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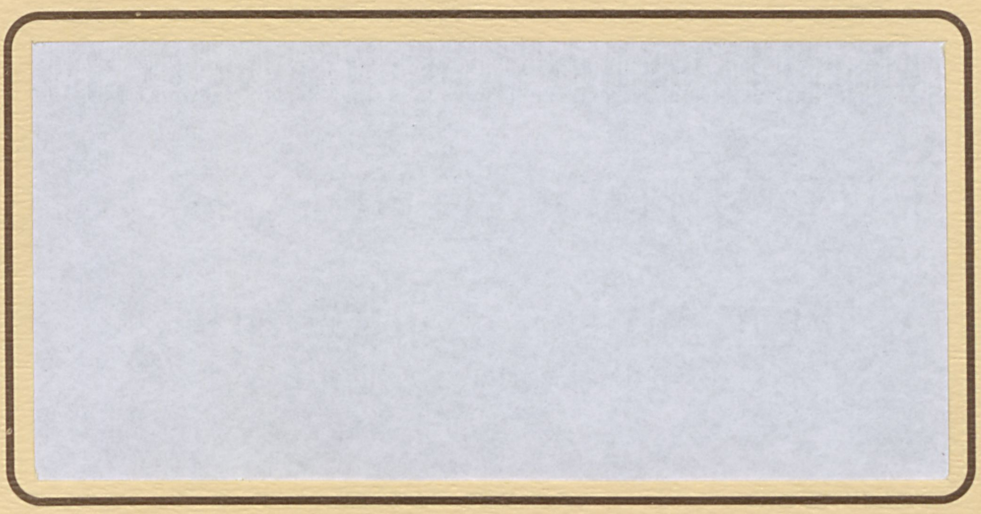
RURAL ECONOMY



PROJECT REPORT

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Edmonton, Canada

Non-Timber Values and Forest Resources

An Annotated Bibliography

Robert Prins, Wiktor Adamowicz and William Phillips

Project Report 90-03

Department of Rural Economy

University of Alberta

for

Forestry Canada

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1 INTRODUCTION

Timber products are traded in traditional economic markets. Therefore, their value is relatively easily determined. However, other products and services of forest land are not traded in well functioning markets, thus their values are not easily determined. Products and services such as wildlife, hunting opportunities, fishing experiences and outdoor recreation activities are provided by the forest and their values, *nonmarket values*, must be recognized in order to manage resources effectively.

Nonmarket, or extramarket, benefits are becoming more important as public land managers realize that wildlands provide a large number of public goods and services in addition to producing traditional commodity resources. In fact, the value of these public goods and services may be larger than the value of commodity resources produced. Estimating values for these public goods and services is necessary information for the efficient management of public lands.

This paper is an annotated bibliography dealing with the estimation of nonmarket benefits (i.e. values of public goods and services). Section 2 summarizes the methodologies available for estimating these values, concentrating on those studies which use the travel cost (TC), contingent valuation (CV), and discrete choice (DC) approaches. Sections 3 and 4 summarize the literature which examine the extramarket benefits of sport angling and sport hunting in Alberta. Section 5 summarizes the available literature which deals with option, existence, and preservation values.

In this paper we have not dealt explicitly with other values of forests which have market prices. Such products as fruits and other forest crops, non-traditional uses of forest land and the value of forests to other market related activities (such as agriculture and water resources) are not considered here for two reasons. First, the primary focus of such an analysis would be the physical relationship between forest land and the production of these goods and services. We chose to concentrate on the economic aspects of the issues. Second, if the physical

information on these alternative products is available, the economic analysis becomes traditional benefit cost analysis. No new methodological challenges arise. Therefore, we have chosen to concentrate on those areas where methodological challenges exits.

2 METHODOLOGY

This section reviews some state of the art studies of the methods available for the estimation of nonmarket benefits. Most studies include empirical examples although they are often very site specific.

There are a number of alternative methods for evaluating nonmarket benefits. The two major categories are; 1) the direct or contingent value method (CVM); or 2) the indirect or travel cost method (TCM). Good reviews of the travel cost method can be found in Smith 1989 and Fletcher, Graham-Tomasi and Adamowicz, 1990. Good reviews of the contingent valuation literature can be found in Mitchell and Carson, 1989 and Cummings *et Al.* 1986.(See Below).

