sections of the following text draw heavily from the paper: Adamowicz, W.L. 1991. Valuation of Environmental Amenities. Presented at the Interdisciplinary Symposium on Agriculture and Water Quality. University of Guelph, Guelph, Ontario. April 23-24, 1991, and published in the proceedings of that conference as well as the proceedings issue of the Canadian Journal of Agricultural Economics, December 1991.

amount the individual would accept in exchange for the good. The exchange is usually measured in monetary units. Value, in this sense, is not the price of a good or the price times the quantity. Thus, goods without prices may have value[4]. Note that value, even defined in this relatively narrow sense, is subject to context effects and a host of perceptions which change over time (see Brown, 1984). Also, valuation in monetary terms is only one of many forms of valuation which requires individuals to assign values to objects.

A variety of other notions of value exist including an entire set of non-anthropocentric values. The latter term refers to the concept that nature has value in itself, independent of humans. One can debate the merits of such a value systems but that is beyond the scope of this paper (for a discussion of these issues see Redclift, 1990 or Pearce and Turner, 1990). Suffice it to say that the measure of value used in current non-market valuation techniques is anthropocentric. In fact, it is a value defined at an individual level.

The total value of a good is not usually the item of interest. The value of changes in quantity, price or quality is often more important. The measurement of value changes in an economic context is defined as the "compensating or equivalent variation" (Boadway and Bruce, 1984). These measures are designed to evaluate the impact of an imposed change in an individual's consumption of goods or services, including environmental services. These notions of value are central to the analysis of non-market benefits.

A number of types of value can be identified at the individual level. The main categorization used in the non-market valuation literature is "**Use Value**" versus "**Non-Use Value.**" These concepts correspond with the **User Services** and **Non-User Services** described above. Use Value refers to the value an individual holds for participating in an activity. Examples include hunting, fishing, camping, etc. Within the category of Use-Values are the so-called consumptive use values and non-consumptive use values. The former are values associated with an activity that consumes the resource in question (ie. fishing). The latter refers to the value associated with an activity that does not affect the resource (ie. birdwatching). These constructs may be experienced simultaneously by any individual.

Non-Use values are those values held by an individual for goods or services they do not actually

---

[4] For market goods and services, the price system may function as a mechanism for the valuation of the marginal unit of a good or service.

consume or actively participate in. For example, an individual may value the existence of old growth forests in British Columbia even though they may never visit one. These values are controversial. The recent case of the Exxon Valdez oil spill raised the issue of Non-Use values to the forefront. Individuals who value the pristine existence of the Alaska coast line were affected by the oil spill. These individuals live around the world, not only near the area affected. Estimating and capturing these values, in an economic framework, is a difficult task indeed.

Non-Use values can be further classified into existence and bequest values. The former refers to the value one places on a the existence of a good (independent of its use) and the latter is the value placed on being able to pass the good on to future generations. A number of reviews of this type include the notion of Option value in the set of non-use values. Option value has a very specific definition in the economics literature. Option value is a concept which incorporates uncertainty into the values described above. Option value is the premium (over the willingness to pay in a deterministic case) that may be attached to a value when the supply of (or demand for) the good is affected by uncertainty. Option value is the difference between an *ex-ante* welfare measure (option price) and an *ex-post* measure (expected willingness to pay). The concept of option value has been the subject of considerable debate and has not been empirically significant in the measurement of benefits (see Mitchell and Carson, 1989).

An extension of use and non-use values is the determination of the change in these values in response to a quality change. The value of a day of recreational fishing will likely increase with an increase in water quality or fish catch. Methods for valuing quality changes are used for the valuation of the third category of non-timber services, **Environmental Control Services**. Changes in Environmental Control Service levels may produce changes in use values and non-use values. Improvements in drinking water quality, for example, are associated with the use value of water. Existence values for pure water may also be relevant. Changes in water quantity services provided by the forest may affect the production of agricultural crops. The value of this service can be measured using the market by estimating the impact of changes in the quantity of water on costs of production. Thus, changes in the environmental control services of the forest can be categorized as use values or non-use values depending on the particular service being considered and there may be market effects as well as non-market effects.

Figure 1 illustrates linkages between use values, non-use values, market values and environmental control services. The top left hand box in Figure 1 depicts the market services provided by the forest. These services are associated with prices through market mechanisms. Under the market services are two boxes illustrating non-market services. The first non-market service box contains services that are

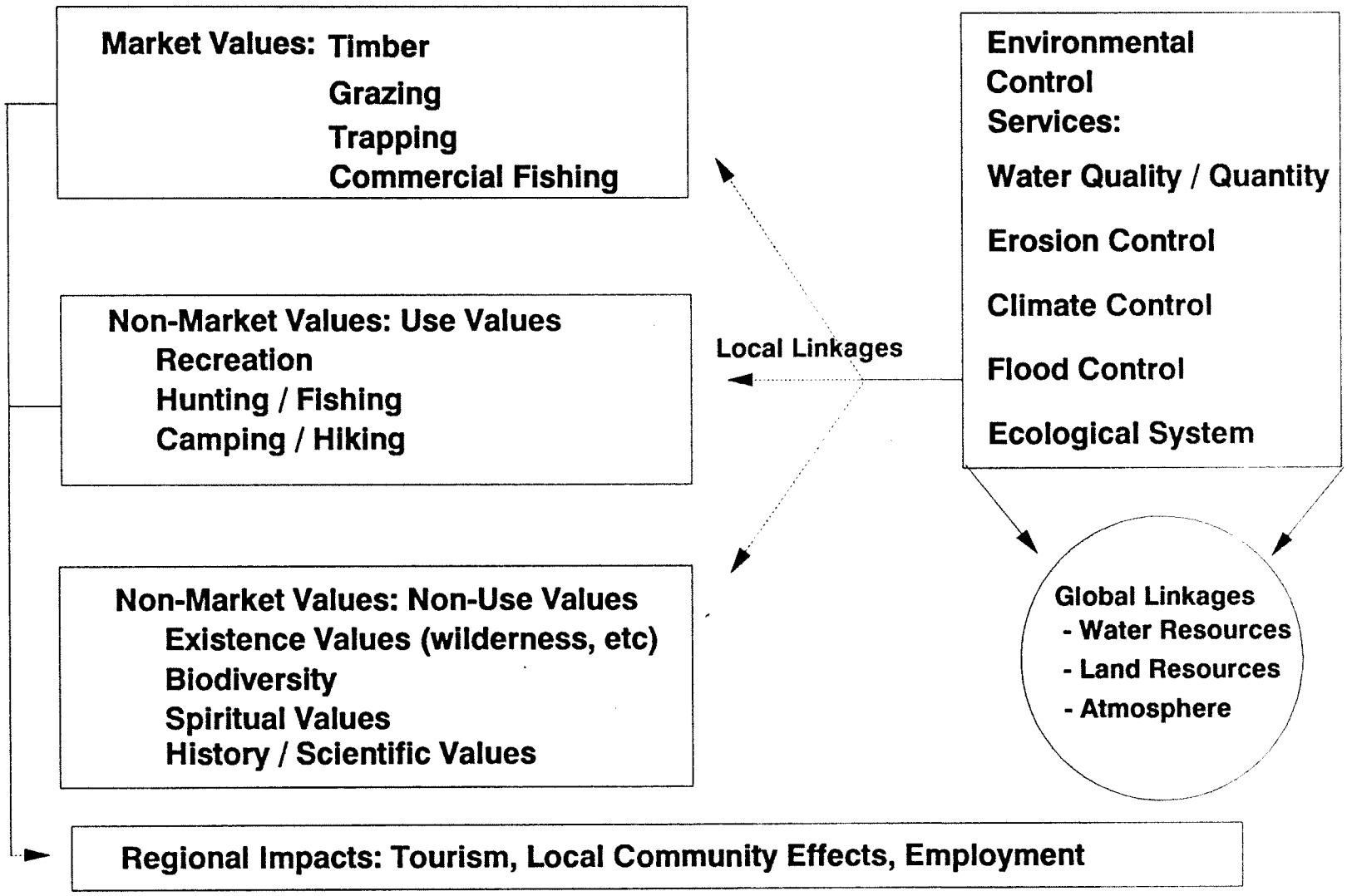
associated with use (travel to the forest or activity within the forest environment). Examples of services which have use-value include hunting, fishing, camping and hiking. The second non-market service box contains non-use values such as existence value, values for biodiversity, and other values that do not require visits to the forest. The market values and use values are linked to regional community impacts. Both timber operations and tourist opportunities support economic activity in regions. Linkages between community effects and non-use values are less direct. On the right side of the diagram the relationship between the environmental control services and market/non-market values is illustrated. The forest provides erosion control, water, wildlife habitat (ecological system) and other services which support both market and non-market elements. Changes in wildlife habitat, for example, will affect hunting and birdwatching values. Similarly, changes in the ecological system may affect tree growth and timber values. The environmental control services of the forest influence, and are influenced by, global systems. Acid rain and global warming are two issues which are global in nature and may affect the local forest system. Changes in the local forest system will also affect global environmental conditions through bio-physical linkages. While figure 1 illustrates the linkages between market values, non-market values and environmental control services, the discussion which follows concentrates on the non-market elements associated with use and non-use values. Both the measurement of the absolute values as well as the values associated with quality changes (or changes in the environmental control services) are discussed.

5. WHAT IS BEING VALUED?

Valuation techniques are designed to determine values of non-market goods and services as they accrue to individuals. Within the economic paradigm, goods and services only have value insofar as they affect humans or they are within a set which humans have preferences over. This set of goods, however, may be quite large. Examples of the goods and services being valued by these techniques include; days (or seasons) of recreational activities (fishing, hiking, etc), the effect of changes in environmental attributes (wildlife populations, water quality, scenery, etc) on recreational values, and the effect of environmental attributes on property values (air, water and noise pollution). Also, a host of non-use values are being investigated using these techniques. Non-use values encompass a wide variety of environmental amenities including the value of endangered species, the value of rainforests, and the value of nature preserves.

Since individuals have different preferences there will be variability in the values across individuals. Note that resources often possess various forms of value. A fish has value as a potential increase in the quality of a recreational experience, as a commercial catch or perhaps some individuals have existence values for this species. It is the service flow that arises from the resource which produces the value.

Figure 1: Timber and Non-Timber Values



6. VALUATION TECHNIQUES

The main objective of non-market valuation is to derive a money based measure of the impact of changes in the quality or quantity of a good or service which is not typically priced in a market. There are two main approaches to valuation, the direct (or survey) approach and the indirect (or inferential approach). The indirect approach is the method which is most comfortable to economists. Almost all traditional economic analysis employs information on actual behavior and attempts to construct models which represent (or could generate) this behavior. Interpolation or extrapolation of this model can be used to estimate the monetary impact of changes in quantity or quality. The direct approach is more foreign to economists. The direct approach involves "conversation" (Smith, 1990) with individuals in an attempt to reveal their "values" for a non-market good or service.

The direct approach ignores the individual's behavior and attempts to structure a situation so that the individual understands the change in environmental conditions and is able to describe values for these goods *as if they were in a market setting.* The market setting notion is crucial for the assignment of monetary values. The indirect approach, on the other hand, tries to build representations of behavior which can then be used to determine the value an individual will assign to a change in the existing conditions. The impact of the change in monetary units is calculated using the compensating or equivalent variation measures discussed above. The advantages and disadvantages of each approach will be discussed below.

6.1 CONTINGENT VALUATION

Contingent valuation (CV) is the most popular of the direct techniques. The term contingent valuation arises from the fact that the valuation of the good is contingent on the assumption of a market for the good. For example, a day of recreational hunting is presented as a market good where one must pay to receive a permit to hunt for the day. CV in its simplest form is a description of the situation (a day of moose hunting) and a question of the form "what would you be willing to pay for a day of moose hunting, over and above all other expenses you might incur." The latter part of the phrase is included to guarantee that the individual is not reporting the expected expenditures on the activity but the willingness to pay over and above expenses. It is this willingness to pay that corresponds to the theoretical measure of equivalent variation mentioned above.

The assumptions required for CV to produce the theoretical welfare measure described above are that the respondent have: (a) an accurate description/understanding of the current level of the good or service being valued (the base level); (b) an accurate understanding of the good being valued (or change in the quality or quantity); (c) an understanding of the time dimension of the change in quality or quantity and how the payment is made; (d) an understanding of what the payment amount is to represent (ie. not a "fair" price but the maximum willingness to pay) (Mitchell and Carson, 1989). The last assumption may be altered slightly depending on the variant of CV chosen.

Although the basic form of CV involves questions about willingness to pay (or willingness to accept compensation) a number of variants of the technique have been developed. CV questions of the form "What would you be willing to pay ..." with a range of values to choose from or a blank for the respondent to place a value in are termed *Open-Ended Contingent Valuation Questions*. A number of variations of this approach include bidding games (ie. would you be willing to pay $X, if NO ask about a smaller value, if YES ask about a larger value) and a variety of mechanisms used to provide benchmarks for the respondent. For example, the respondent could be asked about their willingness to pay for an increase in water quality from the present condition to one in which there would be no odour in the spring months. The respondent may then be presented with benchmarks of the amount they currently spend on water per year and the amount they spend per year for other services (power, libraries, police services, etc.). These benchmarks are used to provide the respondent with an idea of their spending on similar services; municipal utility services are used in this example (see Mitchell and Carson, 1989).

A variant of the approach described above is one which does not require the respondent to determine a value, rather the respondent "votes" on whether the presented value is acceptable or not. This approach is called *Closed-Ended Contingent Valuation*. For example, the respondent could be asked if (s)he would vote YES to a referendum which required individuals to pay an additional $50 per year in exchange for improved hiking trails. The respondent only needs to indicate Yes or No and need not calculate the exact amount they would be willing to pay. The actual amount listed in the referendum ($50 above) is varied across a sample of individuals. These data are used to produce a statistical model which determines the probability of accepting the bid as a function of the bid amount. The expected value of the bid can then be determined from the probability of acceptance times the actual bid (Hanemann, 1984).

