THE ECONOMIC EVALUATION OF NON-MARKETED
RECREATIONAL RESOURCES

by

Michael E. Laub

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of
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We accept this thesis as conforming to the
required standard

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Department of Economics

The University of British Columbia
Vancouver 8, Canada

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Abstract:

The fundamental difficulty faced by researchers attempting to evaluate recreational sites is that outdoor recreation is seldomly marketed. This thesis investigates the validity and feasibility of a number of techniques that attempt to value recreational benefits by simulating markets for access to recreational sites. First, the relevance of deriving statistical demand functions for outdoor recreation is established, along with some of the limitations inherent in such demand functions. A theoretical model of consumer behavior is then developed to provide an analytical framework within which the validity of the various market simulation techniques for estimating recreational demand function can be evaluated. A number of different demand concepts are developed as a result of (i) the income effect of access fees, and (ii) the quality effect arising from the impact access fees have on congestion. Which demand concept is relevant depends on the evaluational point of view. The discussion then proceeds to a number of evaluational "short-cuts" that have been used in the past. These "short-cuts" and the reasons the resulting evaluations are unacceptable are briefly outlined. Five market simulation techniques are isolated for more intensive study, four of which are indirect approaches using differentials in travel costs as proxies for prices, while the fifth relies on direct interviews. Since the simulated demand functions are not themselves subject to direct empirical testing without actually creating a market where none exists, the
evaluation of the validity of these techniques must rely on consideration of both the internal logic of each technique and the assumptions upon which the theoretical framework is based. In order to provide further insight into the conceptual and practical limitations of each approach, there is a comparative application of three of the techniques to the problem of evaluating a sport fishery. The application of the interview approach is used to test some of the assumptions underlying the indirect travel cost techniques as well as to explore the implications of using both the price-compensating and price-equivalent concepts of consumers' surplus in the evaluation. High priority is placed on research to replace the single site evaluation approach for which the currently utilized techniques were designed with a systems approach wherein the demand interactions among the various recreational sites are explicitly incorporated. An evaluational technique is proposed that represents a first step in this direction.

To date, there has been a serious imbalance in the allocation of research effort with a relative over-emphasis on the problems of implementing the various market-simulation techniques and a relative under-emphasis on the extraction and testing the underlying assumptions. This thesis calls attention to this imbalance and attempts to illustrate its fundamental importance.
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Chapter One:
The Relevance of Demand Functions for Outdoor Recreation

A. Introduction:
The provision and maintenance of parks, sport fisheries, hunting and wilderness areas consume productive resources that could be employed elsewhere in the economy and therefore have opportunity costs. In order to determine whether or not providing outdoor recreation represents the optimal use of these resources, it is necessary to know not only the opportunity costs of the inputs, but also the value of the recreational benefits that are generated. However, market prices, our normal value indicators, do not always exist for measuring these benefits. The purpose of this thesis is to consider the validity and feasibility of a number of techniques that attempt to value recreational benefits by simulating markets for access to recreational areas.

B. Outline of the Thesis:
This Chapter deals with some of the criticisms that have been levied against the concept of deriving statistical demand functions for outdoor recreation. The consideration of these criticisms will demonstrate the general limitations facing all market simulation techniques and indicate aspects of the evaluational problem that need additional research.

In Chapter Two, a theoretical model of consumer behavior is developed to supply an analytical framework within which the validity of the various market simulation techniques for estimating recreational demand functions can be evaluated.

A number of "short-cuts" have been used to evaluate recreational
benefits in the past. These short-cuts and the reasons the resulting evaluations are unacceptable are briefly outlined at the beginning of Chapter Three. The core of Chapter Three is the critical evaluation of five techniques, each of which is designed to simulate a market for access to a recreational site. Since the simulated demand functions are not themselves subject to direct empirical testing without actually creating a market where none exists, the evaluation of the validity of these techniques must rely on consideration of both the internal logic of each technique and the assumptions upon which the theoretical framework is based. The intention in Chapter Three is to establish the limitations of these techniques and hence determine the circumstances under which they can be applied with the greatest degree of confidence.

In an attempt to provide further insight into the conceptual and practical limitations of each approach, three of the techniques are applied in Chapter Four to the problem of evaluating the Kootenay Lake sport fishery. A comparison of the results of the application of these techniques and the conclusions derived therefrom appear in Chapter Five.

C. The Relevancy of Statistical Demand Functions for Outdoor Recreation:

There have been objections to the idea of quantifying recreational values in monetary terms and this opposition should be dealt with before proceeding. The opposition arguments are grouped into four general categories below.

1) **Recreational benefits are immeasurable:**

It has been argued that recreational benefits are impossible to evaluate on grounds of their aesthetic content and their intangibility.

However, markets exist for numerous intangible commodities or services with aesthetic aspects such as playing golf, watching ballet, and listening to music, with the only basic difference between these commodities and outdoor recreation being that the latter is often publicly provided outside the market. It is this non-market aspect that creates the evaluational problem and not any characteristic of outdoor recreation itself.

