Valuing Canoeing in Nopiming Provincial Park:

A Preliminary Analysis [1]

Jeffrey Englin[2]

Kalyan Chakraborty[2]

Peter Boxall[3]

and

David Watson[3]

May 1994

Report to the Manitoba District Office, Canadian Forest Service

[1] - The authors gratefully acknowledge funding from the Canada-Manitoba Partnership Agreement in Forestry and the Manitoba Model Forest. The help of Grant Williamson, John McQueen, Trucia Howard, Kelly Leavesly, and Jim Crone was appreciated. Any omission or errors remain the authors' responsibility.

[2] - Department of Agricultural Economics, University of Nevada, Reno, Nevada

[3] - Northwest Region, Canadian Forest Service, Edmonton, Alberta

I. INTRODUCTION

A variety of outputs, both market and non-market, are jointly produced by forests. Managing forests to obtain the greatest overall social benefit is challenging. A key challenge is that a forest's market and non-market outputs are not priced in the same way. Maximizing the forests social value and identifying the trade-offs between market and non-market outputs requires a standard measure of value. A useful measure is dollars. For market commodities, such as timber, minerals and grazing rights, prices are readily available. But for non-market commodities such as wildlife viewing, back-country hiking and canoeing, there is a need to assess the value without market information.

Recreation demand models address the need to price environmental goods. While traditionally designed to measure the value of recreation sites, recent methodologies have been developed to measure the value of changes in site attributes. The most widely used framework for valuing recreation sites is the travel cost demand model (TCM) which was suggested by Hotelling in 1949. The basic idea behind the TCM technique is that the consumption of outdoor recreation requires the user to spend time and money to travel to a recreational site. Since everyone does not live at the same place, the cost of visiting a site will vary across potential users and so economic models can be brought to bear.

Since Harold Hotelling's suggestion to the National Park Service in 1949, economists have been developing techniques to exploit his insight to value outdoor recreation. There are two basic revealed preference approaches for measuring recreational values empirically: (1) models of behavior that focus on the demand for recreational sites and (2) models of the demand for site attributes. This study focuses on valuing site attributes.

McFadden's (1974) random utility framework is one technique that has been developed to estimate the recreational value of site attributes. The main idea behind the random utility model is that given an opportunity set of recreation sites, an individual will choose the site that maximizes his utility. An important aspect of random utility models is that they are developed from economic utility theory and, therefore, allow the application of economic theory in a straightforward manner even though no formal market exists for recreation sites. This approach has been widely applied. Recent applications have included big horn sheep hunting (Coyne and Adamowicz (1992)) and fishing (Bockstael et al (1989), Smith and Karou (1986)) among others.

In this project, the discrete-choice multinominal logit model version of the random utility model (RUM) is used to estimate the value of route attributes to canoeists. The parameters of a multinominal logit RUM are estimated using canoeing permit data for Nopiming Provincial Park in Manitoba, Canada. This work is in contrast to Hellerstein (1989, 1991) who applied count data models to canoeing in the Boundary Waters Canoe Area in Minnesota without accounting for site characteristics. As Hellerstein and Mendelsohn (1993) point out however, the two models are derived from a consistent theoretical structure. Simulating the RUM allows the calculation of willingness-to-pay for forest fire prevention and improved canoe launching facilities. These values provide resource managers with a means to help evaluate management decisions affecting site attributes and recreational experiences. The welfare estimates of this model help policy planners in their task of finding the optimal solution with respect to resource allocation for forest management.

II. THEORETICAL MODEL

Travel Cost Random Utility Models

The revealed preference models of recreational demand for site attributes are based on using travel costs as a proxy for price. The fundamental insight that drives these models is that a consumer must expend resources visiting a site. Travel costs serve as surrogate prices, and variation in these prices causes variation in consumption. Pooling individuals who face different prices and purchase different number of trips allows the estimation of demand functions, and the calculation of the welfare measures. In the traditional travel cost method (TCM), visitors to a recreation site are grouped into zones of origins, and the travel cost is estimated for trips from each origin to the recreation site. Visitation rates (quantities) are then regressed on these travel costs (prices) and a set of socio-economic variables. Total visitation from all relevant origins represents one point on the demand curve for the site at the prevailing travel cost. The rest of the demand curve is generated by assuming that visitors would react to an increase in the entry fee according to the estimated visitation response to increases in travel costs.

The discrete-choice TCM is a variant of the traditional TCM and differs in two ways. First, while the time frame for the traditional TCM is a season (ie. the quantity of trips is the number of trips to a particular site in a season), the discrete-choice TCM models the site choice of each trip independently. Secondly, the discrete-choice model concentrates on explaining site choice as a function of site attributes; whereas the traditional modelling approach focuses on complete sites. An attractive feature of discrete-choice TCMs is they are developed from economic utility theory and, therefore economic benefit estimates can be derived from them, even though no formal market exists for recreation sites.

Discrete-choice models can be explicitly formulated as random utility models (see McFadden (1974)). Random utility models can be used to estimate the demand for and benefits from recreational activities. The random utility model assumes a consumer faces a set of sites from which to make a selection. In choosing between recreation sites, individuals are faced with a discrete and finite set of mutually exclusive alternatives. The underlying assumption of the discrete-choice approach is that individuals use their knowledge of site attributes to rank recreation sites. Each individual then determines the utility that each site yields, and picks the site that yields the highest utility.