An obvious extension of the Closed-Ended CV is to ask respondents a number of referendum questions. Three variants of this multiple question format exist. First, some CV analysts choose to ask a variety of closed ended questions while varying the attribute levels (quality) and/or changing the good in

question slightly (ie. valuing increased fish catch versus increased salmon catch). A second alternative is a form of Bidding Game with the respondent moving towards the maximum willingness to pay. A further extension is to have the respondent vote on packages of payment amounts and quality attributes and use a statistical design such that the impact of changes in attributes and willingness to pay can be examined. The latter has seen limited use in the economics literature (an example is Carson, Hanemann and Steinberg, 1990) but is relatively common in the marketing and business literature and is known as a type of conjoint analysis (Louviere, 1988). All of these approaches have potential for the valuation of non-market goods. However, in each case the situation and the good must be presented to the respondent clearly. Also, the willingness to pay amount must be structured as a true maximum rather than a "fair" price or a price the respondent is used to paying for some other good.

Contingent valuation has been considered by some to be a virtual panacea to the valuation of non-market goods. Both use values and non-use values have been "captured" by the practitioners as well as values of goods and/or quality changes in those goods. Table 1 provides a sampling of CV experiments. Note that the goods being valued range from a day of hunting to the value of Whooping Crane habitat. Clearly, the main advantage of CV is its flexibility and that it is currently the only technique which can be used to estimated non-use values.

However, the CV approach also suffers from a number of drawbacks. The statement attributed to Anthony Scott is most notable. Scott stated "If you ask a hypothetical question you get a hypothetical answer." The notion of asking what essentially constitute "attitude" questions does not rest well with the economics profession. Other social scientists have not had as much philosophical difficulty with attempts to elicit attitudes as a method to predict behavior. In fact, social scientists in psychology, sociology, human geography and various forms of business have examined these "conversational" (Smith, 1990) approaches and while they admit the task is not easy, they state that there is merit in the approach (Peterson, et al., 1988). The criticism attributed to Scott may not be the most difficult one for CV to overcome.

Other drawbacks to the CV approach have been identified. Most of these deal with the difficulty of structuring the design in such a manner that an unbiased estimate of value is produced. The first design issue which plagues CV is the issue of Strategic Behavior. Since most CV approaches are hypothetical the respondent is not penalized for behaving strategically. The respondent has no incentive to reveal their valuation accurately. While the little research performed on strategic behavior in CV surveys suggests that the bias is "small" there is still a need for considerable research in this area (Mitchell and Carson, 1989; Cummings, et al., 1986).

A number of measurement issues also arise in the design of CV experiments. Interviewer effects, implied value cues (starting point issues, anchors, implied ranges on the values), situation misspecification (context effects) and sampling problems (nonresponse, sample selection, etc.) all plague the CV practitioner (Mitchell and Carson, 1989). Furthermore, valuation questions asked in different sequences may produce different results (sequence issues) and the value of subsets of goods may not produce different values than the entire set (embedding) (Kahneman and Knetsch, 1991). All of these suggest that the value obtained by CV approaches may be significantly affected by the question design and the sampling frame.

The most critical attack on CV has been lead by Jack Knetsch of Simon Fraser University. Knetsch suggests that most applications of CV to elicit non-use values are examples of "The wrong answer to the wrong question." In a series of papers Knetsch and his co-authors make a variety of contributions. First, they suggest that willingness to pay and willingness to accept compensation are not similar values (Knetsch and Sinden, 1984; 1987). Traditional economic theory predicts that these two measures will be similar. Empirical research has consistently revealed a 3 to 10 fold difference between willingness to pay and willingness to accept compensation. There are a variety of potential reasons for this including an endowment effect and the possibility of a kinked utility function for gains versus losses. Most CV practitioners, however, use willingness to pay because willingness to accept compensation is more difficult to elicit (especially for environmental goods) and because the values they collect are "unreasonable." Even in cases of environmental damage, where willingness to accept compensation is the appropriate measure to use, willingness to pay is used and thus provides the answer to the wrong question. The reason that Knetsch suggests this is also the wrong answer is obtained from a number of experiments with CV and non-use values. The answers reveal that CV valuations suffer from embedding, design issues and the endowment effect to the point that they may not reflect a true valuation of a good or service. They may be representations of "good feelings" toward a particular good (Kahneman and Knetsch, 1991; Knetsch, 1990).

The evidence on the accuracy and theoretical consistency of CV is certainly mixed. Several authors state that it is a useful mechanism while others claim it is not a true monetary measure of value. Some studies have compared actual market behavior with CV (Bishop and Heberlein, 1979; Bishop et al., 1988; Kealy et al., 1988) and their findings have been complimentary to the CV approach. However, these tests are typically performed on CV estimates of use value or values of goods the respondents are well acquainted with purchasing. The non-use values which currently permeate many of the policy debates (existence values) provide a much greater challenge to CV. The CV measures of non-use value have not been tested against actual markets, in fact, it may not be possible to test such values. These non-use

values, however, include wilderness values, values of endangered species and a number of other values associated with forest lands. Thus the most important application of CV remains in question.

6.2 INDIRECT METHODS

While contingent valuation methods use survey research techniques to try to uncover the value of environmental goods and services, indirect methods rely on observations of existing behavior, usually behavior in economic markets, to discover the value of amenities. There are two general categories of indirect methods, the valuation of recreational activities (Travel Cost Model) and the valuation of environmental services embodied in property values (Hedonic Price Methods). Indirect methods are based on models of economic behavior that are developed by the analyst and tested using observable data. These methods are valid as long as the behavioral model is a reasonable representation of the actual underlying decision making framework. In the following sections the two categories are examined for strengths and weaknesses.

The market methods of valuation require one fairly strong assumption. This assumption, called weak complementarity, requires that the environmental good (or service or quality change) has associated with it some market purchase (travel cost, property value or some other market process). Also, when none of the market good is consumed, it is assumed that there is no demand for the environmental good. This assumption allows the isolation of the effect of the environmental good through the market for the private good. It also rules out the estimation of non-use values. Nevertheless, it provides a practical method of estimating use values.

6.3.1 The Travel Cost Model

The travel cost model is a general form of model used to determine the value of recreational activities and the value of quality changes associated with recreational activities. This model can be used for any "use value" estimate. The variants of the model range from the basic travel cost model (in which travel costs are used as a proxy for the price of visits to a particular recreation site) to the discrete choice models which analyze recreational site choice as a function of site attributes and travel costs. The former has been commonly used to estimate the value of recreation sites and the latter is being used to value changes in site quality characteristics and the impact of closing existing sites or adding new ones. (Three summaries of the travel cost method are available: V.K. Smith, 1989, Fletcher et al., 1990 and McConnell, 1985.)

Depending on the environmental good in question, a variety of travel cost models are available. Table 2 provides some examples of the travel cost models used in the valuation of recreational activities.

The basic travel cost model assumes that travel cost is a proxy for price. If there is variation in the distance from individuals' residences to a particular site and subsequent variation in the number of trips they take, a demand curve for the quantity of trips demanded as a function of travel costs can be obtained from cross section data. This demand curve (price-quantity relationship) provides the necessary elements to estimate the value of the site as the area under the demand curve and above the actual amount spent on travel (see Boadway and Bruce, 1984, for a discussion of the relationship between compensating and equivalent variation and area under the demand curve).

The basic travel cost model assumes a form of behavior that may not be correct for certain forms of recreation. This model assumes that individuals choose the number of trips they are taking to a site at the beginning of the season. This approach also tends to ignore or limit the influence of substitute sites on the demand for visits to a particular site. A number of statistical and theoretical drawbacks to this basic model become evident upon close examination. A summary of these issues is provided in Fletcher et al. 1990 and Smith, 1989.

One of the major disadvantages of the basic travel cost model is that is cannot be used to value quality changes. The values produced are values for the site. Since cross section data are used to estimate the model, temporal site quality changes are ignored. The majority of interest in recreation valuation is on the valuation of quality changes, ie. the value of improved water quality for fishing and swimming. A number of variants of the basic model have been derived to analyze quality changes.

Three models which incorporate quality effects are currently in use in the literature. The first is the "Varying Parameter Model" (see Smith and Desvousges, 1986). The basic travel cost model can be specified as :

$$V = a + b\,P$$

where V is the number of visits by an individual to a site, P is the travel cost (or price) of a visit and a and b are parameters to be estimated. The Varying Parameter model examines basic travel cost models across a number of sites. For sites i = 1 through n the models

$$V_i = a_i + b_i\,P_i$$

are estimated. In a second stage estimation process the parameters a_i and b_i are regressed against quality attributes from the sites producing a systematic parameter variation. The results provide a method of examining the impact of a quality change on the value of a site. While this model can provide estimates of

the value of quality changes, the underlying behavioral model is unclear. Also, a number of questions about the possibility of substitution between sites and the definition of the relevant sites arise in the formation of the model.

A second approach to evaluating quality effects is the Hedonic Travel Cost Model (Brown and Mendelsohn, 1984). This approach assumes that individuals are willing to pay more in travel cost to visit sites with higher quality attributes. Estimation techniques are used to determine the implicit price of quality attributes (the change in travel cost attributable to a change in a quality attribute) from information on site attributes and individual choices. While this model provides estimates of the impact of changes of quality attributes it suffers from a number of theoretical and empirical drawbacks. These drawbacks include the difficulty of site definition and the potential for negative prices (see Smith and Kaoru, 1987). However, a recent application of hedonic travel cost methods illustrates the flexibility in this technique. Englin and Mendelsohn (1991) use a hedonic travel cost model to value the contribution of site quality components of forests to recreation. They consider the impact of campgrounds, clear cutting, old-growth forest, types of roads and other site attributes on recreation values.

The third, and currently most promising approach to the valuation of quality changes is the Discrete Choice or Random Utility Model. This model has its roots in the transportation literature where it has commonly been used to describe the choice of alternative modes of transport. The appealing aspects of this model include; consistency with the notions of utility as a function of site attributes and socioeconomic characteristics, the ability to substitute from one site to another, the ability to model complex behavioral processes (nested choice processes) and the determination of the compensating or equivalent variation directly from the estimated model. The Random Utility Model most commonly in use assumes that trip choices are made independently over the season. The choice of one site over the others is assumed to have a deterministic and stochastic portion. The deterministic portion is made up of variables observable to the researcher (travel cost, site attributes and individuals characteristics). The stochastic portion is the set of determinants unknown to the researcher.

If one site was chosen and others were not, that choice must have yielded the highest utility for the individual. The available attribute and travel cost information (deterministic portion of the utility function) is used to describe the choice in a discrete choice (or limited dependent variable) statistical model (see Maddala, 1983). The selection of a particular distribution for the stochastic component provides a mechanism to estimate the parameters of the utility function. The result is a fully parameterized utility function which can be used to predict choices and evaluate welfare measures.

A variety of discrete choice models have been used to examine the value of quality changes. Carson, Hanemann and Wegge (1989) have constructed a sophisticated model of the Alaska Fishery which includes decisions about participation in fishing, the target fish species chosen, and the site chosen. Each choice is determined as a function of site quality attributes and individual characteristics. This model facilitates the valuation of fishing site closures (perhaps for water quality or contamination reasons), the valuation of changes in fish stock numbers and the valuation of other water quality attribute changes. Similar models have been constructed for recreation hunting site choice (Coyne and Adamowicz, 1990; Adamowicz, et al., 1990[5]), recreational beach use (Bockstael, Hanemann and Kling, 1987; Feenberg and Mills, 1980) and off-shore recreational fishing (Bockstael, McConnell and Strand, 1989).

The advantages of the travel cost approaches are that they derive values from observations of past behavior rather than intentions or attitudes. This corresponds to the traditional economic approach to demand estimation and valuation. The travel cost methods also provide a behavioral model and a set of testable hypotheses. The accuracy of the behavioral model can be tested.

The drawbacks of the travel cost approach include the following. (1) The behavioral model is specified by the researcher and may not accurately reflect that actual decision making structure. (2) The observations of travel cost and site attributes are usually not enough to fully describe the decision makers choice process. In order to describe choices one must recognize that individuals have spatial perceptions that are different than objective measures of distance (see Fletcher et al., 1990). Considerable research effort has been and still needs to be expended on this topic. The fact that perceptions of attributes affect decisions is not surprising to the psychology/geography profession yet there has been little use of perceived measures of quality in recreation choice models. Limited examination has been carried out by David, 1971 and Bockstael et al., 1987. Time constraints and values also play an important role in spatial choice behavior. The value of time may be more relevant as an explanator of site choice than the cost of travel. The value of time issue has plagued travel cost models since their inception (Cesario and Knetsch, 1970) and has an effect on both the specification of the behavioral model and the welfare estimate.

In summary, the travel cost approach provides a framework for the examination of recreation choice behavior in a variety of contexts (choice of visits to a site, site choice, sequential site choice etc.). The valuation of sites and quality attributes is possible. The validity of these values depends on the

---

[5] The Adamowicz et al, (1990) model is a discrete choice model with sequential choice behavior. This model assumes that the choice of the next trip is a function of the travel cost and the experiences on previous trips. It is a relatively simple model of dynamic behavior in recreation choice.

accuracy of the behavioral model assumed by the researcher. Different behavioral assumptions result in significantly different values[6]. In sharp contrast to the Contingent Valuation method, the travel cost methods make explicit assumptions about human behavior and the perceptions of the individual. Contingent Valuation relies on the individual to factor their own perceptions and decision making frameworks into the valuation process.

6.3.2 Hedonic Price Models

The travel cost model and contingent valuation are oriented to individual valuations based on individual decision making. The hedonic price model determines values for environmental quality changes from the implicit effect that quality has on **market** transactions. Hedonic price models are also indirect approaches to valuation as they employ observable information on prices of goods and levels of market and non-market attributes. This technique attempts to identify the contribution of market and non-market aspects of a particular good to market price. For example, the value of residential housing includes the contribution of market goods (square footage, fireplaces, etc) and the surrounding environmental conditions (air quality, noise levels).