2) Market value does not reflect social value of outdoor recreation:

The second argument states that real or simulated market values reflecting willingness to pay do not adequately represent the social value of recreational benefits. This argument has been raised on three grounds. First, if there are significant consumption externalities associated with outdoor recreation, then market simulation techniques will underestimate recreational values. For example, if communing with nature reduces tension, it may benefit society by decreasing the incidence of mental illness and the number of unpremeditated crimes caused by social stress due to the congestion in modern urban society. The extent to which such externalities involved are positive, i.e. external benefits.

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3 Assuming the externalities involved are positive, i.e. external benefits.

externalities exist and are attributable to specific sites or activities, are empirical questions. However, even if externalities are significant, their existence does not invalidate the use of market simulation techniques, but rather indicates the additional need to quantify the externalities to ensure evaluation of all the benefits (and costs) generated by outdoor recreation. The benefits accruing directly to the recreationists are still relevant and can be measured by market simulation techniques.

The second reason for a divergence between market and social values lies in the public good aspects of recreation. While in any given year, only a segment of the population may participate in outdoor recreation at a certain site, there may be other groups who hope to use or have their children use the site in the future. Both users and non-users may be willing to pay a price in order to ensure that the opportunity to use the site will continue to exist. In other words, there could be a demand for the option of using particular recreational resources in the future which is satisfied by the continued existence of the resources.

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6 A public good is one that, if provided, is consumed by all citizens to the same extent due to the impossibility of excluding anyone from enjoying it. On the treatment of public goods see Paul A. Samuelson, "The Pure Theory of Public Expenditure", and "A Diagrammatic Exposition of a Theory of Public Expenditure", in the Review of Economics and Statistics, November 1954, pp. 386-389, and November 1955, pp. 350-356, respectively; and J. G. Head, "Public Goods and Public Policy", Public Finance, September 1962, pp. 197-219. While the "exclusion principle" may be difficult to apply in practice to some recreational sites because of the numerous avenues of access, outdoor recreation itself cannot be regarded as a public good since the amounts consumed by different citizens are not necessarily equal.
Provision of this option is a public good whose value is not reflected in recreationists' current willingness to pay for access to a site. Again, existence of such option demands does not invalidate market valuations of direct recreational benefits, but rather represents a separate facet of the evaluational problem. It is possible that a well-designed interview format could be used to determine the extent of option demands. It should also be recognized that option demands may exist for non-marginal changes in the supply of non-recreational goods for which there are poor substitutes. Where alternative uses of resources allocated to outdoor recreation involve option demands, such demands should be reflected in the calculation of the opportunity costs of the resources.


Aside from recreationists who wish to retain the option of future use of a site, there may be some individuals who are willing to pay a positive price to ensure the continued existence of recreational resources even though they never expect to use them or to have their descendents use them, but simply because they feel better off knowing such resources exist. See John V. Krutilla, op. cit.
The third cause of concern over the use of market simulation techniques to obtain social values for recreational benefits arises from the interdependence between future demand and present supply. A minimum level of skill or habituation is a prerequisite for many forms of outdoor recreation. These skills may not be developed unless opportunities to practise them are readily available. The greater the present opportunities to acquire such skill, the greater will be the future demand for these types of recreational activity. This interaction should not affect the evaluation of direct recreational benefits accruing to current users of a site. The "learning by doing" aspect of outdoor recreation does have serious implications for projections of future levels of demand for some types of recreational areas. Further, in Chapter Three, the interaction between present supply and future demand is seen as one reason for doubting the validity of using some of the market simulation techniques. Again, the existence of an interdependence between current supply and future demand is not confined to outdoor recreation.

3) **Recreational developments redistribute income:**

The provision of outdoor recreation opportunities does have an impact on the distribution of welfare, and recreational developments may be used as redistributitional tools. In this case, the value of the

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benefits may be of less importance than who receives them. With respect to redistribution from high income groups to low income groups, the provision of urban recreational facilities may be effective, but the redistributational role non-urban recreation can play is weakened by the investment in transportation and equipment required for participation. However, while non-urban outdoor recreation may be an inefficient tool for accomplishing some redistributational objectives, this does not preclude the existence of significant distributional effects as a result of non-urban developments. The introduction of distributional objectives adds a new facet to the evaluational problem - the question of how to assign weights to the benefits generated according to who receives them. Thus the magnitude of the benefits must still be estimated. The question of how distributional impacts could be incorporated into the evaluational framework is considered in Chapter Two.