Random Utility Models

The general discussion of random utility travel cost models can be formally presented. It is assumed that an individual derives utility from monetary income and from taking a trip. The observed binary variable for N individuals facing M choices is Y_{ij} (where i=1,2,...N and j=1,2,...M). Here the latent variable which the individual wants to maximize is the utility, U, derived from the trip. It follows that:

$Y_{ij}=1$, If the *ith* individual chooses the *jth* alternative, which implies that

$U_{ij}=\text{Max}\{U_{i1},U_{i2},\ldots,U_{iM}\}$, otherwise,

$Y_{ij}=0$,

where $U_{ij}(.)$ is the utility derived by the *ith* individual from the *jth* alternative. If, in any given situation, an alternative j is chosen, this implies that the utility derived from the *jth* alternative is greater than that from any other alternative k in the individual's choice set. So it follows that $U_{ij}(.) \geq U_{ik}(.)$, for all k not equal to j, j=1,2,...m.

Assuming an individual's utility function consists of both deterministic and random components, the above argument may be written as:

$$V_{ij} + \epsilon_{ij} \geq V_{ik} + \epsilon_{ik} \quad k \neq j \tag{1}$$

Where V_{ij} and V_{ik} are the systematic components of the utility functions of the first and the second alternatives and ε_{ij} and ε_{ik} are the random error terms. In the case of the logit model the errors are assumed to be distributed logistically. The probability that the *ith* individual will choose the *jth* alternative, is written as:

$$P_{ij} = P_r[V_{ik} + \epsilon_{ik} \leq V_{ij} + \epsilon_{ij}] \quad k \neq j \tag{2}$$

Which can be represented as:

$$P_{ij} = P_r[\epsilon_{ik} \leq \epsilon_{ij} + V_{ij} - V_{ik}] \tag{3}$$

Following Morey (1981), Caulkins et al. (1986) and Bockstael et al. (1987), the deterministic components of each of the indirect utility functions are assumed to be linear combinations of the characteristics of the individual and the site characteristics. This may be represented by the following equation as:

$$V = \alpha_1 C_{ij} + \alpha_2 A_j + \alpha_3 Y \tag{4}$$

where; C_{ij} = the travel cost to the *jth* site from the *ith* origin,

A_j = a vector of site characteristics associated with the *jth* alternative,

Y = the income of the individual from the *ith* origin, and,

α_k = the parameters to be estimated in this model.

The probability represented in equation (3) may be rewritten as:

$$P_{ij} = P_r[\epsilon_{ik} \leq \epsilon_{ij} + V(C_{ij}, A_j, Y) - V(C_{ik}, A_k, Y)] \tag{5}$$

Assuming that the random components are identically, independently, and Weibull distributed, the cumulative density function of the probability distribution function is written as:

$$P_{ij}(Y_{ij}=1) = \frac{\exp(V_{ij})}{\sum_{k=1}^{j} \exp(V_{ik})} = \frac{\exp[V(C_{ij}, A_j, Y)]}{\sum_{k=1}^{j} \exp[V(C_{ik}, A_k, Y)]} \quad \text{where } \sum_{j=1}^{m} P_{ij}=1 \tag{6}$$

where $0 \leq P_{ij} \leq 1$, $j = 1,2,...,M$.

The likelihood function for the above probability distribution is written as:

$$\text{Likelihood Function} = \prod_{i=1}^{N} \prod_{j=1}^{M} P_{ij}^{Y_{ij}} \tag{7}$$

The parameters of the model are estimated by maximizing the log of the likelihood function with respect to the unknown parameters. The estimated coefficients are consistent, and asymptotically efficient under very general conditions (See McFadden 1978).

Measuring Welfare With Travel Cost Random Utility Models

Following Hanemann (1984), a Hicksian measure of compensating variation for a change in site quality can be calculated in a travel cost random utility model. The compensating variation is defined as an increase in travel cost which will equate the individual's expected value of the maximum of the indirect utility function with a site quality improvement to the original utility level. In other words, it is the sum of money which would be taken away from the individual who visits a site with improved quality in order to render that person as well off as they were with the original level of the characteristic.

Since the compensating variation is the measure which equates the expected value of the indirect utility functions before and after a quality change from A to A^* C^* is defined as:

$$E[V(C,A^*,Y-C^*)] = E[V(C,A,Y)] \tag{8}$$

where

$$\begin{aligned} V(C,A,Y) = \text{Expected Maximum } [&V_1(C,A,Y) + \epsilon_1, \\ &V_2(C,A,Y) + \epsilon_2, \cdots, V_m(C,A,Y) + \epsilon_m] \end{aligned} \tag{9}$$

If the random errors are distributed as Generalized Extreme Value, then

$$E[V] = \ln G[\exp(V_1),\exp(V_2),\ldots,\exp(Vm)] + k \tag{10}$$

In a simple discrete-choice model, where

$$G = \sum [\exp(V_1) + \exp(V_2) + \cdots + \exp(V_m)] = \sum_{j=1}^{m} \exp(V_j) \tag{11}$$

C* can be estimated by solving the following equation:

$$\begin{aligned} &\exp[V(C_1, A_1^1, Y - C^*] + \cdots + \exp[V(C_m, A_m, Y - C^*)] = \\ &\exp[V(C_1, A_1^0, Y)] + \cdots + \exp[V(C_m, A_m, Y)] \end{aligned} \tag{12}$$

If the marginal utility of income is constant, then solving equations (10) and (11) allows derivation of an expression for the compensating variation as:

$$C^* = \frac{1}{\beta_0}[\ln\sum_{j=1}^{m} \exp(V_{i1}) - \ln\sum_{j=1}^{m} \exp(V_{i0})] \tag{13}$$

Where B_0 is the marginal utility of income, V_{i0} is the level of utility at the initial stage and V_{i1} is the level of utility after the change in site quality. Expression 13 gives the expected compensating variation for one choice occasion. In this model a choice occasion is defined as a trip. By aggregating the individual compensating variation over the total number of canoeists one can calculate the total social welfare measure in this model.