Hedonic price models usually employ statistical procedures to determine the role market and non-market goods play in the determination of price. The marginal value of the house with respect to any attribute is called the implicit price of the attribute. In such a fashion, the implicit prices of air quality and noise levels can be determined and used to evaluate the impact of a general reduction in quality levels (see Bartik, 1988).

The hedonic price technique has been primarily used to evaluate the effect of air quality on urban property values (Harrison and Rubinfeld, 1978; Nelson, 1978; Freeman, 1979). However, there have also been applications to cottages and rural hotels (Wilman, 1984) and noise levels (McMillan, et al., 1980). The approach assumes that individuals have willingness to pay curves for levels of environmental quality attributes. Since individuals are different, each person will have a different curve. Also, a variety of properties are available and these have varying levels of quality associated with them. The interaction between an individual's willingness to pay curve and the supply of properties with various levels of quality

---

[6] Recently, Smith and Kaoru (1990) conducted a "meta analysis" on estimates of welfare from the basic travel cost model. The analysis revealed a surprising degree of consistency between models and supports the use of this approach to modelling some forms of recreation behavior.

produces one point on the hedonic price locus, the locus of points in quality and willingness to pay space (Wilman, 1984). Each property value observation provides one point on this locus. This relationship between willingness to pay and environmental quality allows the estimation of the impact of a change in quality levels on the welfare of the individuals through the property values.

The main criticisms of the hedonic price models revolve around the assumptions required to estimate the hedonic price function. First, it is assumed that the prices reflect equilibrium conditions within the market. Second, both the buyers of properties and the sellers (builders) must have all information about market and non-market goods. Since perceptions are often important in property value selection this assumption seems somewhat weak. Also, it is assumed that movement between properties, in response to changes in market conditions, is relatively costless. Statistical issues of specification and functional form have also been raised in this literature. Finally, the identification of the marginal bid function (for a particular attribute) from the hedonic price function requires that there is variation in an individual's bid function across various levels of the attribute supplied (Wilman, 1984). Identifying the variation in an individual's bid function requires some assumptions on the elasticity of the marginal offer function (the supply of attributes). In the case of multiple attributes some more stringent assumptions on the preferences over attributes are required. One common assumption is that the marginal willingness to pay for each attribute is independent of the other attributes.

The assumptions required for hedonic price analysis may be relatively difficult to meet, however, this technique does provide another component of the impact of environmental change on value, the property value dimension. One should note that this component may or may not be distinct from the impact of a quality change on recreational activity. If the property values contain the capitalized values of recreation (at varying quality levels) adding the hedonic and recreation values together will produce some double counting (McConnell, 1990). Of course, the group of recreationists may be larger than the group of property owners and the values may accrue differently to these two groups.

7. LIMITATIONS OF VALUATION METHODS

Methods for determining non-timber values are subject to a number of limitations. One of the primary limitations is that market based methods cannot be used to place values on all non-timber goods and services. The valuation of a goods or service is based on the assumption that the good or service could be traded in a market or other goods (already traded in markets) can be used to derive the willingness to pay for the non-timber good. In a number of cases it is difficult to conceptualize markets, or market based links, for non-timber goods. Individuals may feel that they have rights in a particular

non-timber good or service and that these rights should be protected. In these cases some form of opportunity cost approach (the economic cost of maintaining the particular non-timber good) may be required for analysis.

A second limitation within the non-timber valuation literature is the treatment of uncertainty and irreversibilities. Uncertainty may enter valuation in cases in which and individual is unaware of the impacts of a non-timber good or service. The threat of irreversible losses must also be incorporated into valuation and decision making. Once a unique natural environment disappears there may be no way to recreate it. Decisions to remove such unique habitats must include an irreversibility factor over and above the non-timber value associated with the area (Pindyck, 1991).

The linkage between physical impacts and economic impacts is often a weakness in valuation models. In order to provide effective measures of economic measures of impact physical and biological models are required to provide input. For example, a certain harvesting practice may affect wildlife habitat and cause a change in birdwatching benefits. Without the linkage between the harvesting practice and the wildlife habitat the economic modeler can only assume what these impacts might be and model the hypothetical impact. Interdisciplinary research between social and physical scientists is required at all stages of the scientific process.

The economic valuation techniques described here are often designed for use in forms of economic analysis which are based on efficiency concepts (e.g. benefit cost analysis). While the primary use of these models has been in economic efficiency analysis there is no reason why they cannot be used to analyze the distributional impacts of non-timber goods and services. There has been some limited analysis of the distribution of non-market values (Adamowicz, et al, 1986) but this is a likely path for future research. Distributional analysis (or equity concerns) often include wider ranging goals such as regional development, human rights and other social goals. Non-timber values provide one measure which may be helpful in such analysis.

The limitations described above may be considered criticisms of most current forms of economic analysis. Within the tools of economic methods, however, there exist further technical limitations. The various techniques applied to non-timber valuation have been the result of a great deal of creativity and a burgeoning demand for such information. While this creativity has only been active in the economics community for about thirty years, a number of useful techniques have been developed. However, a great deal still needs to be done. The contingent valuation technique is currently the only available mechanism for the measurement of non-use values. These values may be among the most significant, and the most

difficult to elicit, of all non-timber values. Furthermore, contingent valuation is under attack on a number of fronts but mostly on the apparent weakness in the non-use value measures. Progress must be made in this area. The most interesting problems in environmental valuation, greenhouse effects, rainforest values, endangered species valuation, etc, are non-use value problems. Some answers may lie in the more sophisticated choice experiments with strong emphasis on structuring and bias reduction.

A host of travel cost models are available to the researcher, a number of which seem to provide relatively accurate behavioral models for a number of situations. However, there needs to be more work done in this area as well. The link between perceived and objective measures of environmental quality must be explored further. Decisions are probably based on perceptions of environmental quality, spatial location (of recreation sites), time requirements and a variety of other factors. Undoubtedly this is an area where economists and other social and physical scientists could collaborate. Without the development of these links, however, not only will behavioral models be inaccurate, policy responses to environmental quality problems will be difficult to determine.

Even with an understanding of perceptions, travel cost models must still be refined to reflect the underlying behavioral model. While the current literature offers a choice among many behavior models, there are very few which consider dynamic elements such as habits, learning by doing or other such processes. This is an area which may produce significant insights into choice behavior and valuation.

Most studies of non-market valuation have been performed on a site specific basis. In particular, studies which examine the impacts of quality changes on non-market values tend to be site specific. Contingent valuation studies often use site specific information to provide a context for the questioning and travel cost studies are commonly based on small geographical site definitions. There is a need to examine non-market values on a larger scale. Site specific studies are useful for detailed analyses of regional issues but national planning exercises require information of a more aggregate nature. National level planning studies also require "macro" information on changing non-market values. The level of non-market value acquired in any given year is useful for understanding the state of non-timber activity. However, in order to evaluate the impact of changing management practices and/or physical effects, the change in these values is also required.

8. NON-MARKET VALUATION IN CANADA

While most applications of non-market valuation have been performed in the United States, several have been performed in Canada. The most notable example is the national survey on the "Importance of Wildlife to Canadians" (Filion, et al, 1990). This survey has been used to examine the

levels of wildlife related recreation activity and associated values of these activities. The survey uses relatively simple contingent valuation questions to determine value and concentrates on total use values (as versus values due to quality changes or non-use values). A second national survey, the National Sportsfishing Survey (sponsored by the Department of Fisheries and Oceans and Provincial Fish and Wildlife Departments) estimates fishing activities and values on a provincial level. This survey also concentrates on use values and total values.

A number of provincial agencies have attempted to estimate values for recreational uses of forest resources. British Columbia, for example, collects use value information for recreational fishing and hunting. Alberta government agencies have funded the collection of values for recreational hunting, fishing and non-consumptive uses of wildlife. Some non-use values have also been collected in Alberta (Adamowicz et al, 1991). A recent survey in Alberta is attempting to capture values for wildlife habitat. While a number of provincial agencies have provided research grants for specific valuation exercises there are no systematic Canada-wide efforts to collect value information other than the national survey on the Importance of Wildlife to Canadians and the National Sportsfishing Survey. Appendix 1 lists the names and addresses of a sample of Canadian researchers actively engaged in non-timber value research.

9. NON-TIMBER ACTIVITIES AND VALUES IN CANADA

Appendix 2 contains a summary of non-timber activities and values by Province for Canada. These data were collected to provide a baseline data set of non-timber activities and values. They were also collected to identify gaps in existing data sets and identify research needs. The data on non-timber activities (fishing, camping, etc.) are provided as indicators of the quantity of non-timber related activities. The values for these activities are often lacking and the degree of transferability of value measures from one jurisdiction to another is uncertain. Other non-timber related statistics include the areas of parks, protected areas and measures of old-growth forests. These statistics are presented since they are likely the source of a variety of non-use values. The data have been collected from national and provincial statistical sources as well as other research reports.

There are a number of "gaps" in the non-timber value database. First and foremost is the lack of non-market value information for most services provided by the forest. Some consumptive values (hunting, fishing) have been collected on a national basis. There are very few measures of nonconsumptive values or non-use values. Typically, the studies measuring nonconsumptive and/or non-use values are small scale, regional efforts. There must be more research in the area of evaluating the tradeoffs between various mixes of services provided by the forest. These studies should try to concentrate on a larger geographical level than previous valuation efforts. Site specific valuation efforts are useful for site specific management (stocking lakes, changing local regulations, etc) but they are limited in their usefulness in

national management of forests.

A second major gap in the non-market valuation area is a measurement of the impact of changes in the physical environment on the non-market values. Only a few studies have been performed in Canada. Information on the impact of environmental changes is essential to evaluate decisions on harvesting approaches, buffer zones, etc.

Collection of the bio-physical information also revealed a number of gaps. Most gaps are due to definitional difficulties. "Old Growth Forest" is difficult to define and a variety of definitions exist. Differing definitions of parks, wilderness areas, recreation areas and historic sites makes the calculation of the areas in each of the designations difficult.

A substantial amount of information is available on hunting and fishing license sales but there are gaps in information on actual participation. Also, differences in definitions between provinces make comparisons of revenues figures and total licence sales difficult. Participation in non-consumptive forms of recreation (hiking, birdwatching, etc) is also difficult to obtain for most regions.

10. RECOMMENDATIONS

(1) Collection of Non-Timber Data: Non-Timber activity and land base data should be collected on an annual basis where possible. These data (activity levels, land areas in parks, etc) should be collected using consistent definitions. Currently there is little consistency in the definitions of such items as old growth forests, park areas and activity data. These data should be collected on an annual basis in order to track changes over time.

(2) Collection of National Non-Timber Values: Research effort should be placed in developing non-timber value estimates that are useful for national level planning. National level non-timber value studies should concentrate on the differences between values in regions and the possible changes in these values as forest operations proceed. These national studies should include nonconsumptive values as well as consumptive values. If possible, some measure of non-use values should be developed. These national level value studies may include large scale surveys or they may include studies of choices and trade offs using representative members of stakeholder groups.

(3) Collection of Regional Non-Timber Values: Regional or site specific non-timber value studies should also be carried out. These studies should concentrate on the changes in values (and/or activity participation levels) in response to changes in the environment. Such studies will enable forest managers to incorporate the non-timber values associated with certain management practices into forest operation decisions.

11. CONCLUSIONS

In the current political and social environment there is considerable support for exercises which attempt to reflect the true worth of environmental services. Non-timber valuation is one such exercise. There is no doubt that values for environmental services will vary across individuals or jurisdictions nor is there any doubt that values will change over time, just as they do for market goods. The task of non-timber valuation is to try to capture the tradeoff between market goods and environmental services in an attempt to reflect the demand for these services. Such information should be useful to policy makers and resource managers alike.

12. ACKNOWLEDGEMENTS

Earl Munro and Leslie Watson of the Department of Rural Economy conducted the search for non-timber activity data and value information. Their many hours of scouring the libraries and telephoning government officials resulted in the appendix tables provided at the end of this text. Many thanks to both of them. A number of individuals have commented on various versions of this paper. Sincere thanks to Peter Boxall and Robert Prins for detailed comments on the drafts. The author has also benefitted from discussions of the non-timber valuation problem with a number of individuals including Peter Boxall, Grant Milne, Bill Phillips, Robert Prins, Jack Smyth and Bill White. Their thoughts helped with the construction of this paper.

13. REFERENCES

Adamowicz, W.L. 1983. Economic Analysis of Hunting of Selected Big Game Species in the Eastern Slopes of Alberta. Unpublished M.Sc. thesis, Department of Rural Economy, University of Alberta, Edmonton, Alberta.

Adamowicz, W.L. Asafu-Adjaye, J., W.E. Phillips, and P.C. Boxall. 1991. Components of the Economic Value of Alberta's Wildlife Resources. *Canadian Field Naturalist.* forthcoming.

Adamowicz, W.L., W.E. Phillips and W. Pattison. 1986. The Distribution of Economic Benefits from Alberta Duck Production. *Wildlife Society Bulletin.* 14:396-398.

Adamowicz, W.L., Jennings, S. and Coyne, A.G. 1990. A sequential choice model of recreation behavior. *Western Journal of Agricultural Economics.* 15:91-99.

Asafu-Adjaye, J. 1989. Issues in the Valuation of Nonmarket Natural Resource commodities: The Case of Wildlife Resources in Alberta. Unpubllished Ph.D. Thesis, Department of Rural Economy, University of Alberta, Edmonton.

Bartik, T.J. 1988. Measuring the benefits of amenity improvements in hedonic price models. *Land Economics.* 64:172-183.

Bishop, R.C., Heberlein, T.A., McCollum, D.W. and Welsh, M.P. 1988. A validation experiment for valuation techniques. Working paper, Center for Resource Policy Studies and Programs. University of Wisconsin, Madison.