Adamowicz, W.L., S. Jennings, and A. Coyne. 1989. 'A sequential choice alternative to the travel cost model.' Dept. of Rural Economy Staff Paper 89-06. U of Alberta, Edmonton.

This paper provides an alternative method for estimating recreation demand. Rather than assuming that the decision on the number trips to a particular site in a given time period (e.g. season) is determined at the beginning of the time period, a sequential approach is assumed. That is, the decision on whether or not to take each additional trip is made after all the previous trips have been consumed. This model has the advantage over traditional TC models in that it specifies non-negative integer values for the number of trips and allows for intraseasonal effects to determine the probability of taking each additional trip.

AERE, 1987. 'Proceedings of the Fourth Annual AERE Workshop: Marine and Sport Fishing Economic Valuation and Management.' U of Washington Press. Seattle, Washington.

This workshop produced a series of 10 papers on four topics including: 1) recreational versus commercial fishing conflicts; 2) measuring the demand for and value of recreational fishing; 3) issues in managing marine fishery resources; and 4) modeling recreational choice decisions.

Asafu-Adjaye, J. 1989. 'Issues in the Valuation of Nonmarket Natural Resource Commodities: The Case of Wildlife Resources in Alberta.' Unpublished Ph.d. dissertation. U of Alberta, Edmonton. 125 pages.

This research experiments with methods of incorporating elements of uncertainty and nonuse values into nonmarket value measures, and to provide empirical information on the economic values associated with wildlife resources in Alberta.

Bishop, R.C., T.A. Heberlein, and M.J. Kealy. 1983. 'Contingent valuation of environmental assets: comparisons with a simulated market.' Natural Resources Journal 23:619-633.

This paper presents a case study on the value of Wisconsin goose hunting permits. Several CV mechanisms and the TC model were used to estimate the value of goose hunting to Wisconsin hunters. It concludes that the CV mechanism understates the WTP and overstates the WTA estimates of environmental benefits.

Bockstael, N. and C.L. Kling. 1988. 'Valuing environmental quality: weak complementarity with sets of goods.' American Journal of Agricultural Economics 70:654-662.

This paper defines a set of goods, rather than a single good, that are weak complements with water quality and discusses the procedure for calculating welfare measures of water quality.

Boyle, K.J. and R.C. Bishop. 1988. 'Welfare measurements using CV: a comparison of techniques.' American Journal of Agricultural Economics 70:20-28.

This paper compares three commonly used techniques for CV questions: iterative bidding; payment cards; and dichotomous choice. It is found that each technique has its own strengths and weaknesses. An empirical analysis is done on the scenic beauty along the Wisconsin river.

Cameron, T.A. 1988. 'A new paradigm for valuing non-market goods using referendum data: maximum likelihood estimation by censored logistic regression.' Journal of Environmental Economics and Management 15:355-379.

This paper proposes an alternative method (to Hanemann (1984) and Sellar et al. (1986)) to estimate the value of nonmarket resources using logit models. The paper examines how the parameters for utility-theoretic inverse Hicksian demand functions can be extracted much more simply and directly.

Caulkins, P.P., R.C. Bishop, and N.W. Bouwes Sr. 1986. 'The travel cost model for lake recreation: a comparison of two methods for incorporating site quality and substitution effects.' American Journal of Agricultural Economics 68:291-297.

This paper illustrates how the assumption regarding recreationist decision making behavior in response to water quality changes in a discrete choice (multinomial logit) model differs from that for the traditional TC models. The discrete choice model. which recognizes site substitution, predicts a smaller outward shift in the demand than the traditional TC model.

Coyne, A. and W. Adamowicz. 1990. 'Economic Effects of Environmental Quality Change on Recreation Demand.' Project Report 90-02. Dept. of Rural Economy, U of Alberta, Edmonton. 59 pages.