III. DATA

Nopiming Provincial Park is situated 125 miles northwest of Winnipeg, Manitoba, Canada. The location of the park is shown in Figure 1. Before canoeing within the boundaries of the park, all canoeists were asked to register with the Manitoba Natural Resources Parks system by completing a Back Country Campers' Registration form. The primary source of data is the information obtained from these registration forms gathered in 1991 and 1992. The forms were collected from registration stations and involved eight different entry points in the park.

The following eight entry points/routes were identified from the forms: (1) Tulabi Lake, (2) Davidson Lake, (3) Rabbit River, (4) Black River, (5) Seagrim Lake System, (6) Flintstone Lake, (7) Beresford/Garner Lakes, and (8) Manigotagan River/Long Lake (Figure 2). The distribution of the total sample among different routes is shown in Table 1. It is interesting to note from the table that the Tulabi Lake route alone accounts for 52% of the total trips taken during the year 1991 and 1992. The Flintstone Lake route attracts the fewest canoeists. After Tulabi Lake, the two most popular routes are the Rabbit River and Seagrim Lake system which account for approximately 19% and 16% of the sample respectively.

Collection and Arrangement of Data

The route characteristics examined in this study include site attributes at the entry points as well as attributes along the canoe routes. For example, the presence of a store or fuel facility, launching facility and campground may effect the choice of a canoe route. Similarly, the presence of large lakes, number of portages, length of the total route and the length of the burned forest along the route may also influence a canoeist's choice of a route. The site attributes at the entry point were identified from the Manitoba Provincial Park map of the Nopiming Provincial Park. The information as to the route attributes were provided by

Forestry Canada, Northwest Region. Characteristics that were considered most important by the canoeists while choosing an alternative have been included in this study. Table 2 shows the route characteristics as defined in this model.

A total of 529 visitor parties (274 in 1991 and 255 in 1992), visited the park during the year 1991 and 1992. These parties included a total of 980 canoeists in 1991 and 1004 canoeists in 1992. Only those registration forms with complete trip information were used in this analysis. This reduced the sample to 498 visitor parties.

The specific information about each trip contained in each permit includes:

(1) Campers' Names

(2) Group Leader's Name

(3) Group Leader's Address

(4) Telephone Number

(5) Type of Organization

(6) Vehicle License Plate Number

(7) Group Size

(8) Departure: Date, Time, Point of Departure, Proposed Route, Destination, Date and Time of Arrival at the Destination

(9) Return: Proposed Route, Point of Return. Date and Time of Return

(10) A Space for Comments

Part of the group leader's address (3) includes the postal code. This postal code, in conjunction with the addresses, is used to develop distance to site information. It is also used to obtain income information from census data. The distances were measured using the following protocol. First the town closest to each entry point is marked on a topographical map. Round trip distances in kilometers were measured from each visitor's home address to all of the entry points using a planimeter. If a complete address is not available or could not be found the distance is measured from the center of the postal code. For visitors from the USA distances between the group leader's home town and the town located nearest to each entry point were measured by using a computer software package. These intermediate distances have been turned into complete distances by adding the distance between the nearest town and each entry point.

Several authors (see McConnell and Strand (1981) and Shaw (1993)) have demonstrated the importance of including the value of time when calculating travel costs. Like most studies we infer the value of travel time from wages. Since individual-specific demographic characteristics were not available wages are inferred from annual income using postal code level data from the Canadian Census. Wages for American visitors were inferred from average zip code income data using the U.S. Census. Following Parsons and Kealy (1992), the price or travel cost from the recreationist's home town to the entry point is calculated by using the following equation:

$$\textbf{travel cost} = 0.22 * \textbf{distance} + (\textbf{distance/50}) * (1/3 * (\textbf{income/2040})) \tag{14}$$

where travel cost is the sum of transit cost and opportunity cost of time. A transit cost per Km of 0.22 cents is reported by the Alberta Motorists Association as the cost to travel one Km using the average Canadian car. We assume an individual's trip time is just the travel time to the site at 50 Km per hour. Each individual is assumed to value an hour in recreational travel at one half of his actual hourly wage rate. The hourly wage is found by dividing income per year by the number of hours worked per year (2040). The descriptive statistics of this study are reported in Table 3.

It is observed from Table 3, that the average round trip travel cost for any route is estimated at \$50.97. However, there are some canoeists who spend as little as \$2.20 for a canoe trip. The maximum round trip travel cost paid by a canoeist is estimated to be \$399.70, which is about 8 times higher than the average travel cost.