4) Recreation is a "merit good":

According to Musgrave, a merit good is a commodity that is considered so meritorious that the government rejects consumers' preferences and provides the good through the public budget in quantities that differ from those that would have resulted in the market place. It is

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12 The view that outdoor recreation is a merit good is advanced by Robinson, op. cit.

obvious that categorizing recreation as a merit good would render both real and simulated market evaluations inadequate as a basis for policy decisions. However, the circular nature of Musgrave's definition raises the question as to whether the category of merit goods is, in reality, a new and independent classification. The only acceptable rationale for such a category must be based on the existence of market imperfections such as consumption externalities or incomplete information possessed by consumers. In either case, the merit good classification is redundant. With respect to the evaluation of recreation, it was noted above that externalities did not invalidate the use of market simulation techniques. And if there is imperfect knowledge, it would seem more logical to correct this imperfection by improved dissemination of information rather than by intervention in the allocative process directly.

In summary, it is argued that outdoor recreation is a marketable commodity and hence, recreational sites can be valued using market simulation techniques. However, it is recognized that considerable further research is needed in the areas of externalities, the distributional impacts, the existence of option demands, and the interaction between present supply and future demand. In this thesis, only the question of

16 On this point and for a more complete discussion of whether or not the merit good category is completely redundant, see McLure, op. cit..
distributional effects is raised and an attempt is made to offer one possible solution.
Chapter II: The Theoretical Framework

A. Theoretical Model of Consumer Behavior:

In this section, a static model of consumer behavior is developed to provide a theoretical framework within which the validity of the various demand estimation techniques can be analysed. This model is representative of a utility-maximizing consumer whose behavior is constrained by the availability of both time and money.¹ For the purposes of this exposition, the full range of possible consumption goods and services is divided into two categories, one representing all opportunities in outdoor recreation at specific sites, and the other including all other consumption possibilities. In the case of the recreational commodities, the money cost to the consumer has two components: the fee he must pay for access to the site, and the associated costs that he must incur to travel and enjoy outdoor recreation at that site (gas, food, equipment rental, and so on). In the case of non-recreational commodities, it is assumed that the commodity price represents the full cash cost of

consumption. For all commodities, recreational and non-recreational, the characteristics are known to the consumers and are constant.

For the \( i^{th} \) individual, let the following notation be used:

- \( I_i \) = non-labor income,
- \( T_i \) = total time available for work, consumption, and recreation,
- \( D_i \) = time spent working,
- \( C_{ix} \) = number of units of the \( x^{th} \) commodity consumed (\( x = 1 \) to \( n \)),
- \( R_{ij} \) = number of units of outdoor recreation consumed at \( j^{th} \) site (\( j = 1 \) to \( m \)),
- \( P_x \) = price per unit for \( x^{th} \) commodity,
- \( t_x \) = time per unit required to consume the \( x^{th} \) commodity,
- \( r_{ij} \) = time per unit required to consume recreation at the \( j^{th} \) site,
- \( a_{ij} \) = costs per unit associated with consuming recreation at the \( j^{th} \) site other than the direct fee or price for site access (if any),

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2 While many non-recreational commodities have significant associated costs, their introduction into the model developed herein would contribute little except increased notational complexity.

3 For simplicity, only one type of recreational activity is implied at each site, but the analysis could be extended to allow several forms of recreation at each site.

4 Some commodities have no significant direct time costs. For example, the consumption of electricity is a situation where \( t_i = 0 \) if one neglects the time required to turn electrical switches on and off.

5 The variable \( r_{ij} \) is subscripted to allow variation among individuals because it includes both the time directly required for participation in outdoor recreation and the associated time required to travel to the site. To reduce notational complexity, it is assumed that a separate trip is made for each unit of recreation consumed. Thus \( r_{ij} \) varies among individuals who reside different distances from site \( j \). For the same reason, \( a_{ij} \) differs among individuals and is subscripted accordingly.
\( e_j \) = price of access to the \( j \)th site per unit of recreation consumed,

\( w_i \) = wage rate per unit of time.

(all variables \( \geq 0 \))

The individual possesses a complete ordinal, transitive ranking of all possible consumption patterns embodied in his utility function:

(1) \( U_i = U_i(D_i, R_{i1} \ldots R_{im}, C_{i1} \ldots C_{in})^6 \)

The individual consumption behavior is determined by his desire to maximize his utility subject to his income and time constraints:

(2) \( I_i + w_i D_i = \sum_{x=1}^{\infty} p_x C_{ix} + \sum_{j=1}^{m} (a_{ij} + e_j)R_{ij} \)

(3) \( T_i = D_i + \sum_{x=1}^{\infty} t_x C_{ix} + \sum_{j=1}^{m} r_{ij} R_{ij} \)

By rewriting these constraints and multiplying by \( \lambda_1 \) and \( \lambda_2 \) respectively, the Lagrangian expression is formed:

(4) \[ Z = U_i(D_i, R_{i1} \ldots R_{im}, C_{i1} \ldots C_{in}) + \lambda_1[I_i + w_i D_i - \sum_{x=1}^{\infty} p_x C_{ix} - \sum_{j=1}^{m} (a_{ij} + e_j)R_{ij}] + \lambda_2(T_i - D_i - \sum_{x=1}^{\infty} t_x C_{ix} - \sum_{j=1}^{m} r_{ij} R_{ij}) \]