This paper develops a methodology which can be used to examine the economic effects of changes in environmental quality on recreation demand, and apply the methodology on an

Alberta case study. The particular application examined is the case of Bighorn sheep hunting on the Eastern slopes of the Alberta Rockies. A multinomial logit model is developed that recognizes discrete choices among hunting sites based on TC, environmental characteristics, and socioeconomic characteristics. This determination of benefits from discrete choice models was originally developed by Small and Rosen (1981) and refined by Hanemann (1984).

Cummings, R.G., D.S. Brookshire, and W.D. Schulze (eds) 1986. Valuing Environmental Goods: An Assessment of the CV Method. Rowman and Allanheld. Totowa, NJ. 270 pages.

This book provides a comprehensive account of the CV methodology, assessing the state of the art for CV.

Fletcher, J.J., T. Graham-Tomasi and W.L. Adamowicz. 1990. 'The Travel Cost Model of Recreation Demand: Theoretical and Empirical Issues.' Leisure Sciences. Forthcoming.

This survey article reviews the theory and implementation of the travel cost model of recreation activity by examining the underlying theoretical base. The paper examines current practices and state of the art methods. Some areas for future research are presented including the value of time, perceptions of environmental quality and identification of the decision process.

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

This paper addresses the issues of how logit models should be formulated so that they are consistent with utility maximization and how compensating and equivalent surplus measures should be derived from the fitted models. These are estimated using Bishop and Herberlein's data (1980).

McConnell, K.E. 1990. 'Models for referendum data: the structure of discrete choice models for contingent valuation.' Journal of Environmental Economics and Management 18:19-34.

This paper compares the deterministic logistic models suggested by Hanemann (1984) and Cameron (1988) and shows them to be dual to each other. The correct specification either function must exclude endogenous variables. This paper also demonstrates that using utility-theoretic models allows one to compare TC and CV models on the basis of implied behavior.

Mitchell, R.C. and R.T. Carson. 1989. Using Surveys to Value Public Goods: The CV Approach. Resources for the Future. Washington, D.C. 463 pages.

This book describes how the CV method works and the nature of the benefits it can be used to measure, compares the CV method to other methods for measuring benefits, and examines the surveys used to collect the data. This book also provides a set of guidelines for CV practitioners, a comprehensive bibliography of the CV literature, and an appendix summarizing more than 100 CV studies.

Peterson, G.L., B.L. Driver, and R. Gregory (eds) 1988. Amenity Resource Valuation: Integrating Economics with Other Disciplines. Venture Publishing Inc. State College, Pennsylvania. 260 pages.

This book focuses on integrating the perspective and methods of economics with other behavioral sciences in the valuation of nonpriced amenity goods and services.

Peterson, G.L. and A. Randall. 1984. Valuation of Wildland Resource Benefits. Westview Press. Boulder, Colorado. 258 pages.

This collection of essays provides a comprehensive review of the most advanced techniques in the valuation of wildlife benefits. The contributors discuss concepts, methods, and problems in wildland benefit valuation, offering critical perspectives on the role of B/C analysis.

Randall, A., J.P. Hoehn, and D.S. Brookshire. 1983. 'Contingent valuation surveys for evaluating environmental assets.' Natural Resources Journal 23:635-648.

This paper examines the strengths and weaknesses of contingent value surveys and the nature of contingent markets.

Sellar, C., J.P. Chavas, and J.R. Stoll. 1986. 'Specification of the logit model: the case of valuation of non-market goods.' Journal of Environmental Economics and Management 13:382-390.

This paper examines the proper specification (functional form) of the logit model in the case of estimating nonmarket commodity demands. An empirical study on recreational boating in Texas is used to illustrate the properly specified logit model.

Sinden, J.A. and A.C. Worrell. 1979. Unpriced Values: Decisions Without Market Prices. John Wiley and Sons. Toronto. 511 pages.

This book is concerned with the general problem of using unpriced values in policy decisions. It attempts to clarify the nature of value by discussing the nature of unpriced values.

Small, K. and H. Rosen. 1981. 'Applied welfare economics with discrete choice models.' Econometrica 49:105-130.

This paper shows how conventional methods of applied welfare economics can be modified to handle discrete choice decisions, focusing on the evaluation of environmental change. The results are applied to stochastic utility models, including probit and logit analysis.