IV. EMPIRICAL RESULTS

This section reports the results of applying discrete choice modelling efforts to the canoeing data. Two sets of results are reported. The first are the econometric estimates of the parameters of the random utility model. The second are the results associated with several counterfactual simulations.

Table 4 presents the final econometric results. Other variables were examined, but the coefficients were not significantly different than zero. The final model includes travel costs, whether there is a developed launching facility at the site, the total length of the route in kilometers and the kilometers of the route that have been burned in a forest fire. All coefficients have the expected signs and are relatively precisely estimated. The estimated coefficients allow the deterministic part of the utility function, V, to be written as:

$$\begin{aligned} V = & -0.0833 * \text{Travel Cost} - 0.0576 * \text{Km Burned} \\ & + 2.6425 * \text{if Developed Launch} - 0.0178 * \text{Length of Route} \end{aligned} \tag{15}$$

The utility associated with each site can be calculated by substituting the quantities of each characteristic at that site into equation 15 and solving for V. Changes in the quantities of attributes result in changes in utility.

The estimated coefficients of this model can be used to estimate two kinds of welfare impacts. One welfare measurement is the value of each of the canoeing routes. The second is the value of route characteristics, in this case forest fires and developed launching facilities. By simulating various changes in the independent variables in this model one can estimate the value of routes and the welfare effects of changing travel costs, forest fires and launching facilities.

One of the most interesting results is simply the estimated economic value of each of the routes. This is estimated by closing a canoe route and estimating the associated impact. Routes were closed by forcing the travel cost so high that no canoeists would choose that site and instead must visit one of the other 7 routes in the park. The most valuable route is Seagrim Lake, valued at \$3.85 per canoeist per trip. Tulabi Lake is also highly valued at \$3.82 per canoeist per trip. The least valuable routes are the Flintstone Lake, the Long Lake and the Davidson Lake routes. The remaining routes are worth about one to three dollars per canoeist. Aggregating over all 1,000 canoeists in a season suggests that the Tulabi Route is worth about \$3,820 per year. The present value of the route (using a 4% discount rate) is a substantial \$95,000 (\$3,820/0.04). Of course, these calculations could be repeated for the other routes and/or other discount rates.

Using the parameters presented in Table 4 we estimated the value of the existing developed launch sites and the value of improving the undeveloped sites. Developed launch sites are available at Rabbit River, Black River, Seagrim Lake, Tulabi Lake, Beresford Lake and Long Lake. The compensating variation, or willingness-to-pay, for these sites is about $30 per trip. If launching facilities were constructed at all the remaining sites the welfare gain would be about $1 per trip. These results suggest that park managers have chosen to develop the highest value launch sites first. Using these annual per trip calculations allows us to estimate the total value of launch sites. Since about 1,000 canoeists visit the park each year the total annual value of the existing improved launch sites is about $30,000. For simplicity we can assume that the launch sites are costless to maintain into perpetuity. Under this situation the present value of the launch sites using a 4% discount rate is about $750,000. Under a similar set of assumptions improving the remaining sites would be worth about $28,000. Table 6 presents the full set of results.

A second set of simulations were conducted to examine the welfare losses associated with forest fires. The existing burns are largely the result of two large forest fires in 1983 that affected these canoe routes. One of the fires, the Maskwa Lake Fire, caused damages to three routes. These include the Rabbit River, Tulabi Lake, and Davidson Lake routes. The second major fire was the Long Lake Fire. The Long Lake fire caused damage to the Flintstone Lake, Seagrim Lake, LongLake, and Beresford Lake routes. As Table 2 shows, the amount of damage attributable to the Long Lake fire on routes ranges from half a kilometer on the Black River route to nineteen and a half on Long Lake. Table 6 reports the annual damage accruing to an "average" individual canoeist from the forest fires.

In Table 5 the compensating variation due to each fire is estimated as the difference between the welfare under the existing conditions and the welfare that would have been captured if there had been no fire. In the case of the Maskwa Fire this amounts to the damage to the Rabbit River, Tulabi Lake, and Davidson Lake (Table 2). The loss is calculated to be about $1.79 per trip. The Long Lake fire affects 3 other routes more severely in terms of route length affected (Table 2). It is estimated to be about $2.57 per trip. The greater impact of the Long Lake fire is largely the result of the scale of the fire damage to the routes.

The damage resulting from two hypothetical fires were also examined. The first calculation examines the welfare loss that would occur if the most popular route, Tulabi Lake, were to be entirely burned as a result of a large forest fire. In this scenario we find that the loss per canoeist is nearly $3.50 per trip. The second scenario we examine is the worst possible case. This is the case when all routes in the entire park were damaged by fire. The per trip damages are estimated to be nearly $15 per trip.