The necessary utility maximizing conditions are:

(5) \[ \frac{\partial Z}{\partial D_i} = \frac{\partial U_i}{\partial D_i} + \lambda_1 w_i - \lambda_2 = 0 \]

\[ 6 \text{ Note that work enters the utility function directly and hence its effect on the individuals's welfare is not limited to work's impact on income and time constraints.} \]

\[ 7 \text{ To ensure that the satisfaction of these conditions yields a maximum, the second order conditions must also be fulfilled. Therefore, the bordered Hessian determinants must alternate in sign, beginning with a negative value.} \]
The conditions in equations (5) to (7) can be alternatively stated in terms of equalities between marginal rates of substitution and relative cash-time price ratios:

(10) \[
\frac{\partial U_i}{\partial R_{i,j}} = \frac{\lambda_1(a_{i,j} + e_j) + \lambda_2 r_{i,j}}{\lambda_1(a_{i,k} + e_k) + \lambda_2 r_{i,k}} \quad \text{for all } j \text{ and } k
\]

(11) \[
\frac{\partial U_i}{\partial C_{i,x}} = \frac{\lambda_1(a_{i,j} + e_j) + \lambda_2 r_{i,j}}{\lambda_1 P_x + \lambda_2 t_x} \quad \text{for all } j \text{ and } x
\]

Where \(\lambda_1\) represents the marginal utility of money income and \(\lambda_2\) represents the marginal utility of time for the \(i^{th}\) individual.
The utility-maximizing conditions in equations (5) through (9) provide \((n + m + 2)\) equations in \((n + m + 2)\) unknowns: \(n C_{ix}\)'s, \(m R_{ij}\)'s, \(\lambda_1\), and \(\lambda_2\). Demand functions for each commodity and access to each recreation site can be derived by solving for the \(C_{ix}\)'s and \(R_{ij}\)'s. Such demand functions are, of course, contingent on continued optimizing behavior by the consumer. The general demand function for recreation at site \(j\) for individual \(i\) is:

\[
R_{i} = R_{ij}[I_i, T_i, w_i, (a_{i1} + e_1), \ldots (a_{ij} + e_j), \ldots (a_{im} + e_m), P_i \ldots P_n, r_{i1} \ldots r_{ij} \ldots r_{im}, t_l \ldots t_n]
\]

However, if the other variables are held constant, the demand function can be reduced to reflect only the relationship between the quantity of recreation consumed and the access price:
If there are no aggregation problems, the market demand for access to site \( j \) (\( Q_j \)) can be obtained by the horizontal summation of individual demands for each \( e_j \):

\[
Q_j = \sum_{i} f_{ij}(e_j)
\]

B. Aggregation Problems arising out of Quality Effects:

In outdoor recreation there may be aggregation problems arising out of the deleterious effect congestion can have on the quality of the recreational experience. Where the intensity of site utilization is a determinant of the quality of the recreational experience offered by the site, the site's characteristics cannot be assumed to remain constant when the access fee changes. A change in \( e_j \) will have an impact on \( R_{ij} \) not only because of the direct price effect, but also because the change in \( e_j \) changes the level of utilization (\( Q_j \)), thereby affecting the quality of recreation at the site and consequently the demand for access:

\[
R_{ij} = g_{ij}(e_j,Q_j)
\]

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8 Since the individual's own use cannot be regarded as contributing to congestion in his eyes, the variable reflecting level of use (the quality component that is variable with respect to \( e_j \)) should actually be \( Q_j - R_{ij} \). However, assuming there are many recreationists each of negligible importance in terms of total demand, this adjustment can be omitted.
The effect of a change in $e_j$ can be found by totally differentiating equation (18) for the $i^{th}$ individual:

\[ \frac{dR_{ij}}{de_j} = \frac{\partial R_{ij}}{\partial e_j} + \frac{\partial R_{ij}}{\partial Q_j} \cdot \frac{dQ_j}{de_j} \]

where:

\[ \frac{dQ_j}{de_j} = \sum_i \frac{\partial R_{ij}}{\partial e_j} + \sum_i \frac{\partial R_{ij}}{\partial Q_j} \cdot \frac{dQ_j}{de_j} \]

Rearranging the terms in (20) results in:

\[ \frac{dQ_j}{de_j} = \sum_i \frac{\partial R_{ij}}{\partial e_j} \]

\[ \frac{1 - \sum_i \frac{\partial R_{ij}}{\partial Q_j}}{\partial Q_j} \]

Substituting (21) into equation (19) yields the reaction of the $i^{th}$ individual to a change in $e_j$:

\[ \frac{dR_{ij}}{de_j} = \frac{\partial R_{ij}}{\partial e_j} + \frac{\partial R_{ij}}{\partial Q_j} \cdot \frac{\sum_i \frac{\partial R_{ij}}{\partial e_j}}{1 - \sum_i \frac{\partial R_{ij}}{\partial Q_j}} \]