Smith, V.K. 1989. 'Travel Cost Recreation Demand Methods: Theory and Implementation. Resources for the Future, Quality of the Environment Division Working Paper #QE89-03. Washington, D.C. 70 pp.

This paper presents a review of travel cost methods and an analysis of the problems and further research that should be carried out in this field.

Smith, V.K., W.H. Desvousges, and A. Fisher. 1986. 'A comparison of direct and indirect methods for estimating environmental benefits.' American Journal of Agricultural Economics 68:280-290.

This paper reports the results of a detailed comparison of the estimated benefits associated with water quality improvements using both the indirect (TC) and direct (CV) methods. The estimates obtained by both methods are comparable although analyst judgement plays a very important role in the development of both methods.

Stynes, D.J. and G.L. Peterson. 1984. 'A review of logit models with implications for modeling recreation choices.' Journal of Leisure Research 16(4):295-310.

This paper summarizes the properties of binomial and multinomial logit models and reviews the application of these models to predicting recreation activity and site choice (substitution).

Walsh, R.G. 1986. Recreation Economic Decisions: Comparing Benefits and Costs. Venture Publishing Inc. State College, Pennsylvania. 638 pages.

This text is an undergraduate level book on the economic of recreation. It includes discussions of the calculation of economic benefits from recreation, measurement of trends in recreation and the analysis of regional impacts of recreation activities. This book provides a good source of information on U.S. parks and wilderness areas in its examples of recreation activities.

3 SPORT ANGLING

A Alberta Extramarket Benefit (EMB) Sport Angling Surveys

A number of sport angling surveys have been performed in Alberta in order to estimate the value of sportsfishing. This recreational activity is one form of non-timber value associated with the forest resource. The primary focus of these surveys is to capture the economic value of the activity. Little emphasis has been placed on the value of the activity as the quality of the facility or site changes. These changing quality factors may be most important in the future as the impact of forest development on non-timber values is required.

Miller, R.J. 1971. 'Alberta's Hunting and Fishing Resource: an Economic Evaluation.' Economics Division, Resource Economics Branch, Alberta Department of Agriculture. 90 pages.

This study uses 1968 data, based on 129 watershed sub-basins, to estimate the daily and yearly extramarket benefits captured by resident Alberta sport anglers. A CV methodology is used. Miller also notes that the Alberta fish resources have values to a large segment of the population who do not fish (i.e. option values and existence values), although he does not attempt to measure them.

Table 1: EMB's for sport angling by resident anglers in Alberta, 1968-69.

Year	EMB/activity day ($/person/day)	EMB/year ($ million)
1968	7.93	15.4
1969	7.20	16.1

NOTE: EMB's represent more than 80% of total social net benefits in this study.

Phillips, W.E., D. DePape, and C. Ewanyk. 1977a. 'Socioeconomic Evaluation of the Recreational use of Fish and Wildlife Resources with Particular Reference to the AOSA. Volume 2: Recreational Fishing.' Department of Rural Economy, U of Alberta. 176 pages.

This study uses 1976 data, based on 129 watershed sub-basins and the Alberta Oil Sands Area (AOSA), to estimate the daily and yearly extramarket benefits captured by resident Alberta sport anglers. These benefits are estimated for the entire province, as well as for the AOSA alone. A CV methodology is used. Phillips notes that it is essential to know where the anglers fish, what they fish for, and how they utilize and value each individual site visited. A separate study done by Phillips estimates the EMB's captured by non-resident sport anglers in Alberta.

Table 2: EMB's for sport angling by resident anglers in Alberta, 1976.

Region	EMB/activity day ($/person/day)	EMB/year ($ million)
Province of Alberta	13.99	23.0
Alberta Oilsands Area	23.07	1.3

NOTE: EMB's represent more than 90% of total social net benefits in this study.

Alberta Forestry Lands and Wildlife, Fish and Wildlife Division. 1987. 'Sport Fishing in Alberta, 1985.' Information and Publication Branch, Department of Fisheries and Oceans, Ottawa. 12 pages.