Bishop, R.C. and Heberlein, T.A. 1979. Measuring values of extramarket goods: Are indirect methods biased?" *American Journal of Agricultural Economics.* 61:926-930.

Blackorby, C. 1990. Economic policy in a second-best environment. *Canadian Journal of Economics.* 23:748-771.

Boadway, R.W. and Bruce, N. 1984. *Welfare Economics.* Basil Blackwell, Oxford.

Bockstael, N.E., Hanemann, W.M. and C.L. Kling. 1987. Estimating the value of water quality improvements in a recreational demand framework. *Water Resources Research.* 23:951-960.

Bockstael, N.E., K.E. McConnell and I.E. Strand. 1989. A random utility model for sportsfishing: Some preliminary results of Florida. *Marine Resource Economics.* 6:245-260.

Bodden, K. and P. Lee. 1986. The 1985 Economic Survey of Alberta Resident Pheasant Hunters. Technical Report #1. Alberta Forestry, Lands and Wildlife. Edmonton, Alberta.

Bowes, M.D. and J.V. Krutilla. 1985. Multiple Use Management of Public Forestlands." *Handbook in Natural Resource and Energy Economics.* A.V. Kneese and J.L. Sweeney (eds). Elsevier Science Publishers, New York. 531-569.

Bowker, J.M. and J.R. Stoll. 1988. Use of Dichotomous Choice Nonmarket Methods to Value the Whooping Crane Resource. *American Journal of Agricultural Economics.* 70:372-381.

Brown, G. and Mendelsohn, R. 1984. The hedonic travel cost method. *Review of Economics and Statistics.* 66:427-433.

Brown, T.C. 1984. The concept of value in resource allocation. *Land Economics.* 60:231-246.

Boxall, P.C., H.A. Stelfox and G.T. Hvenegaard. 1991. A Socioeconomic Study of the Urban Participants of

the 1988 Christmas Bird Count in Alberta. Socioeconomic Technical Report #5. Alberta Forestry Lands and Wildlife, Edmonton, Alberta.

Boxall, P.C., Duarte-Pedrosa, A. and L.C. Smith. 1989. Human Dimensions in fish and Wildlife Management. Socioeconomic Technical Report #4. Alberta Forestry Lands and Wildlife, Edmonton, Alberta.

Canada's Green Plan. 1990. Minister of Supply and Services, En21-94/1990E. Ottawa.

Carson, R., Hanemann, W.M. and Steinberg, D. 1990. A discrete choice contingent valuation estimate of the value of Kenai King Salmon. *Journal of Behavioral Economics.* 19:53-68.

Carson, R., Hanemann, W.M. and Wegge, T.W. 1989. A nested logit model of recreational fishing in Alaska. Paper presented at the Western Economics Association, Lake Tahoe, CA, June 22.

Cesario, F.J. and Knetsch, J.L. 1970. Time bias in recreation demand estimates. *Water Resources Research.* 6:700-704.

Coyne, A.G. and Adamowicz, W.L. 1990. Economic Effects of Environmental Quality Change on Recreation Demand. Project Report 90-02. Report to the Recreation Parks and Wildlife Foundation. Department of Rural Economy, University of Alberta. Edmonton.

Crocker, T.D., Schulze, W., Ben-David, S. and Kneese, A.V. 1979. *Experiments in the Economics of Air Pollution.* Environmental Protection Agency, Washington.

Cummings, R.G., Brookshire, D.S. and Schulze, W.D. eds. 1986. *Valuing Environmental Goods: A State of the Arts Assessment of the Contingent Method.* Rowman and Allanheld, Totowa, N.J.

David, E.L. 1971. Public perceptions of water quality. *Water Resources Research.* 7:453-457.

Englin, J. Backcountry Hiking and Optimal Timber Rotation. 1990. *Journal of Environmental Management.* 97-105.

Englin, J. and R. Mendelsohn. 1991. A hedonic travel cost analysis for valuation of multiple components of site quality: the recreation value of forest management. *Journal of Environmental Economics and Management.* 21:275-290.

Feenberg, D. and Mills, E. 1980. *Measuring the Benefits of Water Pollution Abatement.* Academic Press, Orlando.

Filion, F.L., Jacquemot, A., Boxall, P., Reid, R., Bouchard, P. DuWors, E., and Gray, P.A. 1990. *The Importance of Wildlife to Canadians.* Environment Canada, Canadian Wildlife Service. CW 66-103/2-1990E, Ottawa.

Fletcher, J.J., Adamowicz, W.L. and Graham-Tomasi, T. 1990. The travel cost model of recreation demand: theoretical and empirical issues. *Leisure Sciences.* 12:119-147.

Freeman, A. M. III. 1979. *The Benefits of Environmental Improvement: Theory and Practice.* The Johns Hopkins University Press for Resources for the Future, Baltimore.

Hanemann, W.M. 1984. Welfare evaluations in contingent valuation experiments with discrete responses. *American Journal of Agricultural Economics.* 66:332-341.

Harrison, D. and Rubinfeld, D. 1978. Hedonic housing prices and the demand for clean air. *Journal of Environmental Economics and Management.* 5:82-102.

Hvenegaard, G.T., J.R. Butler and D.K. Krystofiak. 1989. Economic values of bird watching at Point Pelee national park, Canada. *Wildlife Society Bulletin.* 17:526-531.

Kahneman, D., Knetsch, J.L. and Thaler, R. 1990. Experimental tests of the endowment effect and the Coase theorem. *Journal of Political Economy*. 98:1325-1348.

Kahneman, D. and Knetsch, J.L. 1991. Valuing public goods: The purchase of moral satisfaction. *Journal of Environmental Economics and Management*. Forthcoming.

Kneese, A.V. 1984. *Measuring the Benefits of Clean Air and Water.* Resources for the Future Press, Washington.

Knetsch, J.L., and Sinden, J.A. 1984. Willingness to pay and compensation demanded: Experimental evidence of an unexpected disparity in measures of value. *Quarterly Journal of Economics*. 99:507-521.

Knetsch, J.L., and Sinden, J.A. 1987. The persistence of evaluation disparities. *Quarterly Journal of Economics*. 102:691-695.

Knetsch, J.L. 1989. The endowment effect and evidence of nonreversible indifference curves. *American Economic Review*. 79:1277-1284.

Knetsch, J.L. 1990. Environmental policy implications of disparities between willingness to pay and compensation demanded measures of values. *Journal of Environmental Economics and Management*. 18:227-237.

Louviere, J.J. 1988. *Analyzing Decision Making: Metric Conjoint Analysis.* Sage Publications, Newbury Park, CA.

Maddala, G.S. 1983. *Limited-dependent and Qualitative Variables in Econometrics*. Cambridge University Press, New York.

McConnell, K.E. 1985. The economics of outdoor recreation. Pages 677-722 in Kneese, A.V. and Sweeney, J.L. eds. *Handbook of Natural Resources and Energy Economics*. North Holland, New York.

McConnell, K.E. 1990. Hedonic and travel cost models. *Land Economics*. 66:121-127.

McMillan, M.M., Reid, B.G. and Gillen, D.W. 1980. An extension of the hedonic approach to estimating the value of quiet. *Land Economics*. 56:315-328.

Mitchell, R.C. and Carson, R.T. 1984. National fresh water quality benefits. Paper presented at the meetings of the Association of Environmental and Resource Economists, Cornell University, August.

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

Nelson, J.P. 1978. Residential choice, hedonic prices and the demand for urban air quality. *Journal of Urban Economics*. 5:357-369.

Pearce, D.W. and Turner, R.K. 1990. *Economics of Natural Resources and the Environment.* Johns Hopkins Press, Baltimore.

Peterson, G.L., Driver, B.L. and Gregory, R. eds. 1988. *Amenity Resource Valuation: Integrating Economics with Other Disciplines*. Venture Publishing, State College, PA.

Pindyck, R.S. 1991. Irreversibility, Uncertainty and Investment. *Journal of Economic Literature*. 29:1110:1148.

Redclift, M. 1990. Economic models and environmental values: A discourse on theory. Pages 51-66 in Turner, R.K. editor. *Sustainable Environmental Management*. Westview Press, Boulder, CO.

Repetto, R., W. Magrath, M. Wells, C. Beer and F. Rossini. 1988. *Wasting Assets: Natural Resources in National Income Accounts.* Washington, D.C. , World Resources Institute.

Ribaudo, M.O., Piper, S. Schaible, G.D., Langner, L.L. and Colacicco, D. 1989. CRP: What economic benefits? *Journal of Soil and Water Conservation*. 44:421-424.

Smith, R. 1974. The feasibility of an injury tax approach to occupational safety. *Law and Contemporary Problems*. 38:730-744.

Smith, V.K. 1989. Taking stock of progress with travel cost recreation demand models: Theory and implementation. *Marine Resource Economics*. 6:279-310.

Smith, V.K. 1990. Can we measure the economic value of environmental amenities? *Southern Journal of Economics*. 56:865-878.

Smith, V.K. and Desvousges, W.H. 1986. *Measuring Water Quality Benefits*. Kluwer Nijhoff, Boston.

Smith, V.K. and Desvousges, W.H. 1987. An empirical analysis of the economic value of risk changes. *Journal of Political Economy*. 95:89-114.

Smith, V.K. and Kaoru, Y. 1987. The hedonic travel cost model: A view from the trenches. *Land Economics*. 63:179-192.

Smith, V.K. and Kaoru, Y. 1990. Signals or noise: Explaining the variation in recreation benefit estimates. *American Journal of Agricultural Economics*. 72:419-433.

Sorg, C.F. and Loomis. J.B. 1986. Economic value of the Idaho sport fisheries with an update on valuation techniques. *North American Journal of Fisheries Management*. 6:494-503.

Thayler, R. and Rosen, S. 1975. The value of saving a life: Evidence from the labor market. Pages 265-297 in Terleckyj, N.E., editor. *Household Production and Consumption*. Columbia University Press, New York.

Thompson, J.P., A.R. Sen and R.C. Scace. Bow River Recreational Study. 1987. Reid Crowther and Partners Ltd. Calgary, Alberta.

van Ravenswaay, E.O. and Hoehn, J.P. 1990. The impact of health risk on food demand: A case study of apples and alar. Staff paper 90-31. Department of Agricultural Economics, Michigan State University.

Wilman, E.A. 1984. *External Costs of Coastal Beach Pollution: A Hedonic Approach*. Resources for the Future Press, Baltimore.

Wilman, E.A. and J. Perras. 1987. Recreation Benefits. Department of Economics, University of Calgary. 81 pp. Calgary, Alberta

Table 1: Examples of Contingent Valuation Estimates

Object	Method	Source	Value
Hunting (season)	Open	Filion et al., 1990	$268 / year
Nonconsumptive Recreation	Open	Filion et al., 1990	$122 / year
Birdwatching	Open	Hvenegaard et al, 1989	$76 / day
Hunting Trips	Open	Adamowicz, 1983	$53-73 / day
Hunting Trips	Open	Asafu-Adjaye, 1989	$204 / season
Non-Use Values: Grizzly Bear Habitat	Open	Asafu-Adjaye, 1989	$45 / year
Whooping Crane Habitat	Closed	Bowker & Stoll, 1989	$21 - $149 / year
Deer Hunting Permits (hypothetical)	Closed	Bishop et al., 1988	$32 / permit
Deer Hunting Permits (actual cash offers)	Closed	Bishop et al., 1988	$24 / permit
Fishing Trip	Open	Sorg & Loomis, 1986	$40 / trip
Fishing Trip (double # of fish caught)	Open	Sorg & Loomis, 1986	$51 / trip

Table 2: Examples of Travel Cost Models for Recreation Valuation

Model	Object	Source	Value
Basic Travel Cost Model	Recreation Southern Alberta	Wilman and Perras, 1987	$4 -15 / day
Basic Travel Cost Model	Hunting Permit	Bishop & Heberlein, 1979	$11 - 45 / permit
Hedonic Travel Cost	Forest Recreation	Englin & Mendelsohn, 1991	$180 /trip for provision of a campsite plus quality effects[1]
Generalized Travel Cost	Water Recreation	Smith and Desvousges, 1986	$37 for a quality improvement from boatable to swimable
Sequential Choice Model	Hunting	Adamowicz et al,1990	$35 / visit
Discrete Choice Model	Hunting	Coyne & Adamowicz, 1992	$1 - 6 / trip plus quality effects[1]
Discrete Choice Model	Fishing	Bockstael et al, 1989	$.3 - 1.5 / trip for a 20% increase in catch rate
Discrete Choice Model	Fishing	Carson et al, 1989	$21 / trip loss from closing 1 site plus quality effects[1]

[1] Plus quality effects indicates that a variety of values of quality changes are computed.

APPENDIX 1: INDIVIDUALS INVOLVED IN NON-TIMBER VALUE ESTIMATION IN CANADA

ADAMOWICZ, Dr. W. L.
Office: Dept. of Rural Economy, 515 Gen. Serv. Bldg., Univ. of Alberta, Edmonton, Alberta, Canada T6G 2H1 (403) 492-4603 **Office Fax:** (403) 492-7219 **Bitnet No.:** RECD@MTS.UCS. UALBERTA.CA

BOXALL, Mr. PETER C.
Office: Forestry Canada, Northern Forestry Center, Edmonton, Alberta.
Canada

DUPONT, Dr. DIANE P.
Office: Dept. of Economics, Brock Univ., St. Catharines, Ontario L2S 3A1, Canada.

JOHNSON, Dr. GARY
Office: Department of Agricultural Economics and Farm Management, University of Manitoba, Winnipeg, Manitoba.

KNETSCH, Dr. JACK L.
Office: Sch. of Resource & Environmental Management, Simon Fraser Univ., Burnby, B.C. V5A 1S6, Canada (604) 291-3421 **Office Fax:** (604) 291-4968

LOUVIERE, Dr. JORDAN
Office: Department of Marketing and Economic Analysis, Faculty of Business, University of Alberta, Edmonton.