For the market as a whole, the reaction to a change in $e_j$ is:
(23) \[ \sum_{i} \frac{\partial R_{ij}}{\partial e_{j}} = \sum_{i} \frac{\partial R_{ij}}{\partial e_{j}} + \sum_{i} \frac{\partial R_{ij}}{\partial Q_{j}} \cdot \frac{1}{1 - \sum_{i} \frac{\partial R_{ij}}{\partial Q_{j}}} \]

\[\text{price effect} \quad \text{quality effect}\]

As long as \( \frac{\partial R_{ij}}{\partial e_{j}} < 0 \) and \( \frac{\partial R_{ij}}{\partial Q_{j}} < 0 \), an increase in \( e_{j} \) will reduce the aggregate level of utilization \( Q_{j} \) less than would be suggested by the direct price effect alone because of the offsetting influence of the quality effect.

Diagramatically, the quality effect is illustrated in Figure 1. When the access fee \( (e_{j}) \) is zero, the level of use \( (Q_{j}) \) is \( Q_{j} \). \( BQ_{1} \) represents the market demand curve indicating the quantity of recreation that would be consumed at any \( e_{j} \) and reflect both price and congestion effects. As a result of the intensity of use declining as \( e_{j} \) increases, the quality of the recreational experience offered by site \( j \) is positively correlated with \( e_{j} \). Hence, the quality of the recreation improves as you move up \( BQ_{1} \).

---

9 This holds as long as recreation is not a Giffen good.

10 It is, of course, possible for \( \frac{\partial R_{ij}}{\partial Q_{j}} > 0 \) if individual \( i \) enjoys crowds and the marginal utility to him of a unit of recreation increases as \( Q_{j} \) increases.
Figure 1: Quality-Compensated Demand Curve
However, if the quality effect is removed, a second demand curve can be generated wherein recreational quality is constant for all e_j. In Figure 1, AQ_1 represents such a constant quality or quality-compensated demand curve for access to site j. The level of quality embodied in AQ_1 is the quality prevailing when Q_j = 0Q_1. If a fee of OG were actually imposed, the level of use would decline from 0Q_1 to 0Q_2. The direct price effect Q_1Q_3 is partially offset by the reduction in congestion which increases the number of recreationists willing to pay OG for access to the site by Q_3Q_2 (the quality effect). The discussion will return to the question of quality effects in Section D below.

C. Income Effects:

The preceding section indicated that different demand functions could be derived depending on whether or not the possible quality effects of varying fee levels are included. The purpose of this section is to illustrate that aside from the quality-compensated question, different demand functions could be derived depending on whether or not the income effects of varying fee levels are included. The question as to which demand concepts are relevant for the evaluational process is treated in the following section.

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11 An analogy could be drawn with income-compensated demand curves wherein the income effects of price changes have been removed (i.e. compensated for).

12 There is a family of quality-compensated demand curves, one for each possible level of congestion which is then held constant for all e_j.

13 For the purposes of this section only, it is assumed that the quality effect of changing access fees is negligible.
An individual recreationist with a portion of his indifference map (curves I, II and III) is represented in Figure 2. The recreationist has a money income of OY₂ per year. When access to the site is free, he faces a price line Y₂L₁ which enables him to consume OQ₁ visits and hence reach indifference curve III at point A.

If a positive access fee per visit is imposed, the price line pivots toward the vertical axis to a position like that of Y₂P₂. The fee is represented by the difference in the slopes of Y₂L₁ and Y₂P₂ and will be designated as f₁. Faced with price line Y₂P₂, the recreationist would move to point T on indifference curve II, where he consumes OQ₃ visits. As the fee per visit rises, the recreationist reacts by reducing the number of visits consumed. The reactions of the recreationist in Figure 2 are traced out by a price consumption curve (PCC).

Note that as the fee increases and the recreationist moves along PCC towards the vertical axis, his level of welfare or real income is changing, i.e. he is moving to lower and lower indifference curves. This is a result of the income effect of the higher fees. To remove the income effect, the recreationist must be maintained on one indifference curve while the fee is varied. Thus, starting at point A

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14 The slope of Y₂L₁ represents the on-site costs (food, accomodation, etc.) given a zero price for access. Y₂L₁ is assumed linear and originates at Y₂ implying that the individual resides very near the site and hence incurs negligible travel costs in order to reach the area. The implications of the above analysis would not be changed by allowing for significant travel costs.
Figure 2: Relationship between Compensation-Required and Willingness-to-Pay

Expenditure on all other goods ($)

Figure 3: Compensated and Uncompensated Demand Curves Derived from Figure 2

Fee ($)
with a zero fee, the effect of imposing a fee of $f_1$ is determined by pivoting the price line on indifference curve III to $Y_5 P_1$ where the slope is equal to the slope of $Y_2 P_2$. The new vertical intercept of the price line ($Y_5$) implies that the recreationist's money income has been increased to $OY_5$ to compensate him for the loss of real income due to the imposition of the fee, i.e. to remove the income effect. The individual moves from point A to point R reducing his consumption of recreation from $OQ_1$ to $OQ_4$. This movement is a reaction to the change in relative prices between recreation at this site and all other commodities, i.e. the substitution effect. If the compensation for the income effect ($Y_2 Y_5$) is not paid, the individual would move to point T and the further reduction in the number of visits consumed from $OQ_4$ to $OQ_3$ represents the income effect of the change in fee.