This study uses 1985 data, based on 9 fishing areas in Alberta, to estimate the daily and yearly extramarket benefits captured by resident Alberta sport anglers. These benefits are estimated for the entire province. A CV methodology is used.

Table 3: EMB's for sport angling for resident sport anglers in Alberta, 1985.

Region	EMB/activity day ($/person/day)	EMB/year ($ million)
Province of Alberta	20.93	113.0

Reid Crowther and Partners Ltd. 1987. 'Bow River Recreation Study: An Assessment of Recreational Use and Economic Benefits. Volume 2: River Surveys.' Alberta Forestry Lands and Wildlife, Resource Evaluation and Planning Branch, Edmonton. 226 pages.

This study uses 1985 data, collected from a 111 km section of the Bow River within Calgary, to estimate the daily and yearly extramarket benefits captured by resident Alberta and non-resident sport anglers. These benefits are estimated for the 111 km section of the Bow River studied. A CV methodology is used.

Table 4: EMB's for sport angling by resident and non-resident anglers on a 111 km section of the Bow River in Calgary, Alberta, 1985.

Season	EMB/activity day ($/person/day)	EMB/year ($ 1 000)
Summer	8.11	659
Winter	3.11	13
Spring	3.28	9

Wilman, E.A. and J. Perras. 1987. 'Recreation Benefits.' Department of Economics, U of Calgary. 81 pages.

This study uses 1985 AWA data, collected from three recreation areas: the Upper Oldman Area (UOA); the Panther Corners Area (PCA); and the South Castle Area (SCA). This data is used to estimate the daily and yearly extramarket benefits captured by resident Albertans for recreational opportunities in these areas including sport fishing. A simple TC methodology is used. Wilman suggests that the real information required is that regarding the gains or losses in value which result from environmental or policy changes. She recommends using a sequential approach to obtain this information.

Table 5: EMB's for recreational opportunities including sport angling in the UOA, PCA, and SCA's of Alberta, 1985.

Region	EMB/activity day ($/person/day)	EMB/year ($ million)
Upper Oldman Area (UOA)	4 - 15	0.4 - 1.3
Panther Corner and South Castle Areas	9	NA

NOTE: 1. Wilman also reports that Radford and Wiebe (1975) calculated EMB's of $19.4/person/day exclusively for sport angling on the Upper Oldman and Livingston rivers.

Except for Wilman (1985), all of the existing Alberta studies which estimate the EMB's of sport fishing use simplistic CVM approaches. This data cannot easily be used to analyze resource value changes (i.e. they give the value of the fisheries resource at one point in time for the entire province or specific regions only). All of the Alberta studies mentioned do not recognize the importance of substitute sites or of environmental quality on influencing the sport anglers decision on where and when to fish.

B Non-Alberta EMB Sport Angling Surveys

There are six recent studies of importance regarding the valuation of fisheries resources in the US. These include surveys and studies that were conducted in Alaska (1989), Idaho (1985), Michigan (1989), Minnesota (1989), Indiana, and the East Coast. Both the Alaska (Carson et al., 1989) and Michigan (Jones, 1989) studies used the discrete choice travel cost methodology. The Idaho survey (Sorg et al., 1985) uses both the CV and TC methodologies. The Minnesota survey has just recently been completed and further research of the data collected is pending. In all cases, the major feature of these studies is their recognition of substitute sites and environmental quality and their impact on sport anglers choices. That is, they recognize the impacts that substitute sites and environmental quality have on the value of the sport fisheries resource.

Carson, R.T., W.M. Hanemann, and T. Wegge, 1989. 'A nested logit model of recreational fishing demand in Alaska.' Paper presented at the Western Economics Association Annual Meeting. Lake Tahoe, Nevada. 18 pages.

This paper describes a discrete choice TC model to value recreational fishing in Alaska. The model recognizes environmental quality on fishing value and also that environmental quality changes over the season. Fishing quality and value is considered in a temporal (weekly) framework.

Jones, C.A. 1989. 'An economic model to assess fish-kill damages.' Resources (Fall 1989):14-16.

This paper describes a discrete choice TC model used to assess the changes in fisheries values resulting from changes in environmental quality. The methodology used is applicable to other classes of recreational goods.