MCKENNY, Dr. DAN
Office: Forestry Canada, Sault-Ste-Marie Ontario.

MULLER, Dr. R. ANDREW
Office: Dept. of Economics, McMaster Univ., Hamilton, Ontario L8S 4M4, Canada (416) 525-9140, Ext. 3831 **Bitnet No.:** MULLERA@SSCVAX.CIS.MCMASTER.CA

PEARSE, Dr. PETER
Office: Faculty of Forestry, University of British Columbia, Vancouver, B.C.

PHILLIPS, Dr. WILLIAM E.
Office: Dept. of Rural Economy, Univ. of Alberta, Edmonton, Alberta, CANADA T6G 2H1 (403) 492-4228 **Home:** 108 Ironwood Place, Edmonton, Alberta, CANADA T6T 6R4 (403) 437-3345

PRINS, ROBERT
Office: Policy & Economics Directorate, 4th Fl., Fuller Bldg., 75 Albert St., Ottawa ON K1A 1G5, Canada (819) 997-1107 **Office Fax:** (613) 992-9201

STOKOE, Dr. PETER
Office: School for Resource and Environmental Studies, Dalhousie University, 1312 Robie Street, Halifax, Nova Scotia, Canada B3H 3E2 (902) 424-3632

THOMPSON, JOHN
Office: Alberta Environment, 9th Floor, Oxbridge Pl., 9820 106th St., Edmonton, Alberta T5K 2J6, Canada.

VAN EGTEREN, Dr. HENRY
Office: Dept. of Economics, Univ. of Alberta, 8-19 HM Tory Bldg., Edmonton, Alberta T6G 2H4, Canada.

VAN KOOTEN, Dr. G.C.
Office: Department of Agricultural Economics, University of British Columbia, Vancouver, B.C.

VICTOR, Dr. PETER
Office: VHB Research and Consulting Inc., 720 Spadina Avenue, Suite 509, Toronto, Ontario M5S 2T9, Canada

WHITE, Dr. WILLIAM
Office: Forestry Canada, Northern Forestry Center, Edmonton, Alberta.

WILMAN, Dr. ELIZABETH A.
Office: Dept. of Economics, Univ. of Calgary, Calgary, Alberta T2N 1N4, Canada (403) 220-6761, X5857
Office Fax: (403) 282-8606 **Bitnet No.:** WILMAN@UNCAMULT

APPENDIX 2: NON-TIMBER ACTIVITIES AND VALUES IN CANADA: INITIAL ESTIMATES BY PROVINCE

BRITISH COLUMBIA

British Columbia Provincial Parks

	1986	1987	1988	1989	1990
Class "A" Parks (ha.)	3,019,765	4,038,060	4,038,450	4,247,252	4,270,732
Number Class "A"	291	298	297	316	323
Class "B" Parks (ha.)	1,229,782	25,212	25,212	3,778	3,778
Number Class "B"	4	2	2	2	2
Class "C" Parks (ha.)	1,146	1,146	953	716	816
Number Class "C"	35	35	30	28	28
Recreation Areas (ha.)	410,408	1,163,757	1,166,464	974,887	971,337
Number of:	39	51	54	36	35
Wilderness Conservancy (ha.)	131,523	131,573	131,523	131,523	131,523
Number of:	1	1	1	1	1
Total (ha.)	4,792,624	5,361,598	5,362,602	5,378,156	5,378,186

Class "A" Parks are intended to preserve outstanding natural, scenic and historic features for public recreation use. No commercial or industrial exploitation is permissible except as may be necessary to planned recreational use.

Class "B" Parks are intended primarily for public use. Other resource use may be permitted provided it does not detract from the potential of the park.

Class "C" Parks are intended primarily for recreational use by local residents and are managed by park boards appointed from the area residents. No commercial or industrial exploitation is permitted except as may be necessary to planned recreational use.

Recreational Areas are intended primarily for public recreational use. Other resource use may be permitted provided it does not detract from the area's recreational potential.

Wilderness Conservancies are roadless tracts in which both natural and ecological communities are preserved intact. No exploitation or development, except as may be necessary for the preservation of natural processes, is permissible.

British Columbia Provincial Parks
Public use of Provincial Parks

	1985	1986	1987	1988	1989	1990
Camper Visits*	1,962,944	2,028,637	2,226,992	2,202,701	2,336,790	2,356,487
Total Visits	15,397,108	16,998,262	18,927,227	19,593,962	20,550,729	21,377,248
Revenue	3,411,590	3,531,143	4,093,210	4,476,326	5,160,550	5,727,349

* Camper Visits refers to individual, this figure was obtained by taking party nights x 3.2.
Total Visits refers to overnight use (parties x 3.2) + day use (party x 3.5) + boating use (party x 3.2)
Revenue refers to camping, mooring, backcountry and group camping fees up to 1988, after 1988 backcountry fees are not included.

British Colombia
Hunting Statistics

	1985-86	1986-87	1987-88	1988-89	1989-90	1990-91
Licenses						
Resident	426,343	422,299	450,028	471,057	488,969	499,932
Non-resident	14,987	16,026	17,732	18,402	18,912	17,890
Total	441,330	438,325	467,760	489,459	507,881	517,822
Revenue	6,058,188	6,120,795	6,672,992	6,965,660	7,154,399	7,383,706

British Columbia
Sport Fishing Licenses Sold

	1985-86	1986-87	1987-88	1988-89	1989-90	1990-91
Licences Sold	389,917	409,670	429,573	458,120	473,292	482,852
Revenue	3,381,486	3,717,248	4,119,031	4,772,637	4,742,332	4,913,302
National Parks						
Revenue	18,245	15,238	19,740	13,292	14,050	12,206

Average Daily Expenditures 1988-89
1989 Dollars

	Resident Hunters	Non-Resident Hunters
Black bear	$114	$306
Caribou	198	416
Cougar	167	524
Deer	76	264
Elk	89	338
Grizzly bear	183	330
Moose	84	245
Goat	238	455
Sheep	171	519
Small game	32	--
Upland birds	23	--
Waterfowl	42	--

ALBERTA

Alberta Provincial Parks

	1985	1987	1990	1991
Provincial Parks (ha.)	125,196	125,410	126,200	126,200
# of Parks	62	61	61	61
Recreation Areas (ha.)	N/A	N/A	15,200	15,200
# Recreation Areas	N/A	N/A	126	132
Ecological Reserves (ha.)	N/A	N/A	21,400	24,800
# Ecological Reserves	N/A	N/A	11	12
Wilderness Areas (ha.)	560,700	560,700	560,400	560,400
# Wilderness Areas	4	4	4	4
Natural Areas (ha.)	18,200	318,06	35,600	35,600
# Natural Areas	95	101	119	118
Total Area (ha.)	704,096	717,884	758,800	760,200

Alberta Provincial Parks
Public use of Provincial Parks

	1985-86	1986-87	1987-88	1988-89	1989-90	1990
Camper Permits	N/A	437,084	453,243	483,094	462,307	N/A
Camper Nights	*1,207,254	1,492,858	1,503,812	1,501,314	*1,378,189	N/A
Day Users	N/A	4,155,762	5,051,642	6,062,102		
Revenue	2,046,118	2,927,930	3,421,602	4,633,655	3,710,084	N/A

* Does not include group camping nights

Alberta
Hunting Statistics

	1985-86	1986-87	1987-88	1988-89	1989-90	1990-91
Licenses	456,379	463,591	454,690	438,349	445,066	406,794
Wildlife Certificates	146,413	151,708	148,621	144,738	140,115	130,351
Total	602,792	615,299	603,311	583,349	585,181	537,145
Year	1985	1986	1987	1988	1989	1990
Game Licence Fees:	4,507,464	3,937,874	3,889,149	4,641,623	4,163,915	4,875,158

Alberta
Sport Fishing Licenses Sold

	1985	1986	1987	1988	1989	1990
Licenses Sold:						
Canadian licences	340,197	337,429	345,828	337,666	327,559	303,571
Non-Canadian	4,707	5,881	6,694	6,578	6,837	6,744
Total	344,904	343,310	352,522	344,244	334,396	310,315
Revenue:						
Canadian	1,700,985	1,687,145	1,729,140	1,688,330	2,292,913	2,124,99
Non-Canadian	37,220	45,365	51,852	78,936	82,044	80,928
Total	1,738,205	1,732,510	1,780,992	1,767,266	2,374,957	2,205,925
National Parks:						
Revenue	258,613	274,098	260,390	224,914	206,263	182,519

Nonmarket Values Measured in Alberta

Activity	Value	Year of Study	Source
Water Based Recreation on the Bow River	$7.61 / user / day	1987	Thompson et al, 1987
Existence Value (Protect Against Decline in Quality of Bow River)	$25.10 / person / year	1987	Thompson et al, 1987
Value of Big Game Hunting	$204.06 / hunter /year	1988	Asafu-Adjaye, 1989.
Preservation of Grizzly Bear Habitat (defined in study)	$80.92 / person / year	1988	Asafu-Adjaye, 1989.
Recreational Fishing	$20.93 / user / day	1985	Alta. For., Lands and Wildlife, 1987
Outdoor Recreation (in Southern Alberta)	$4 - $15 / user / day	1987	Wilman and Perras, 1987
Hunting (in the eastern slopes of the Rocky Mountains)	$53.00 - $73.00 / resident hunter / day $37.00 - $246.00 / nonresident hunter / day	1983	Adamowicz, 1983
Pheasant Hunting	$17.44 - $25.37 / hunter / day	1985	Bodden and Lee, 1986
Birdwatching (Christmas Bird Count)	$37.00	1988	Boxall et al, 1991
Bighorn Sheep Hunting	Site Closures: $3,000 - $25,000 per season. 10% Sheep Pop. Increase: $7,244 10% decline in hunter congestion: $8,494	1990	Coyne and Adamowicz, 1990

SASKATCHEWAN

Saskatchewan Provincial Parks

	1985	1988	1990	1991
Provincial Parks (ha.)	500,700	908,000	908,000	908,000
# of Parks	155	31	31	31

Saskatchewan Provincial Parks
Public use of Provincial Parks

	1985	1986	1987	1988	1989	1990
Camping Permit days	205,207	216,552	178,737	174,608	168,965	168,019
Camper Nights	749,234	789,361	663,578	647,761	618,436	628,730
Visitors:						
Provincial Parks	2,828,585	2,798,623	3,011,741	3,099,183	3,313,170	2,467,496
Recreation Sites	981,597	1,221,456	817,413	814,239	855,656	673,239
Total Visitors*	4,477,214	4,698,121	4,697,732	4,823,439	5,233,488	3,741,371
Revenue	*6,639,870	6,649,852	6,607,254	6,310,680	5,971,002	5,733,573

* For fiscal year 1985-86

Saskatchewan
Hunting Statistics

	1985-86	1986-87	1987-88	1988-89	1989-90
Licences sold:					
Total Game Bird	43,921	47,206	41,114	36,756	34,363
Total Big Game	87,354	87,671	80,802	86,858	89,152
Total	131,275	134,877	121,916	123,614	123,515
Licence Fees	3,217,190	3,383,413	N/A	N/A	3,836,523
Recreation Days:	1985	1986	1987	1988	1989
Game Bird	146,759	196,220	178,224	145,338	N/A
Big Game	127,432	313,009	292,923	308,305	308,005
Total	274,191	509,229	471,147	453,643	N/A

Saskatchewan
Sport Fishing Licenses Sold

	1984-85	1985-86	1986-87	1987-88	1988-89	1989-90
Provincial:						
Licences sold	178,901	180,877	186,645	170,082	168,622	169,823
Provincial Revenue	1,961,268	1,985,158	2,120,642	2,838,628	2,815,641	2,775,280
National Parks:						
Revenue	40,907	80,681	74,476	77,550	59,673	60,302

*87/88 & 88/89 Data from Arctic and Central Regional Statistics

MANITOBA

Manitoba Provincial Parks

	1985	1988	1990
Provincial Parks (ha.)	1,025,232	1,431,600	1,316,400
# of Parks	157	164	139

Manitoba Provincial Parks
Public use of Provincial Parks

	1985-86	1986-87	1987-88	1988-89	1989-90
Permits Issued	98,229	105,589	104,624	106,656	91,434
Unit Days	355,778	377,044	386,452	388,690	361,225
Total Traffic Count	1,377,408	1,524,093	1,689,909	1,778,927	1,500,278
Revenue*	4,644,585	4,880,745	5,440,033	5,658,760	5,27,763

* Total Revenue collected by the Parks Branch

Manitoba
Hunting Statistics

	1985-86	1986-87	1987-88	1988-89	1989-90	1990-91
Licenses Sold:						
Resident	81,571	85,120	89,977	88,684	86,135	87,272
Non-resident	1,228	1,334	1,325	1,162	1,131	1,189
Non-res. Alien	4,816	5,883	6,343	5,689	5,138	5,916
Total	87,615	92,337	97,645	95,535	92,404	94,377
Revenue:						
Resident	1,162,435	1,198,577	1,276,398	1,262,988	1,467,539	1,495,027
Non-resident	65,942	70,894	72,139	64,546	70,317	74,808
Non-res. Alien	426,112	522,330	567,500	517,584	546,835	633,926
Total	1,654,488	1,791,801	1,916,036	1,845,117	2,084,691	2,203,760
Wildlife Certificates:						
# Sold	62,607	64,615	66,782	63,995	31,724	61,717
Revenue	409,699	422,833	503,693	482,613	465,264	465,219

Manitoba
Sport Fishing Licenses Sold

	1984-85	1985-86	1986-87	1987-88	1988-89	1989-90	1990-91
Licenses Sold:							
Canadian sold	154,489	154,602	158,412	158,118	153,156	148,048	146,351
Non-Canadian sold	33,711	32,564	34,345	35,695	32,441	32,822	725,839
Total Number Sold	188,200	187,166	192,757	193,813	185,597	180,870	176,004
Revenue:							
Canadian	696,542	851,476	872,568	870,850	1,147,682	1,067,000	1,031,279
Non-Canadian	646,676	822,045	842,310	863,340	756,810	29,653	602,454
Total	1,326,732	1,657,589	1,698,056	1,716,662	1,888,553	1,792,839	1,633,733
National Parks:							
Revenue	21,708	40,124	37,840	46,476	43,610	37,985	35,240

ONTARIO

Ontario Provincial Parks

	1986	1987	1988	1989	1990
Parks Area (ha.)	5,659,105	5,659,105	5,648,460	6,328,407	6,328,288
# of Parks	219	219	216	261	261
Recommended Parks (ha.)	696,072	696,072	* --------	--------	-------
# of Recom. Parks	51	51			
Total Area	6,355,177	6,355,177	* --------	--------	-------

* Recommended Parks phased out

Ontario Provincial Parks
Public use of Provincial Parks

	1985	1986	1987	1988	1989	1990
Campers	1,429,440	1,289,588	1,497,678	1,451,641	1,432,744	1,426,301
Camper Nights	3,718,634	3,658,493	3,903,590	3,806,253	3,769,360	3,780,098
Total Vistors	7,524,003	7,488,170	8,019,822	7,774,409	7,793,966	7,722,064
Revenue*	8,385,588	8,178,661	8,992,248	10,756,514	11,108,144	13,300,000

* Includes Permits, Camping Permits, Concession Rentals, and Misc.