The individual's market demand curve is drawn in Figure 3 as $f_2 D$ and represents the recreationist's reaction to various fee levels as described by his price consumption curve PCC in the upper diagram. In other words, $f_2 D$ reflects both the income and the substitution effects. Thus, points D and M in the lower diagram correspond to points A and T respectively in the upper diagram. It is also possible to derive an income-compensated demand curve reflecting the individual's reaction to fee changes with the level of real income constant. Thus $f_4 D$ in Figure 3 reflects the individual's behavior given various fee levels if he is compensated for the income effect arising when these fees are imposed, i.e. he is maintained on
indifference curve III in the upper diagram. Points D and N on \( f^D \) in the lower diagram correspond to points A and R respectively in the upper diagram.

There is a different income-compensated demand curve for each level of real income or welfare for the individual. Accordingly, the demand curve \( f^J \) in the lower diagram is an income-compensated curve derived in a fashion similar to that of \( f^D \), but maintaining the individual at the level of welfare represented by indifference curve I in Figure 2. These demand curves can also be related to the annual value of access. To aid in the exercise, the individual represented in Figure 2 is depicted again in Figure 4. The recreationist again has a cash income of \( OY_2 \) and faces a price line \( Y_2L_1 \) when access to the site is free. Consequently, the individual's most advantageous position is point A on indifference curve III where he consumes \( OQ_1 \) visits at this site per year. Without access to the site, this recreationist would be at point \( Y_2 \) on indifference curve II and would require a minimum annual cash supplement of \( Y_3Y_2 \) to enable him to reach indifference curve III again (at point \( Y_3 \)). The annual payment of \( Y_3Y_2 \) is the minimum compensation that the individual would accept to reimburse him for the loss of his recreation. Hence \( Y_3Y_2 \) is a measure of the annual value of access to the site for this recreationist and corresponds to the area beneath the income-compensated demand curve \( f^D \) in Figure 3.

Note however, that he would not be willing to pay \( Y_3Y_2 \) per year.
Figure 4: Individual Consumption Decisions Regarding Recreation
in order to use the site. If he were faced with an all or nothing decision where in order to visit the site he had to buy an annual licence, the maximum licence fee he would be willing to pay is $Y_2X$. At this fee level, the recreationist would be indifferent between (i) not buying the licence and therefore not visiting the site which would leave him at position $Y_2$, and (ii) buying the licence and consuming $OQ_2$ visits which leaves him at position $B$. Thus, while the user would require a minimum cash payment of $Y_3Y_2$ (area under $f^D$ in Figure 3) to compensate him for the loss of his recreation, he would be willing to pay a maximum of only $Y_2X$ (which corresponds to the area under $f^J$ in Figure 3) in order to retain his access to this site. The compensation-required $(Y_3Y_2)$ will always be greater than willingness-to-pay $(Y_2X)$ as long as the income elasticity of demand for recreation at the site is positive. If the income elasticity

---

As long as recreation is a normal good and the principle of diminishing marginal rates of substitution holds, it can be shown that $Y_3Y_2$ is always greater than $Y_2X$. In Figure 4, point A must lie to the right of point B if recreation is a normal good to indicate that the number of visits consumed increases as income rises (prices constant, i.e. $Y_2L_1$ parallel to $XL_2$). Further, if the price line $Y_2L_1$ and $XL_2$ are rotated around indifference curves III and II respectively while holding $Y_2L_1$ and $XL_2$ parallel, the point of tangency on III must always lie to the right of the point of tangency on II. Since this means that the point where III has the same slope as II must always be further to the right on III, and since both II and III demonstrate diminishing marginal rates of substitution, the vertical distance between II and III must increase as one moves towards the vertical axis and $AF < Y_2X = EB < CB < Y_3Y_2$, so $Y_3Y_2 > Y_2X$. 


was zero everywhere, then $Y_3 Y_2$ would be equal to $Y_2 X$. The size of the difference between $Y_3 Y_2$ and $Y_2 X$ reflects both the degree of income elasticity and the size of $Y_2 X$ relative to the angler's income. Even if $Y_2 X$ is a small part of total income, it could represent a significant proportion of "discretionary" income, i.e. that portion of total income not committed through contract or habit to rent, food, taxes, pension plans, etc.. It is possible that the income elasticity of demand is significant for minor income fluctuations which would normally affect only the discretionary component of total income. This in turn could imply a sizeable difference between $Y_3 Y_2$ and $Y_2 X$ even when the latter was small relative to $OY_2$.