Sorg, C.F. et al., 1985. 'Net economic value of cold and warm water fishing in Idaho.' Resource Bulletin RM-11. USFS RM Forest and Range Experiment Station. 26 pages.

This paper uses the results from a state wide Idaho survey to estimate the values for cold and warm water fishing using both consumer surplus and expenditures as components of total consumption value. The net economic values were calculated using the TC method. The CV method was used in this study to measure the value of the last trip taken during the year (1985). The analysis of net WTP for cold and warm water fishing was then used to test the TC and CV methodologies.

C General Alberta Sport Angling Surveys

Boxall, P.C., A. Duarte-Pedrosa, and L.C. Smith. 1989. 'Human Dimensions in Fish and Wildlife Management. Volume I: A Guide to Existing Information in Alberta.' Socioeconomic Technical Report No. 4. Alberta Forestry Lands and Wildlife, Fish and Wildlife Division. 64 pages.

This paper summarizes the available literature dealing with the socioeconomic and trip profile characteristics of sport anglers in Alberta. Profiles of angling trips includes information on: location; duration; expenditures; creel counts; species catch; activity days; and species desirability. Few of the studies mentioned examine site desirability. The objectives of most of these studies (surveys) have been: 1) to try and determine what factors are most important to sport anglers in their fishing experience (i.e what factors influence fishing activities and values); and 2) to gather data on the effectiveness of Fish and Wildlife programs. The extramarket benefit evaluation of the fisheries resource encompasses both these objectives regarding angler values and preferences.

4 SPORT HUNTING

A Alberta EMB Sport Hunting Surveys

Sport hunting surveys are also conducted to determine the economic value of the activity rather than the value of changes in site attributes. The majority of the studies listed below report expenditure and values of recreational activity at a a point in time.

Pattison, W.S. 1970. 'Moose Hunting Activity in Northern Alberta: A Case Study in Wildlife Economics.' Unpublished M.Sc. Thesis. U of Alberta, Edmonton.

This study uses 1968 data, collected from Big Game Zone 1 in Northern Alberta, to estimate the daily and yearly extramarket benefits captured by resident and non-resident Albertan moose hunters. A simplistic CV methodology is used.

Table 6: EMB's for sport hunting of moose by resident and nonresident hunters in Big Game Zone 1 of northern Alberta, 1968.

Hunter Type	EMB/activity day ($/person/day)	EMB/year ($ million)
Resident	4.13	NA
Nonresident	11.99	NA
All Hunters	5.45	0.75

Miller, R.J. 1971. 'Alberta's Hunting and Fishing Resource: an Economic Evaluation.' Economics Division, Resource Economics Branch, Alberta Department of Agriculture. 90 pages.

This study uses 1968 data, collected for 15 big game zones, 6 waterfowl zones, and 5 upland bird zones, to estimate the daily and yearly extramarket benefits captured by resident and non-resident Albertan hunters. A simplistic CV methodology is used.

Table 7: EMB's for sport hunting by resident hunters in Alberta, 1968-69.

Year	EMB/activity day ($/person/day)	EMB/year ($ million)
1968	9.40	10.2
1969	8.33	6.5

NOTE: EMB's represent more than 75% of total social net benefits for resident hunters in this study.

Table 8: EMB's for sport hunting by non-resident hunters in Alberta, 1968-69.

Year	EMB/activity day ($/person/day)	EMB/year ($ million)
1968	18.07	NA
1969	11.52	NA

Prather, R.A. 1974. 'Alternative Methods of Estimating Benefits: An Economic Evaluation of Big Game Hunting in Alberta.' Unpublished M.Sc. Thesis. U of Alberta, Edmonton.

This study uses 1969 data, collected for 9 big game zones, to estimate the daily and yearly extramarket benefits captured by resident and non-resident Albertan hunters. Both the CV methodology and the TC technique are used.

Table 9: EMB's for sport hunting by resident and non-resident hunters in Alberta using CVM, 1969.

Hunter Type	EMB/activity day ($/person/day)	EMB/year ($ million)
Resident	10.45	4.7
Non-resident	16.08	0.5

Table 10: EMB's for sport hunting by resident and non-resident hunters in Alberta using TCM, 1969.