Ontario
Hunting Statistics

	1985-86	1986-87	1987-88	1988-89	1989-90	1990-91
Total Licenses:						
Resident	526,640	555,723	572,155	584,541	597,591	
Non-resident	33,542	37,367	37,812	33,816	32,041	
Total	560,182	593,090	609,867	618,357	629,632	
Expenditure:						
Resident	70,080,000	69,551,000	89,210,000	94,848,000	105,876,000	
Non-resident	11,962,000	2,461,000	16,174,000	14,288,000	13,930,000	
Total	82,042,000	62,012,000	105,384,000	109,136,000	119,806,000	
Year	1985	1986	1987	1988	1989	1990
Hunter Days	1,467,600	1,580,000	1,682,100	1,683,100	1,745,500	
Licence Fees	7,074,137	7,074,137	7,441,700	8,128,385	9,108,005	9,260,285

Ontario
Sport Fishing Licenses Sold

	1985	1986	1987	1988	1989	1990
Licenses sold:						
Resident	Not	Required	146,488	998,635	1,019,201	N/A
Non-Res. Canadian	32,206	33,309	36,899	46,671	45,395	N/A
Non-Res. Alien	552,988	542,748	567,723	610,037	643,671	N/A
Total	N/A	N/A	751,110	1,655,343	1,708,267	
Revenue:						
Resident	0	0	1,458,465	9,766,475	9,961,270	N/A
Non-Resident	201,288	208,181	368,990	466,710	453,950	N/A
Non-res. Alien	9,628,526	9,809,054	11,315,772	11,986,781	13,551,392	N/A
Total	9,829,814	10,017,235	13,143,227	22,219,966	23,966,612	
National Parks						
Revenue	* 3,879	3,971	5,217	4,912	4,506	4,146

* Fiscal year 1985-86

QUEBEC

Quebec Provincial Parks
Area in Hectares

	1985	1988	1990
Provincial Parks (ha.)	9,224,100	9,224,100	7,000,000
Number of Parks	91	91	55

Quebec Provincial Parks
Public use of Provincial Parks

	1985-86	1986-87	1987-88	1988-89	1989-90	1990-91
Camper Nights	307,269	253,746	353,535	447,858	435,746	349,126
Total Visitors	2,863,125	2,711,160	2,888,053	3,282,556	3,110,872	3,288,602

Quebec
Hunting Statistics

	1985-86	1986-87	1987-88	1988-89	1989-90
Licenses Sold:					
Resident	564,774	580,720	575,406	572,330	595,714
Non-resident	12,370	13,963	16,550	17,205	18,902
Total	577,144	594,683	591,956	589,535	614,616
Revenue:					
Resident	7,325,374	7,659,433	9,183,272	9,836,373	9,836,373
Non-Resident	917,305	1,065,840	1,485,226	1,486,007	1,689,254
Total	8,242,679	8,725,273	10,668,498	11,322,380	11,525,627

Quebec
Sport Fishing Licenses Sold

	1984-85	1985-86	1986-87	1987-88	1988-89	1989-90
Provincial Licences:						
Resident	686,400	698,599	714,133	740,531	777,519	779,310
Non-Resident	62,100	60,205	61,518	61,683	65,017	63,696
Total	748,500	758,804	775,651	802,214	842,536	843,006
Provincial Revenue:						
Resident	3,796,450	4,040,500	4,497,130	5,020,414	6,045,516	6,258,744
Non-Resident	1,290,000	1,542,190	1,656,368	1,740,533	1,904,180	1,939,812
Total	5,086,450	5,582,690	6,153,498	6,760,947	7,949,696	8,198,556
National Parks:						
Revenue	47,410	47,020	46,910	35,684	31,337	32,110

Participants in Activities, 1990

	Fishing	Hunting	Observation
Number of Participants	1,091,527	437,700	3,736,381
Number of Days	15,390,531	6,521,730	194,702,814

* Participation of residents only.

PRINCE EDWARD ISLAND

Prince Edward Island Provincial Parks

	1985	1988	1990
Provincial Parks (ha.)	3,896	1,500	1,500
# Provincial Parks	44	31	31

Prince Edward Island
Protected Areas in Hectares

	1989	1990	1991
Natural Areas Protection Act Sites	40	12	70
Wildlife Management Sites	60	58	

Prince Edward Island Provincial Parks
Public use of Provincial Parks

	1985	1986	1987	1988	1989	1990
Camping Permits	23,992	26,877	29,302	27,358	29,818	29,250
Camper Nights	63,099	70,687	77,069	71,952	78,421	76,928
Total Vistors	610,076	498,067	455,800	N/A	N/A	513,372
Revenue*	704,500	752,100	937,900	948,200	1,109,200	1,104,000

* Includes total park revenue including golf, ski passes, etc.

Prince Edward Island
Hunting Statistics

	1985	1986	1987	1988	1989	1990
Licenses:						
Resident	4,838	4,719	4,342	4,085	3,792	3,640
Non-resident	575	696	908	1,082	1,258	1,417
Total	5,413	5,415	5,250	5,167	5,050	5,057
Revenue:	43,764	46,079	63,200	67,224	71,081	75,435

Prince Edward Island
Sport Fishing Licenses Sold

	1985	1986	1987	1988	1989	1990
Provincial:						
Licences sold	13,847	14,087	13,045	12,973	13,527	13,462
Revenue	70,377	73,054	90,025	90,422	94,555	94,048
National Parks:						
Revenue	10	350	340	220	180	280

NEW BRUNSWICK

New Brunswick Provincial Parks

	1985	1986	1987	1988	1990
Provincial Parks (ha)	22,370	21,985	21,981	22,070	24,900
Number of Parks	59	47	47	49	48

New Brunswick Provincial Parks
Public use of Provincial Parks

	1985-86	1986-87	1987-88	1988-89	1989-90
Camping Permits	280,645	268,100	293,896	269,180	
Camper Nights*	533,225	482,580	382,064	349,934	
Total Visitors	2,522,324	2,009,165	2,065,734	2,182,020	
Revenue	1,389,500	1,489,200	1,542,100	1,617,600	1,822,700*

* estimated

New Brunswick
Hunting Statistics

	1985	1986	1987	1988	1989	1990
Licenses sold*						
Resident**	154,531	147,069	145,888	133,360	131,122	116,641
Non-resident	7,411	9,790	10,546	10,365	9,021	6,909
Total	161,942	156,859	156,434	143,725	140,143	123,550
Revenue	2,292,688	2,368,309	2,373,003	2,591,099	2,752,167	2,546,829

* Includes Deer, Bird, Bear, Moose, and Varmint
** All licenses unspecified were considered resident

New Brunswick
Sport Fishing Licenses Sold

	1985	1986	1987	1988	1989	1990
Provincial:						
*Licences sold	180,173	179,333	180,108	175,090	102,537	101,049
Revenue	484,278	529,990	560,831	610,090	1,325,419	1,322,823
National Parks:						
Revenue	15,947	16,098	16,015	13,309	12,063	11,295

* Includes free licences

NOVA SCOTIA

Nova Scotia Provincial Parks
Area in Hectares

	1987	1988	1990
Provincial Parks (ha.)			9,017
Number of Parks	110	118	121

Nova Scotia Provincial Parks
Public use of Provincial Parks

	1985	1986	1987	1988	1989	1990
Camping Permits	43,036	39,331	45,719	43,275	49,638	47,637
Camper Nights	N/A	N/A	N/A	N/A	142,957	N/A
Revenue*	227,597	241,016	281,924	258,909	315,950	328,470

* Total park revenue.

Nova Scotia
Hunting Statistics

	1985	1986	1987	1988	1989	1990
Licenses:						
Resident	143,535	139,914	122,781	119,972	120,848	102,673
Non-resident	1,891	2,638	2,053	2,256	2,153	1,761
Total	145,426	142,552	124,834	122,228	123,001	104,434
Revenue:	1,972,285	1,973,780	1,922,847	1,904,248	2,134,864	1,849,168

Nova Scotia
Sport Fishing Licenses Sold

	1985	1986	1987	1988	1989	1990
Provincial:						
Licences sold	83,947	73,599	74,358	73,969*	76,997	76,588
Revenue	520,330	683,142	683,580	700,055*	723,000	808,369
National Parks:						
Revenue	14,549**	20,778	22,232	21,142	22,423	22,894

* Number of youth Salomon licences not available
** National park revenue figures are for the 1984/85 fiscal year.

NEWFOUNDLAND

Newfoundland Provincial Parks
Area in Hectares

	1985	1986	1987	1988	1989	1990
Provincial Parks	24,631	24,631	24,631	24,631	24,631	24,631
(# of Parks)	(74)	(74)	(74)	(74)	(74)	(74)
Park Reserves	7,505	7,505	7,505	7,538	7,538	7,552
(# of Reserves)	(3)	(3)	(3)	(4)	(4)	(5)
Wilderness and Ecological Reserves						
Designated	2,012	109,262	109,262	109,262	109,262	402,206
(# designated)	(5)	(7)	(7)	(7)	(7)	(10)
Provisional	2,960	351,660	351,660	351,660	351,660	4,390
(# Provisional)	(2)	(5)	(5)	(5)	(5)	(5)

NOTE: Wilderness and Ecological Reserves preserve and protect in an undisturbed state, representative and unique natural features, sites, objects, or landscapes of provincial significance for scientific and educational purposes for the benefit of present and future generations. These areas are managed exclusively for the preservation and interpretation of the particular values for which they are set aside. Designated reserves are those reserves which have been given permeant full reserve status. Provisional reserves are areas of land which have been identified as requiring protection under the Wilderness and Ecological Reserves Act and are thus given such protection on a temporary basis until the required processes have been gone through to determine whether the area should be given permanent protection.

Newfoundland Provincial Parks
Public use of Provincial Parks

	1985	1986	1987	1988	1989	1990
Camping Permits	75,766	71,663	93,690	100,361	107,018	109,892
Camper Nights	303,064	286,652	347,760	401,444	428,072	343,289*
Total Visitors	1,460,040	1,446,066	1,617,342	1,766,983	1,596,202	1,754,103
Revenue*	497,164	523,169	609,407	608,361	642,500	642,621

* Can not be directly compared with previous years. As of 1990, the actual number of camper nights is calculated based on the actual number of persons registered rather than through the use of a formula.

Newfoundland
Hunting Statistics

	1985	1986	1987	1988	1989*	1990
Licenses						
Resident	89,199	83,222	80,304	90,929	66,619	N/A
Non-resident	1,805	1,907	1,843	2,175	4,823	N/A
Total	91,004	85,129	82,147	93,104	71,442	N/A
Revenue						
Resident	1,115,681	1,070,259	1,054,493	1,198,331	958,570	N/A
Non-resident	477,511	478,334	479,552	576,684	845,350	N/A
Total	1,593,192	1,548,588	1,534,045	1,775,015	1,803,920	N/A

* 1989 does not included Waterfowl Licenses

Newfoundland
Sport Fishing Licenses Sold

	1985	1986	1987	1988	1989	1990
Licences						
Resident	16,980	19,706	18,299	21,258	19,428	N/A
Non-Resident	3,961	4,213	5,123	5,864	4,445	N/A
Total Sold	20,941	23,919	23,422	27,122	23,873	N/A
Total Revenue	337,850	324,550	335,150	271,220	335,110	N/A
National Parks						
Licences						
Revenue*	3,361	3,980	3,320	3,955	4,770	4,930

* Federal Revenue is for the fiscal year 1985/56 and so on.

YUKON TERRITORIES

Yukon Territorial Parks
Area in Hectares

	1990
McAthur Game Sanctuary	169,600
Kluane Game Sanctuary	645,700
Total	815,300

Yukon Parks
Public use of Territorial Parks

	1987	1988	1989	1990	1991
Total Visitors*	160	215	186	300	101

* Territorial Parks do not have campgrounds.

Territorial Campgrounds

	1985-86	1986-87	1987-88	1988-89	1989-90	1990-91
Permits	10,554	10,055	N/A	16,469	N/A	20,273
Revenue	70,858	67,543	89,113	105,803	129,870	115,220

* Includes sales of both annual and daily campground permits.