In addition to the discussion of the value of improved launching sites the intertemporal welfare effects of forest fires can also be examined. Unlike the launching sites, however, the effects of forest fires fade over time. As the forest grows back the impact of the fire fades. While it is possible that the time path of the welfare effects of recovery from a fire could be a non-linear function, we have only enough information for a linear analysis. We examine the Long Lake fire as an example. The linear analysis proceeds from two observations. One is that the value we observe today is $2.57 per trip and that the fire is about ten years old. Second, the forest will return to climax conditions, no damages, in approximately 100 years (pers. comm. Manitoba Forest Branch). Using these two points we solved for the linear function that relates damages and time. This function is:

$$\textbf{Damages} = -\$2.86 + \$0.02 * (\text{years since burn}) \tag{16}$$

Figure 3 shows this relationship. The total damages from the fire is found by discounting the damages in each year back to the present. The present value of the damage function is shown in equation 17.

$$\textbf{Present Value of Damages} = \int_{0}^{100} [-2.86 + 0.02 * X] * e^{-r*X} dx \tag{17}$$

By choosing different discount rates, r, one calculate the present value of the Long Lake forest fire. Table 6 shows these results for a range of discount rates. The per canoeist values run from \$25 for a 10% discount rate to \$100 for a 1% discount rate. If 1,000 canoeists per year use the Nopiming Park canoeing opportunities the total rates are between \$25,000 and \$100,000 in damages.

V. SUMMARY AND CONCLUSIONS

Key forestry management issues include the *degree of development* and the *treatment of forest fires*. This preliminary analysis has focused on the valuation of these two attributes to canoeists. The analysis found that developed canoe launching sites are valued by canoeists but that fire damage is not.

The quantitative results suggest that the benefit of launch site improvements to canoeists is substantial. The value of existing improvements is measured at nearly \$30 per canoeist per trip. Since about a 1,000 canoeists per year visit Nopiming the annual value is large, about $30,000 per year. The present value of the investment in improvements should be $300,000 at conventional discount rates. Improvements at the remaining sites would be worth about $1 per canoeist per year. The results clearly show that the highest valued improvements have taken place first and that the recreational damage from fire is substantial. This study finds that the damage from the 1983 Long Lake fire is $2.57 per canoeist per trip. The 1983 Maskwa Lake fire is less damaging, about $1.79 per trip. In general, this is due to the smaller scale of the Maskwa Lake fire in relation to canoe routes.

An important point about the random utility model used in this study and resulting welfare estimates is that they are independent of the participation decision. Since we only have participants (permit holders) we cannot quantify the change in the number of canoeists if the quality of the canoeing changes. Similarly our results are restricted to Nopiming Park. We have no information from other canoe parks and cannot estimate the degree of substitutability between Nopiming and other canoe areas. It is safe to say that the number of recreationists will probably increase in cases of improved site qualities. This random utility model does not account for these increases in participation. As a result, the welfare estimates are likely to be underestimates of the true value of site improvements.

VI. BIBLIOGRAPHY

Bockstael, N. E., M. W. Hanemann and C. L. Kling. (1987). "Estimating the value of water quality improvements in a recreational demand framework." *Water Resources Research*, 39:813-828.

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

Caulkins, P. P., R. C. Bishop. and N. W. Bouwes. (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.

Clawson, M. and J. Knetsch. (1966). Economics of outdoor research. Baltimore: Johns Hopkins University Press.

Coyne, A.G. and Adamowicz, W. L. (1992). "Modeling choice of site for hunting bighorn sheep." *Wildlife Society Bulletin*, 20:26-33.

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

Hellerstein, D. (1989). The Use of Count Data Models in Travel Cost Analysis: An Application to the Boundary Waters Canoe Area. Unpublished PhD. dissertation, Yale University, New Haven, CT.

Hellerstein, D. (1991). "Using Count Data Models in Travel Cost Analysis with Aggregate Data," *American Journal of Agricultural Economics*. 73:860-867.

Hellerstein, D. and R. Mendelsohn. (1993). "A Theoretical Foundation for Count Data Models, with an Application to a Travel Cost Model." *American Journal of Agricultural Economics*. 75: 604-611.

McConnell, K. E. and I. Strand. (1981). "Measuring the cost of time in recreation demand analysis: An application to sports fishing." *American Journal of Agricultural Economics*. 63:153-156.

McFadden, D.. (1978). "Modeling the choice of residential location." in Spatial interaction theory and planning models. A. Karlqvist, eds. North-Holland Publishing. 75-96.

McFadden, D. (1974). "Conditional logit analysis of qualitative choice behavior." in P. Zarembka, eds. Frontiers in econometrics. Academic Press, London, New York.

Morey, E. R.. (1981). "The demand for site specific recreational activities: A characteristic approach." *Journal of Environmental Economics and Management*. 8:345-371.

Parsons, G. R. and M. J. Kealy. (1992). "Randomly drawn opportunity sets in a random utility model of lake recreation." *Land Economics*. 68:93-106.

Shaw, D. (1992). "Searching for the Opportunity Cost of an Individuals Time." *Land Economics*. 68:107-115.

Smith, V. K. and Y. Kaoru. (1986). "Modeling recreation demand within a random utility framework." *Economics Letters*. 22:395-399.