Hunter Type	EMB/activity day ($/person/day)	EMB/year ($ million)
Resident	6.08	2.7
Non-resident	16.80	0.5

Phillips, W.E., D. DePape, and C. Ewanyk. 1977b. 'Socioeconomic Evaluation of the Recreational use of Fish and Wildlife Resources with Particular Reference to the AOSA. Volume 3: Recreational Hunting.' Department of Rural Economy, U of Alberta. 176 pages.

This study uses 1976 data, collected for 9 big game zones and the Alberta Oil Sands Area, to estimate the daily and yearly extramarket benefits captured by resident and non-resident Albertan hunters. A simplistic CV methodology is used.

Table 11: EMB's for sport hunting by resident and non-resident hunters in Alberta and in the AOSA, 1976.

Province of Alberta	Resident ($/person/day)	Non-resident ($/person/day)
Big game	31.58	54.97
Bird game	21.60	38.68
All game	33.24	48.48
Alberta Oil Sands Area	**Resident ($/person/day)**	**Non-resident ($/person/day)**
Big game	25.75	NA
Bird game	12.00	NA
All game	29.85	NA

Adamowicz, W.L. 1983. 'Economic Analysis of Hunting of Selected Big Game Species in the Eastern Slopes of Alberta.' Unpublished M.Sc. Thesis. U of Alberta, Edmonton.

This study uses 1981 data, collected for the East Slopes of Alberta, to estimate the daily extramarket benefits captured by resident and non-resident Albertan hunters. The CV methodology is used.

Table 12: EMB's/person/day for sport hunting of selected big game species by resident and nonresident hunters anglers in the East Slopes of Alberta, 1981.

Species	Resident ($/person/day)	Non-resident ($/person/day)	All Hunters ($/person/day)
Mountain Sheep	72.94	246.53	73
Moose	72.01	93.38	72
Grizzly Bear	70.48	116.67	70
Mountain Goat	68.04	NA	68
Elk	63.00	61.50	63
Black Bear	53.20	37.08	NA

Bodden, K. and P. Lee. 1986. 'The 1985 Economic Survey of Alberta Resident Pheasant Hunters.' Alberta Forestry Lands and Wildlife, Fish and Wildlife Division, Technical Report No. 1. 49 pages.

This study uses 1985 data, collected for 9 provincial grazing reserves, 4 Buck for wildlife areas, 3 regions in Southern Alberta, to estimate the daily and yearly extramarket benefits captured by resident Albertan hunters. Both the CV and TC methodologies are used.

Table 13: EMB's for sport hunting of pheasants by resident hunters in Alberta, 1985.

Method	EMB/activity day ($/person/day)	EMB/year ($ million)
CVM	$17.44	0.7
TCM	$25.37	1.2

Asafu-Adjaye, J. 1989. 'Issues in the Valuation of Nonmarket Natural Resource Commodities: The Case of Wildlife Resources in Alberta.' Unpublished Ph.d. dissertation. U of Alberta, Edmonton. 125 pages.

This study uses 1988 data, collected for Alberta, to estimate the yearly extramarket benefits captured by resident Albertan hunters. The CV methodology is used.

Table 14: EMB's for sport hunting by resident hunters in Alberta, 1988.

Species	EMB/activity season ($/person/season)
Big game	204.06
Grizzly bear	151.12

B General Alberta Sport Hunting Surveys

As for sport angling, Boxall et al. (1989) summarizes the available literature that deals with the socioeconomic characteristics and trip profiles of sport hunting in Alberta. Profiles of hunting trips includes information on: location; duration; expenditures; species harvest; activity

days; and species desirability. Little of this research has examined the impact of site desirability and environmental quality on the value of sport hunting except for one recent study by Coyne and Adamowicz (1990).