Yukon
Hunting Statistics

	1985-86	1986-87	1987-88	1988-89	1989-90	1990-91
Licenses Sold	5,082	5,019	5,565	5,533	5,617	5,411
Revenue	98,607	104,967	118,980	120,408	126,999	120,430

Yukon
Sport Fishing Licenses Sold

	1985-86	1986-87	1987-88	1988-89	1989-90	1990-91
Provincial:						
Resident	7,277	7,066	7,929	8,658	8,736	8,275
Canadian	4,008	4,046	4,880	4,970	2,927	4,011
Alien	4,646	4,701	4,685	4,638	3,082	4,699
Total	15,931	15,813	17,494	18,266	14,745	16,985
Revenue:	104,500	107,715	114,780	118,985	255,355	255,740
National Parks:						
Revenue	4,465	4,858	5,462	5,170	6,907	5,677

NORTHWEST TERRITORIES

Northwest Territories
Hunting Statistics

	1986-87	1987-88	1988-89	1989-90	1990-91
Total Hunters	1,868	2,091	1,975	2,294	2,365

* Non-native hunters only, having lived in NWT for a minimum of 2 years.

Sport Fishing Licenses Sold

	1985-86	1986-87	1987-88	1988-89	1989-90	1990-91
Territorial:						
Resident	13,281	11,909	13,502	13,353	13,807	
Non-Resident	3,626	3,284	3,802	3,363	3,564	
Total Sold	3,626	15,193	17,304	16,716	17,371	
Revenue:						
Resident	66,405	59,545	67,510	66,765	69,035	
Non- Resident	54,390	49,260	57,030	50,445	53,460	
Total Revenue	120,795	108,805	124,540	117,210	122,495	
National Parks:						
Revenue	0	0	0	0	0	0

CANADIAN NATIONAL PARKS

National Parks - Yearly Revenue by Province

	1984/85	1985/86	1986/87	1987/88	1988/89	1989/90	1990/91
British Columbia	1,611,844	2,289,353	2,402,623	2,489,105	2,632,114	2,599,548	2,732,240
Alberta	13,838,052	17,853,324	19,505,038	20,396,884	23,766,890	21,297,555	19,763,155
Saskatchewan	721,603	858,019	955,937	959,103	1,111,554	1,072,984	1,108,123
Manitoba	821,853	1,073,258	1,142,518	1,247,218	1,272,249	1,217,792	1,227,420
Ontario	360,021	503,062	564,077	613,228	834,569	857,009	870,174
Quebec	396,701	693,208	763,790	862,143	938,954	1,016,408	1,201,678
Newfoundland	288,364	440,075	491,214	566,646	612,521	680,913	495,903
Prince Edward Island	379,349	640,261	810,967	902,949	845,921	1,014,424	1,057,712
Nova Scotia	560,960	848,872	876,330	928,741	908,050	981,205	1,052,974
New Brunswick	430,227	649,836	659,271	813,605	780,968	820,863	846,208
Northwest Territories	0	0	0	0	0	3,224	0
Yukon	75,167	82,784	73,049	78,915	87,443	96,457	97,006
Total	19,484,141	25,932,052	28,244,814	29,858,537	33,791,233	31,658,382	30,452,593

National Parks
Campground Use - Number of Party Nights*

	1986/87	1987/88	1988/89	1989/90	1990/91
British Columbia	68,473	70,166	70,629	71,718	71,407
Alberta	325,104	336,075	365,997	352,711	359,524
Saskatchewan	23,857	24,739	28,714	29,183	28,404
Manitoba	24,122	25,344	23,789	26,290	23,901
Ontario	11,303	11,581	12,512	14,231	11,906
Quebec	39,514	42,924	48,281	51,391	51,441
Newfoundland	26,634	33,314	34,289	28,295	17,465
Prince Edward Island	33,538	34,738	31925	N/A	30,852
Nova Scotia	43,727	50,604	48,380	52,478	51,132
New Brunswick	39,650	46,533	46,497	48,103	46,103
Northwest Territories	0	0	0	0	0
Yukon	2,896	3,223	3,010	1,401	898
Total (rounded)	638,818	679,870	714,033	675,801	693,239

* Does not include group camping attendance.

National Parks
Visitor Information

	1985/86	1986/87	1987/88	*1988/89	1989/90	1990/91
British Columbia	5,950,000	6,560,000	6,660,000	2,670,000	2,760,000	2,790,000
Alberta	6,020,000	6,470,000	6,200,000	5,786,000	5,996,600	5,927,300
Saskatchewan	310,000	220,000	200,000	170,000	190,000	191,400
Manitoba	810,000	860,000	950,000	390,000	390,000	350,000
Ontario	850,000	810,000	870,000	730,000	630,000	750,000
Quebec	920,000	940,000	1,030,000	480,000	520,000	480,000
Newfoundland	630,000	620,000	750,000	269,000	279,000	310,000
Prince Edward Island	1,620,000	1,620,000	1,530,000	810,000	810,000	650,000
Nova Scotia	1,060,000	1,020,000	1,130,000	740,000	740,000	700,000
New Brunswick	1,230,000	1,220,000	1,420,000	360,000	370,000	390,000
Northwest Territories	1,460	1,070	1,300	1,710	1,660	2,300
Yukon	65,000	69,000	82,000	80,084	69,099	75,160
Total (rounded)	19,470,000	20,260,000	20,810,000	12,490,000	12,750,00	12,620,000

* A different method of calculation was introduced in 1988-89. After 1988-89 through-fare traffic was not included as parks visitors.

Threatened Species In Canada 1988

Mammals	Birds	Reptiles, Amphibians, Fish	Plants	Plants Continued
Beluga Whale Eastmain	Burrowing Owl	Black Redhorse	American Chestnut	Kentucky Coffee Tree
Maritime Woodland Caribou	Ferruginous Hawk	Blackfin Cisco	American Water-willow	Mosquito Fern
Newfoundland Pine Marten	Henslow's Sparrow	Copper Redhorse	Athabasca Thrift	Nodding Pagonia
North Pacific Humpback Whale	Peregrine Falcon subspecies *tundrius*	Great lakes Deepwater Sculpin	Blue Ash	Pitcher's Thistle
Peary Caribou	Roseate Tern	Shorthead Sculpin	Bluehearts	Red Mulberry
Prairie Long-tailed Weasel	Loggerhead Shrike	Enos Lake Stickleback	Giant Helleborine	Plymouth Gentian
Wood Bison		Lake Simcoe Whitefish	Colicroot	Sweet Pepperbush
		Shortjaw Cisco	Ginseng	Tyrrell's Willow
		Shortnose Cisco	Golden Crest	

Endagered Species In Canada 1988

Mammals	Birds	Reptiles, Amphibians, Fish	Plants	Plants Continued
Bowhead Whale	Eskimo Curlew	Acadain Whitefish	Cucumber Tree	Pink Coreopsis
Eastern Cougar	Greater Prairie Chicken	Aurora Trout	Eastern Mountain Avens	Pink Milkwort
Right Whale	Mountain Plover	Leatherback Turtle	Eastern Prickly Cactus	Skinner's Agalinis
Beluga Whale St. Lawerence River, Ungava Bay	Peregrine Falcon subspecies *anatum*	Salish Sucker	Furbish's Lousewort	Slender Bush Clover
Sea Otter	Spotted Owl		Gattinger's Agalinis	Small White Lady's Slipper
Vancouver Island Marmot	Kirtland's Warbler		Heart-leaved Plantain	Southern Maidenhair Fern
	Whooping Crane		Hoary Mountain Mint	Small Whorled Pogonia
			Large Whorled Pagonia	Spotted Wintergreen
				Water-pennywort

Threatened Species In Canada 1990

Mammals	Birds	Reptiles, Amphibians, Fish	Plants	Plants Continued
Beluga Whale Eastmain	Burrowing Owl	Black Redhorse	American Chestnut	Kentucky Coffee Tree
Maritime Woodland Caribou	Ferruginous Hawk	Blackfin Cisco	American Water-willow	Mosquito Fern
Newfoundland Pine Marten	Henslow's Sparrow	Copper Redhorse	Anticcosti Aster	Nodding Pagonia
North Pacific Humpback Whale	Peregrine Falcon subspecies *tundrius*	Great lakes Deepwater Sculpin	Blue Ash	Pitcher's Thistle
Peary Caribou	Roseate Tern	Shorthead Sculpin	Bluehearts	Red Mulberry
Prairie Long-tailed Weasel	Loggerhead Shrike	Enos Lake Stickleback	Giant Helleborine	Plymouth Gentian
Wood Bison	Baird's Sparrow	Lake Simcoe Whitefish	Colicroot	Sweet Pepperbush
Habour Porpoise		Shortjaw Cisco	Ginseng	Tyrrell's Willow
		Shortnose Cisco	Golden Crest	Thift
		Margined Madtom	Bird's Foot Violet	Western Blue Flag
				Purple Twayblade

Endagered Species In Canada 1990

Mammals	Birds	Reptiles, Amphibians, Fish	Plants	Plants Continued
Bowhead Whale West. Artic	Eskimo Curlew	Acadain Whitefish	Cucumber Tree	Pink Coreopsis
Eastern Cougar	Greater Prairie Chicken	Aurora Trout	Eastern Mountain Avens	Pink Milkwort
Right Whale	Mountain Plover	Leatherback Turtle	Eastern Prickly Cactus	Skinner's Agalinis
Beluga Whale St. Lawerence River, Ungava Bay	Peregrine Falcon subspecies *anatum*	Blanchard's Cricket Frog	Furbish's Lousewort	Slender Bush Clover
Sea Otter	Spotted Owl	Salish Sucker	Gattinger's Agalinis	Small White Lady's Slipper
Vancouver Island Marmot	Kirtland's Warbler		Heart-leaved Plantain	Southern Maidenhair Fern
Wolverine Eastern pop.	Whooping Crane		Hoary Mountain Mint	Small Whorled Pogonia
	Piping Plover		Large Whorled Pagonia	Spotted Wintergreen
	Harlequin Duck Eastern pop.			Water-pennywort

Overmature and Productive Land in Canada
(1,000,000 ha.)

	B.C.	Alta	Sask.	Man.	Ont.	Que.	N.B.	Nfld.	P.E.I.	N.S.	Yukon	N.W.T.	Can.
Productive land	51.10	25.44	15.89	14.92	38.29	54.79	6.09	11.18	0.28	3.85	7.56	14.32	243.70
Overmature land	0.08	2.88	1.08	0.29	7.61	0.00	0.19	0.99	0.00	0.02	0.00	0.02	13.14
Overmature as a Percentage of Productive (%)	0.16	11.32	6.80	1.94	19.87	0.00	3.12	8.86	0.00	0.52	0.00	0.14	5.39

Source: *Selected Forestry Statistics Canada 1988.* Forestry Canada, Ottawa, June 1989

Old Growth Forest

Using data from satellite images, historical records, and biogeoclimatic maps, it was concluded that in 1990, Vancouver Island contained 829,000 ha of ancient temperate rainforest (p.4). On the north coast of B.C., 66 out of a total of 180 primary watersheds larger than 5,000 ha. are still undeveloped. Five major parks on Vancouver Island contain 75,000 ha of ancient forest.

Source: *Ancient Rainforests at Risk*: An Interim Report by the Vancouver Island Mapping Project. (1991) Sierra Club of Western Canada & The Wilderness Society.

Using data from B.C. Ministry of Forests, Inventory Branch for Crown Land only within Timber Supply Areas. This excludes TFL, crown granted land, private land, Federal and PP, as well as other land alienations. Age classes 8 (141-250 yrs) and 9 (251+ years). Age class 9 stands are referred to as over-mature. No annual totals over the years we want.

Age Class 8	141-250 years	10,495,629 ha
Age Class 9	251+ years	4,451,428 ha.

A draft report, *Old Growth in the Boreal Mixedwood Forest Section* (1991) by Matt Fairbarns, estimates that 20% of the productive forest land base in the north east boreal mixed wood forest is considered to be old growth. This area of land studied was 1.34 million hectares. Matt Fairbarns based his definition of old growth primarily on height (according to John Rentool, Alberta Forest Services).

The Economic Significance of Wildlife Related Activities in Canada 1987

	B.C.	Alberta	Saskatchewan	Manitoba	Ontario
Expenditures					
Recreational Hunting	137,400,000	124,700,000	42,300,000	64,700,000	314,000,000
Non-Consumptive	901,300,000	537,100,000	181,500,000	130,600,000	1,304,800,000
All Wildlife Activities	1,038,600,000	661,300,000	223,800,000	195,300,000	1,618,800,000
Per Person Expenditures					
Daily Hunting	17.3	19.1	17.0	16.6	19.9
Yearly Hunting	296.5	291.7	221.3	249.3	366.5
Daily Non-consumptive	7.9	7.9	7.5	6.6	8.2
Yearly Non-consumptive	148.4	163.0	120.7	118.3	132.9

	Quebec	New Brunswick	Nova Scotia	Prince Edward Island	Newfoundland	Canada
Expenditures						
Recreational Hunting	225,200,000	56,600,000	49,700,000	4,200,000	41,900,000	1,060,300,000
Non-Consumptive	743,600,000	80,100,000	105,700,000	15,300,000	39,000,000	4,038,900,000
All Wildlife Activities	968,800,000	136,800,000	155,400,000	19,500,000	80,900,000	5,099,200,000
Per Person Expenditures						
Daily Hunting	11.3	12.8	12.1	15.4	13.0	15.8
Yearly Hunting	167.7	223.6	259.4	319.8	282.4	268.3
Daily Non-consumptive	5.3	6.0	7.2	6.4	6.3	7.2
Yearly Non-consumptive	84.3	114.2	107.7	113.0	104.8	121.7

The Economic Significance of Sport Fishing In Canada 1985

	B.C.	Alberta	Saskatchewan	Manitoba	Ontario
Direct Expenditures					
Resident	277,003,325	127,023,100	49,751,531	54,093,833	696,437,620
Non-Resident	104,625,611	5,467,100	20,953,782	31,332,735	284,803,439
Total	381,628,936	132,490,200	70,705,313	85,426,568	981,241,059
Total per angler	N/A	433.33	393.99	488.11	448.98
Total per angler-day	N/A	24.66	36.33	31.83	N/A
Major Purchases					
*Total Sport Fishing	324,099,396	162,158,400	80,739,923	73,869,898	782,402,747
Total per angler	N/A	530.06	499.90	422.10	358.0