Table 1: Routes and Use		
Route Number	**Route Name**	**Percent Of Trips**
1	**Flintstone Lake**	0.40
2	**Rabbit River**	19.04
3	**Black River**	1.20
4	**Seagrim Lake**	15.63
5	**Tulabi Lake**	52.10
6	**Beresford Lake**	8.82
7	**Davidson Lake**	1.00
8	**Long Lake**	1.80

Table 2. Route Characteristics								
Characteristic	**Flintstone Lake**	**Rabbit River**	**Black River**	**Seagrim Lake**	**Tulabi Lake**	**Beresford Lake**	**Davidson Lake**	**Long Lake**
Presence of Large Lakes on Route (Yes=1; No=0)	1	0	0	0	1	1	0	1
Presence of a Retail Store by Launch Site (Yes=1; No=0)	0	0	0	0	1	1	0	1
Whether the Launch Site is Improved (Yes=1; No=0)	0	1	1	1	1	1	0	1
The Number of Portages	1	4	0	4	5	2	0	9
Proximity of a Major Campground to the Entry Point	10.0	8.0	6.0	2.0	0	0	18.0	18.0
The Total Route Length (km)[1]	26.0	32.0	78.0	14.0	46.0	34.0	53.0	87.0
KM of Route Burned in Maskwa Lake Fire[1]	0	8.0	0	0	2.0	0	1.0	0
KM of Route Burned in Long Lake Fire[1]	18.0	0	0	7.0	0	15.0	0	0
Total KM of Route Burned[1]	18.0	8.0	0.5	7.0	2.0	15.0	17.0	30.0

[1] - These variables reflect the distance for routes that are largely one way (e.g. Davidson, Black River, Long Lake) and those that are return trips (e.g. all the others).

Table 3. Descriptive Statistics for Basic Variables (3984 Observations)				
Variables	**Mean**	**Standard Deviation**	**Minimum**	**Maximum**
Travel Cost	50.97	29.26	2.20	399.70
Developed Launch	0.67	0.43	0	1
KM on Route Burned	12.18	9.13	0.50	30.00
Trip Length	46.25	23.76	14	87
Distance Traveled	231.58	132.96	10.00	1816.00
Annual Income	33.014	4.157	21.14	51.10

Table 4. Random Utility Model Results [a]	
Variable	**Coefficient**
Travel Cost	-0.0833*** (0.0266)
Kilometers of Routed Burned	-0.0576*** (0.0185)
If Launching Site Improved	2.6425*** (0.4305)
Total Route Length in Kilometers	-0.0178*** (0.0024)
ρ^2	0.226
Log-Likelihood	-800.90

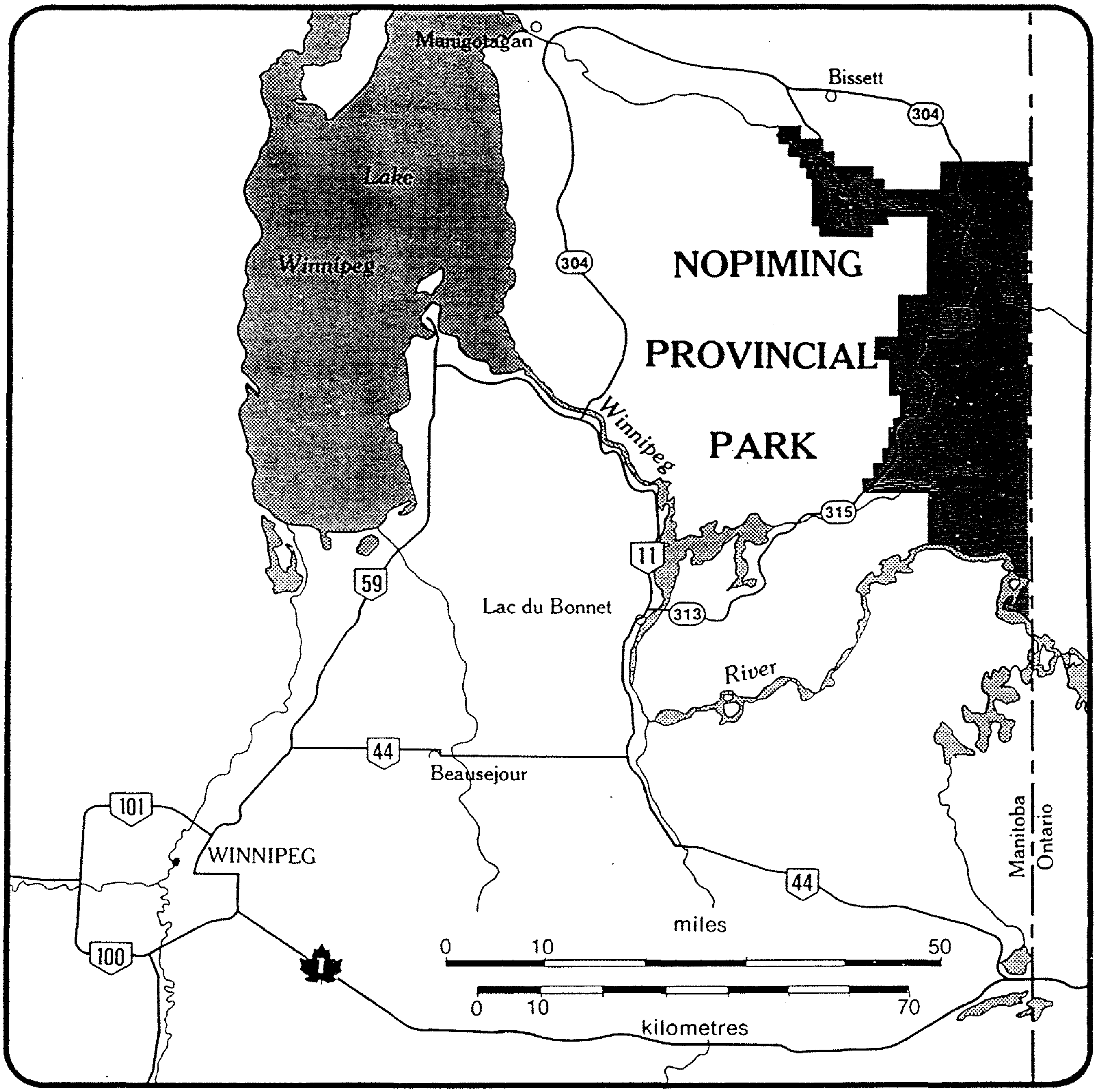
a - standard errors in parentheses
** - significant at the 5% or beyond
*** - significant at the 1% or beyond