5 AESTHETIC / BEQUEST / EXISTENCE / OPTION VALUES

There exists a range of literature dealing with the value of nonconsumptive uses of the environment. These values fall under a number of headings including: aesthetic values; bequest values; existence values; and option values (prices). These techniques are also the most common used to value water resources and changes in water quality. The following is a partial list of the most relevant papers dealing with the valuation of environmental benefits. Much of this literature on these values originates from a paper by Weisbrod (1964). These methodologies may be useful in analyzing selected resource use conflicts and problems in Alberta. To date, very little work has been done in valuing the non-consumptive uses of Alberta's environment and natural resources. Phillips et al. (1977c) has done some recent work in this area with respect to the total value of wildlife in Alberta, as has Asafu-Adjaye (1989).

Bishop, R.C. 1982. 'Option value: an exposition and extension.' Land Economics 58:1-15.

This paper provides an exposition and summary of option value, which is used to clarify the issues and arguments surrounding the concept. In addition, this paper also looks at supply side option value as opposed to demand side option value. Supply option values arise from an uncertainty in the supply of natural resources.

Brookshire, D.S., B.C. Ives, and W.D. Schulze. 1976. 'Valuation of aesthetic preferences.' Journal of Environmental Economics and Management 3:325-346.

This paper addresses the problem of quantifying aesthetic losses which are associated with deteriorations in environmental quality. This paper reports on a bidding game applied to estimate the aesthetic damages from the possible construction of a power generating station on Lake Powell. Three problems associated with the interpretation of bidding games are

explained theoretically and empirically: 1) incentives for biased responses; 2) divergence between compensating and equivalent variation; and 3) problems of interpersonal comparison in the aggregation of individual bids.

Brookshire, D.S., L.S. Eubanks, and A. Randall. 1983. 'Estimating option prices and existence values for wildlife resources.' Land Economics 59:1-15.

This paper explores the analytical structure of option price and existence value and develops a modification of the CV approach to estimate option price and existence value for specific natural resources whose future supply is uncertain. Empirical analysis explores the case of grizzly bear and bighorn sheep wildlife resources in Wyoming.

Desvouges, W.H., V.K. Smith, and A. Fisher. 1987. 'Option price estimates for water quality improvements: a contingent valuation study for the Monongahela river.' Journal of Environmental Economics and Management 14:248-267.

Freeman, A.M. III. 1984. 'The sign and size of option value.' Land Economics. 60:1-13.

This paper examines the expected sign of option values, and the relative size of this expected option value (i.e. will the size of the option value be large enough to make any difference in a benefit-cost analysis.

Greenley, D.A., R.G. Walsh and R.A. Young. 1981. 'Option value: some empirical evidence from a case study of recreation and water quality.' Quarterly Journal of Economics 96:657.

This paper develops a procedure for measuring option value and preservation values of water quality which is applied to a case study in the South Platte River Basin, Colorado.

Madariaga, B. and K.E. McConnell. 1987. 'Exploring existence values.' Water Resources Research. 23:936-942.

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6 CONCLUSION

Most of the available literature dealing with extramarket benefits has been concerned with developing the methodology for properly valuing these benefits. The empirical analyses associated with these methodological studies usually look at the benefits of recreational opportunities (i.e fishing, hunting, boating, camping) and water quality as it relates to these recreational opportunities. Very little empirical analysis has been done on the nonmarket benefits of forest lands *per se*.

The primary focus in the literature has been on consumptive use of resources, primarily hunting and fishing. In the future the pressure of non-consumptive users will have to be recognized. At present there are very few analyses that consider non-consumptive users. Also, there has been little analysis of the non-use values associated with forest land. The difficulty in quantifying non-use values plus the paucity of survey results leads to a rather large deficiency of research in this area.

The early methodological literature on recreation valuation focused on travel cost models, while later literature has concentrated on contingent value models. The most recent and promising literature deals with discrete choice logit models which incorporate site substitution and environmental quality considerations. These models are a refinement on the early travel cost models and can estimate changes in nonmarket values resulting from changes in environmental quality or management practices. Thus, these models can be very useful to public land managers. In particular, if forest land use changes affect recreational participation and enjoyment the model should capture participation changes, changes in welfare measures and changes in the location of participation. The models which incorporate substitution possibilities are likely to be the most useful in the near future as they will be called on to predict changes in use related activities as the correspond to changes in the land base.