D. **Evaluational Point of View and Selection of the Appropriate Demand Concept:**

The conventional definition of a demand curve states that the demand curve indicates the maximum quantity of a specific commodity that will be purchased by a particular individual or group at each price in a given time period, other things being equal. The last phrase implies that the different points on the demand schedule differ with respect to price and quantity, but not with respect to "other things". The conventional list of other things includes (1) tastes and preferences, (2) money income, and (3) prices of other commodities. Different selections of the "other things" to be held constant will
yield different demand curves. For example, the list for the income-compensated demand curve substitutes real income for money income. Thus, there is a different conventional or market demand curve for each level of money income, while there is a different income-compensated demand curve for each level of real income.

In the preceding two sections, it is possible to identify four different demand concepts which are summarized in the chart below:

**Chart I: Four Concepts of Demands**

<table>
<thead>
<tr>
<th>Quality Effect</th>
<th>Removed or Compensated-removed or compensated-Included</th>
</tr>
</thead>
<tbody>
<tr>
<td>removed or compensated-for A</td>
<td>included C</td>
</tr>
<tr>
<td>included B</td>
<td>D</td>
</tr>
</tbody>
</table>

In this section it is argued that both cells A and D contain demand concepts that are relevant for the problem of evaluating recreational sites: the quality-compensated, income-compensated demand function where both effects are removed (cell A) and the demand function including both income and quality effects (cell D).

The concept of demand that is relevant depends on the nature of the evaluational problem, which in turn depends on the point of view.

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16 For an extensive discussion as to which definition Alfred Marshall had in mind in his *Principles of Economics* and the relative usefulness and logic of the two approaches, see Milton Friedman, "The Marshallian Demand Curve", *The Journal of Political Economy*, December 1949, pp. 463-495.
selected for the evaluation. In general, a society is concerned primarily with the welfare of its own members and will evaluate any project on the basis of benefits and costs accruing to its members. Thus in Canada, the same project is evaluated by an agency of a provincial government differently than by an agency of the federal government if the project's impacts extend over more than one province. The provincial government is primarily concerned with the impacts felt by its residents while the federal government is concerned with the impacts felt by all residents of Canada. Both governments tend to ignore all project impacts affecting non-residents of Canada except insofar as feedback mechanisms exist that permit such "foreign impacts" to indirectly affect Canadian and/or provincial residents.

a) Benefits accruing to residents of an evaluating agency's area of jurisdiction-

In outdoor recreation, benefits accrue directly to the recreationist and access to a recreational site enhances the quality of life. It is the economic value of this improvement in welfare that the evaluating agency should attempt to measure for residents of its jurisdictional area. However, society is concerned not only about the magnitude of the benefits accruing to resident recreationists, but also about the distribution of the benefits. Incorporating distributional considerations

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17 For simplicity, members of both provincial and national societies are identified with people resident within the relevant political boundaries.

18 There can be various classes of non-residents and interjurisdictional agreements that provide for preferential treatment for certain classes of non-residents.
is a difficult and complex matter. In the absence of explicit social weights to be assigned to benefits according to those receiving them, it is proposed to proceed on the assumption that the present distribution of welfare will be maintained. This does not necessarily imply that society has no intention of changing the prevailing distribution, but rather this assumption implies that regardless of the non-optimality of the current distribution, society does not wish to use the provision of outdoor recreation as a redistributional device. Therefore, recreational evaluations should proceed on Paretian efficiency principles.

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20 It can be argued that redistributional goals can be achieved more efficiently by other means and that if other redistributional policies have been implemented, incorporating redistributional goals in recreational evaluations as well could conflict with other policies or lead to redistributional "overkill".
no project should be undertaken unless it is possible for the
beneficiaries to compensate those who stand to lose. This means
that a proposed recreational site should not be developed unless the
potential recreationists are willing to outbid the alternative users
of the resources involved. Further, an existing recreational site
should not be displaced by an alternative use of the resources unless
the alternative generates sufficient net benefits to allow full
compensation to be paid to the recreationists currently using the site.
In terms of the measures of demand discussed above, resident benefits
accruing from existing non-priced sites would be valued by using a
quality and income compensated demand curve (cell A), derived from
the horizontal summation of the individual curves corresponding to
$\mu^D$ in Figure 3. The area under this aggregate compensated demand
curve would measure the minimum total compensation payments necessary
to reimburse the recreationists for the loss of their recreation.
The resident benefits anticipated from a proposed site would be valued
by using a quality and income compensated demand curve derived
from the horizontal summation of individual curves corresponding to

Pareto efficiency requires not only that compensation be possible, but that it actually be paid. The extent to which compensation actually takes place will depend on society's distributional goals. However, the assumption that recreational projects will not be used as redistributional devices implies that compensation will take place (if feasible). The costs of accomplishing whatever redistribution deemed necessary as a result of a project should be included as project costs in the evaluation.
The area under this aggregate compensated demand curve would measure the maximum fees that the potential recreationists would be willing to pay for access to the site.