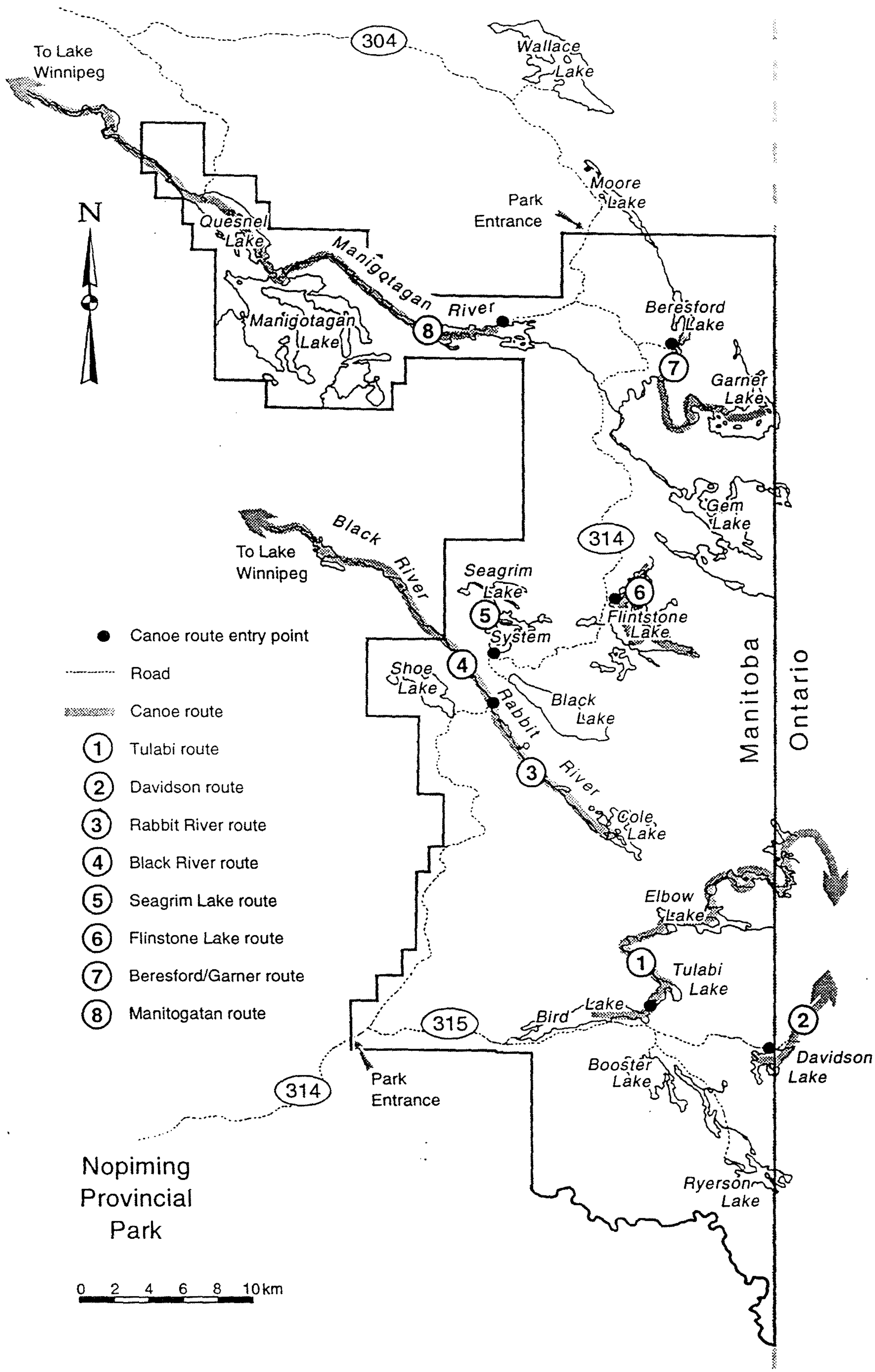
Table 5. Value of Routes to Individual Canoeists	
Route	**Willingness-to-Pay**
Flintstone Lake	$0.09
Rabbit River	$2.95
Black River	$2.11
Seagrim Lake	$3.85
Tulabi Lake	$3.82
Beresford Lake	$0.80
Davidson Lake	$0.07
Long Lake	$0.10