	Quebec	New Brunswick	Nova Scotia	Prince Edward Island	Newfoundland
Direct Expenditures					
Resident	535,387,803	19,916,937	14,264,064	1,608,729	32,795,902
Non-Resident	51,901,048	4,870,596	934,900	422,787	3,442,987
Total	587,288,851	24,787,533	15,198,964	2,031,516	36,238,889
Total per angler	N/A	211.19	223.13	170.73	356.53
Total per angler-day	N/A	N/A	N/A	N/A	15.27
Major Purchases					
*Total Sport Fishing	12,542,621	26,471,214	19,241,802	1,693,842	39,708,064
Total per angler	69.0	225.53	N/A	142.35	390.66

	N.W.T.	Yukon	Canadadian Totals
Direct Expenditures			
Resident	3,826,343	2,567,210	3,448,354,756
Non-Resident	11,748,194	3,085,726	125,611,058
Total	15,574,537	5,652,936	3,573,965,814
Total per angler	1,014.69	466.59	724.42
Total per angler-day	N/A	N/A	N/A
Major Purchases			
*Total Sport Fishing	4,589,305	3,309,773	1,956,039,380
Total per angler	299.00	261.48	396.48

* Total Attributable to Sport Fishing

Summary Statistics for Government Owned Conservation Areas

Type	Juris-diction	Quebec		New Bunswick		Nova Scotia		Prince Edward Island		Newfoundland	
		Area (ha)	(#)	Area (ha)	(#)	Area (ha)	(#)	Area (ha)	(#)	Area (ha)	(#)
Parks											
NAP	F	93,500	(3)	44,420	(2)	135,420	(2)	2,591	(1)	234,240	(2)
PVP	P	245,881	(14)	17,427	(1)	5,714	(15)	446	(1)	1,368	(19)
PVR	P	156,721	(7)	4,754	(4)	7,313	(113)	1,555	(31)	23,144	(57)
Ecological Reseves											
ECR	P	10,786	(23)	142	(3)	237	(4)	101	(1)	8,677	(11)
WDA	P									478,100	(3)
Wild Life Areas											
NTA	P/M					486	(1)	212	(9)		
MBS	F	110,466	(33)	260	(2)	4,213	(8)	130	(1)	870	(1)
NWA	F	5,404	(8)	3,997	(4)	2,324	(5)				
WMA	F/P/T	15,613,460	(67)	315,949	(10)	93,032	(15)	27,368	(6)		
WPA	P/T/M			4,960	(6)	74,479	(9)			1,210	(1)
Historical Parks											
HEA	P										
HIA	F/P/T	145	(9)	305	(3)	5,304	(8)	93	(2)	8,173	(4)
Other											
NCC	F	35,387	(17)								
CAA	M										

Explanatory Notes:

Type of Conservation Area
NAP = National Park
PVP = Provincial Park (non-recreation)
PVR = Provincial Park (recreation)
ECR = Ecological Reserve
WDA = Wilderness Area
NTA = Nature Trust Area
MBS = Migratory Bird Sanctuary
NWA = National Wildlife Area
WMA = Wildlife Management Area
WPA = Wildlife Protection Area
HEA = Hetitage Area/Park
HIA = Historic Area/Park
NCC = National Capital Commission Area
CAA = Conservation Authority Area

Jurisdiction: The current Managing authority: F=federal, P=Provincial, T=Territorial, M=multiple

Summary Statistics for Government Owned Conservation Areas

Type	Juris-diction	B. C.		Alberta		Saskatchewan		Manitoba		Ontario	
		Area (ha)	(#)	Area (ha)	(#)	Area (ha)	(#)	Area (ha)	(#)	Area (ha)	(#)
Parks											
NAP	F	629,870	(6)	4,958,300	(5)	478,110	(2)	297,590	(1)	219,090	(5)
PVP	P	4,441,061	(333)	142,441	(123)	896,366	(11)	1,463,720	(15)	5,148,236	(149)
PVR	P	949,092	(154)	465,969	(101)	59,899	(285)	22,751	(3)	964,316	(71)
Ecological Reseves											
ECR	P	518,246	(129)	21,085	(11)	750	(1)	58,899	(12)	322,167	(242)
WDA	P			100,989	(3)					61,404	(32)
Wild Life Areas											
NTA	P/M										
MBS	F	3,091	(7)	14,130	(4)	61,572	(15)			39,091	(13)
WA	F	2,302	(5)	376	(3)	5,494	(7)	63	(2)	5,199	(10)
WMA	F/P/T					15,602	(1)	3,054,765	(71)	891,873	(14)
WPA	P/T/M			68,039	(8)	19,911	(7)			23,029	(20)
Historical Parks											
HEA	P	2	(2)	613	(1)	140	(15)				
HIA	F/P/T	87	(2)	229	(1)	945	(13)	64	(3)	64	(6)
Other											
NCC										16,778	(45)
CAA										54,769	(319)

Explanatory Notes:

Type of Conservation Area
NAP = National Park
PVP = Provincial Park (non-recreation)
PVR = Provincial Park (recreation)
ECR = Ecological Reserve
WDA = Wilderness Area

NTA = Nature Trust Area
MBS = Migratory Bird Sanctuary
NWA = National Wildlife Area
WMA = Wildlife Management Area
WPA = Wildlife Protection Area

HEA = Hetitage Area/Park
HIA = Historic Area/Park
NCC = National Capital Commission Area
CAA = Conservation Authority Area

Jurisdiction: The current Managing authority: F=federal, P=Provincial, T=Territorial, M=multiple

Summary Statistics for Government Owned Conservation Areas

Type	Juris-diction	N.W.T		Yukon		Canada - Total	
		Area (ha)	(#)	Area (ha)	(#)	Area (ha)	(#)
Parks							
NAP	F	7,745,380	(3)	3,218,340	(2)	18,056,900	(34)
PVP	P					12,373,860	(682)
PVR	P	5,542	(34)	384,000	(1)	3,045,056	(906)
Ecological Reseves							
ECR	P					939,090	(437)
WDA	P					640,493	(38)
Wild Life Areas							
NTA	P/M					698	(10)
MBS	F	11,078,900	(14)			11,312,723	(98)
NWA	F	81,000	(1)			106,159	(45)
WMA	F/P/T	442,700	(1)	300,000	(1)	20,754,828	(185)
WPA	P/T/M	2,646,400	(3)	391,800	(2)	3,429,828	(56)
Historical Parks							
HEA	P					775	(18)
HIA	F/P/T	70	(4)			15,479	(55)
Other							
NCC						52,165	(62)
CAA						54,769	(319)

Explanatory Notes:

Type of Conservation Area
NAP = National Park
PVP = Provincial Park (non-recreation)
PVR = Provincial Park (recreation)
ECR = Ecological Reserve
WDA = Wilderness Area
NTA = Nature Trust Area
MBS = Migratory Bird Sanctuary
NWA = National Wildlife Area
WMA = Wildlife Management Area
WPA = Wildlife Protection Area
HEA = Hetitage Area/Park
HIA = Historic Area/Park
NCC = National Capital Commission Area
CAA = Conservation Authority Area

Jurisdiction: The current Managing authority: F=federal, P=Provincial, T=Territorial, M=multiple

REFERENCES FOR DATA BY PROVINCE

BRITISH COLUMBIA

Canada Parks Service, Financial Planning, Dick Sloan. 12/19/91. Personal Communication.
Ministry of Environment, Lands & Parks. 1985-90. *B.C. Provincial Parks List.*
_____, Donna Selbee. 01/06/92. Personal Communication.
Ministry of Environment, Wildlife Branch . 01/06/92. Personal Communication.
_____, Arlene James. 01/02/92. Personal Communication.
Ministry of Forests, Inventory Branch. 1984. *Forest and Range Resource Analysis.*

ALBERTA

Alberta Government. 1985-90. *Recreation and Parks Annual Report.* Edmonton.
Alberta Government. 1985-90. *Park Users Statistics.* Edmonton.
Canada Parks Service, Financial Planning, Dick Sloan. 12/19/91. Personal Communication.
Central and Arctic Region, Dept. of Fisheries and Oceans, Laura Anderson. 01/13/92. Personal Communication.
Treasury Bureau of Statistics. 1985, 1987, 1990, 1991. *Alberta Facts.* Edmonton.

SASKATCHEWAN

Canada Parks Service, Financial Planning, Dick Sloan. 12/19/91. Personal Communication.

Saskatchewan Parks and Renewable Resources, Wildlife Branch, Fred Beek. 01/06/92. Personal Communication.
Saskatchewan Government. 1985-90. *Saskatchewan Annual Report: Sask. Parks and Renewable Resources.*
Statistics Canada. 1985, 1988, 1990. *Canada Year Book.* Ottawa, Ontario: Minister of Supply and Services Canada.

MANITOBA

Canada Parks Service, Financial Planning, Dick Sloan. 12/19/91. Personal Communication.
Manitoba Natural Resources, Licensing Section. 01/07/92. Personal Communication.
Manitoba Natural Resources. 1985-90. *Annual Statistic.*
Statistics Canada. 1985, 1988, 1990. *Canada Year Book.* Ottawa, Ontario: Minister of Supply and Services Canada.

ONTARIO

Canada Parks Service, Financial Planning, Dick Sloan. 12/19/91. Personal Communication.
Ontario Government, Ministry of Natural Resources. 1985-1991. *Ontario Provincial Parks: Statistics.*

QUEBEC

Canada Parks Service, Financial Planning, Dick Sloan. 12/19/91. Personal Communication.

Government of Quebec, MLCP, Service de la recherche et de l'analyse de marche, Pierre Bouchard. 01/31/92. Personal Communication.

Government of Quebec, MLCP, Gabriel Alain. 01/09/92. Personal Communication.

Roy, Marie-Helene. 1991. *Statistiques et Evolution des Ventes et des Tarifs des Permis de Chasse, de Peche et de Piegeage (1980-1990)*. Government of Quebec, MLCP.

Statistics Canada. 1985, 1988, 1990. *Canada Year Book*. Ottawa, Ontario: Minister of Supply and Services Canada.

NEWFOUNDLAND

Canada Parks Service, Financial Planning, Dick Sloan. 12/19/91. Personal Communication.

Government of Newfoundland and Labrador, Dept. of Environment and Lands, Parks Division, Rockey Higdon. 12/20/91. Personal Communication.

Government of Newfoundland and Labrador, Dept. of Environment and Lands, Wildlife Division. 01/08/92. Personal Communication.

Wildlife Division, Dept. of Environment & Lands. -- hunting and fishing stats & $.

NOVA SCOTIA

Canada Parks Service, Financial Planning, Dick Sloan. 12/19/91. Personal Communication.

Department of Lands and Forests, Financial Officer, Judy Clattenburg. 12/18/91. Personal Communication.

Department of Lands and Forests, Ron Day. 01/03/92. Personal Communication.

Statistics Canada. 1985, 1988, 1990. *Canada Year Book*. Ottawa, Ontario: Minister of Supply and Services Canada.

NEW BRUNSWICK

Canada Parks Service, Financial Planning, Dick Sloan. 12/19/91. Personal Communication.

Natural Resources and Energy, Fish and Wildlife Branch, Edith Cogswell. 12/20/91. Personal Communication.

New Brunswick Government. 1985-90. *New Brunswick Provincial Parks: Statistical Report*.

New Brunswick Government. 1985-1990. *Main Estimates*.

Statistics Canada. 1985, 1990. *Canada Year Book*. Ottawa, Ontario: Minister of Supply and Services Canada.

PRINCE EDWARD ISLAND

Canada Parks Service, Financial Planning, Dick Sloan. 12/19/91. Personal Communication.

Department of Tourism and Parks, Parks, Dave Mills. 12/20/91. Personal Communication.

Department of the Environment, Island Conservation Strategy, Bruce Smith. 01/07/92. Personal Communication.

Department of Community and Cultural Affairs, Fish and Wildlife Division. 12/19/91. Personal Communication.

Statistics Canada. 1985, 1988, 1990. *Canada Year Book*. Ottawa, Ontario: Minister of Supply and Services Canada.

YUKON TERRITORIES

Canada Parks Service, Financial Planning, Dick Sloan. 12/19/91. Personal Communication.
Department of Renewable Resources. 12/18/91. Personal Communication.
Department of Renewable Resources, Jan Trim. 01/09/92. Personal Communication.

NORTHWEST TERRITORIES

Canada Parks Service, Financial Planning, Dick Sloan. 12/19/91. Personal Communication.
Central and Arctic Region, Dept. of Fisheries and Oceans, Laura Anderson. 01/13/92. Personal Communication.
Economic Development and Tourism, Department of Renewable Resources, Wildlife Management Division, Bruno Croft. 01/03/92. Personal Communication.
Economic Development and Tourism, Tourism and Parks, Keith Thompson. 01/03/92. Personal Communication.

OTHER TABLES

Canadian Wildlife Service. 1989, 1990. *Endangered Species in Canada*. Environment Canada.
Environment Canada, Canadian Parks Service, Financial Planning, Dick Sloan. 12/19/91. Personal Communication.
Environment Canada, Canadian Parks Service, Socio-Economic Branch, Jim Ewers. 12/19/91. Personal Communication.
Environment Canada, State of the Environment Reporting, Tony Turner. 1990. *National Conservation Areas Data Base*.
Filion, F.L., Jacquemot, A., Boxall, P., Reid, R., Bouchard, P., DuWors, E., and Gray, P.A. 1990. *The Importance of Wildlife to Canadians*. Environment Canada, Canadian Wildlife Service. CW 66-103/2-1990E, Ottawa.
Fisheries and Oceans. 1988. *Survey of Sport Fishing in Canada 1985*. Canada.
Forestry Canada. 1989. *Selected Forestry Statistics: Canada 1988*. Information Report E-X-41.