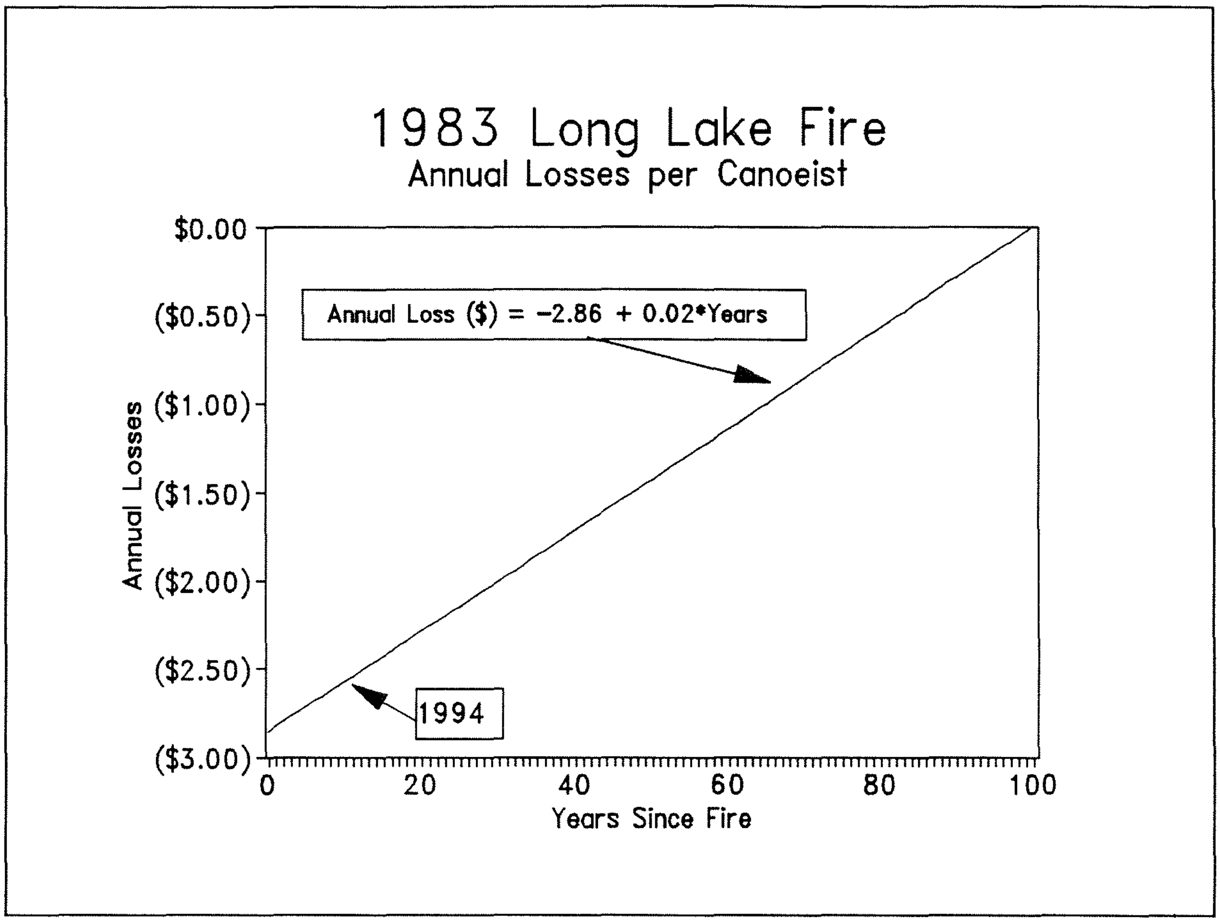
Table 6. Individual Canoeists per Trip Willingness-to-Pay Simulations	
Scenario	**1993 Annual Welfare Impacts**
Historical Fires	
1983 Long Lake Fire	-$2.57
1983 Maskwa Lake Fire	-$1.79
Potential Fires	
Tulabi Route	-$3.46
All Routes in Nopiming	-$14.94
Landing Area Improvements	
Existing Improvements	$29.72
Improving Remaining Sites	$1.12

Table 7. Present Value of Damages to a Single Canoeist from 1983 Long Lake Fire for Selected Discount Rates

Discount Rate	Present Value of Damages
1%	$105.57
3%	$65.10
5%	$45.77
7%	$34.97
10%	$25.70


Manigotagan
Bissett
304
Lake
Winnipeg
304
NOPIMING
PROVINCIAL
PARK
Winnipeg
315
11
59
Lac du Bonnet
313
River
44
Beausejour
101
WINNIPEG
44
Manitoba
Ontario
miles
0
10
50
100
0
10
70
kilometres


To Lake Winnipeg
304
Wallace Lake
N
Moore Lake
Park Entrance
Quesnel Lake
Manigotagan River
8
Manigotagan Lake
Beresford Lake
7
Garner Lake
Gem Lake
Black River
To Lake Winnipeg
314
Seagrim Lake
6
5
Flintstone Lake
System
4
Shoe Lake
Rabbit River
Black Lake
Manitoba
Ontario
3
Cole Lake
Elbow Lake
1
Tulabi Lake
Bird Lake
315
2
Davidson Lake
Booster Lake
314
Park Entrance
Ryerson Lake
Canoe route entry point
Road
Canoe route
1 Tulabi route
2 Davidson route
3 Rabbit River route
4 Black River route
5 Seagrim Lake route
6 Flinstone Lake route
7 Beresford/Garner route
8 Manitogatan route
Nopiming Provincial Park
0 2 4 6 8 10km


1983 Long Lake Fire
Annual Losses per Canoeist
Annual Loss ($) = −2.86 + 0.02*Years
1994
$0.00
($0.50)
($1.00)
($1.50)
($2.00)
($2.50)
($3.00)
Annual Losses
0
20
40
60
80
100
Years Since Fire