The preceding discussion assumed that resident access to outdoor recreation sites will continue to be zero (or nominally) priced and therefore valued a site at the level of use corresponding to zero access fees using cell A demand concepts. However, the cell D or market concept of demand becomes relevant if access fees are actually imposed. The assumption that zero (or nominal) fees will continue to exist in the future is based on the premise that the managing agency will want to maximize the value of the site and if the marginal cost imposed by the last visit is negligible, value (net revenue plus consumers surplus) is maximized at a zero access.

The area under $f_2$, $f_J$ corresponds to Hick's "price equivalent" consumer surplus while the area under $f_4$, $f_D$ is the "price compensating" measure. The question of which consumer surplus concept is relevant is discussed in D. Patinkin, "Demand Curves and Consumer's Surplus", in Measurement in Economics, (California: Stanford University Press, 1963), and G. Brown, "Policy Questions and Measures of Consumer Surplus", (unpublished paper, University of Washington, Department of Economics). Krutilla, Cicchetti, Freeman III, and Russell, op. cit., demonstrate that the quantification of option values also must be preceded by the decision as to which consumer surplus is relevant.
price. However, if the interaction between levels of use and quality of recreation is strong, it is conceivable that maximization of the value of the site will necessitate the rationing of resident use through fees. Figure 5 depicts an example of such a situation. The level of use at a zero fee is OD and JD represents the market demand curve reflecting both the income and quality effect of varying access fees (a cell D demand function). The imposition of an access fee of BC dollars would reduce use from OD to OH, as indicated by JD. One consequence of imposing such a fee would be to raise the quality of the recreational experience by reducing congestion. This could increase the value of the site. In Figure 5, AD represents the income and quality-compensated demand curve (cell A) relevant at a zero fee with a level of use of OD. In other words, AD represents the willingness of recreationists to pay for access to the site given constant real incomes and constant quality at the level associated with OD visits per unit of time. Only OC recreationists would be willing to pay BC for access given this level of quality. However, if the fee BC is actually imposed, it rations access and raises the quality, increasing the number of recreationists willing to pay this fee. While the reduction in real income caused by the fee sets up a counteracting influence, the net result in Figure 5 is indicated by FG. FG is the quality and income compensated demand curve (again a cell A function) consistent with a fee of BC and a level of use OH.
Figure 5: Congestion as a Demand Shifter
Accordingly the value of the site at a fee of zero is OAD, while at a fee of BC the value rises to OFEH. As long as the increase in consumer's surplus for the remaining users (AFEK) is greater than the loss of consumers surplus for the excluded users (HKD), the value of the site will increase as the fee increases. When evaluating either an existing or proposed recreational site, it is relevant to ask what the value of the site would be if properly managed - even though there is some uncertainty as to whether or not the management will be optimal.

It is, of course, possible to ration access to a site without using fees, but non-price rationing has significant welfare implications as has been demonstrated by Seneca. Following Seneca's approach, Figure 6 represents a recreational site able to handle up to OC visits without serious quality effects. The marginal operating costs per visit are assumed to be zero. The number of visits demanded at a zero fee is OD as indicated by the market demand function AD. Assume that the site is to be managed with a capacity constraint of OC, i.e. to prevent congestion no more than OC visits will be allowed in each time period. If price rationing is used, the access fee will be set

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23 Even if fees are thought to be politically undesirable at present, the cost of not rationing use through fees (which again requires knowledge of the quality-fee relationship) may become sufficiently high to cause governments to alter their pricing policies.

Figure 6: Welfare Effects of Zero Pricing
at OP per visit and the value of the site will be OABC (composed of revenues totalling OPBC and consumers surplus of PAB). The use of price-rationing ensures that the OC users who do gain access to the site are those who value access most highly as measured by their willingness-to-pay. If, however, access is rationed on a first-come, first-served basis, some of the recreationists on the BD portion of the demand curve will gain access hence displacing some of the recreationists on the AB portion. Accordingly, the value of the site, as measured by willingness-to-pay, will fall. If all users have an equal probability of gaining access, non-price rationing will generate a site value of OAC, with AC representing the willingness-to-pay of those who gained access on a first-come, first-served basis. The cost to society of using non-price rationing is the area ABC. Seneca's model can be extended to show non-price rationing can also lead to over-expansion of facilities. The demand for additional capacity is represented by the portion of the market demand curve excluded from access by the capacity constraint. Under price-rationing, the demand for new capacity is BD. However, with non-price rationing many of the recreationists excluded from the existing site by the capacity constraint are from the AB portion of the market demand curve and are willing-to-pay more for access than some users who have access. Hence the curve reflecting willingness-to-pay for access to a new site is ED. So, if price rationing is used at the existing site, the value of
expansion to service the CD recreationists excluded by the capacity constraint is represented by the area BCD. If non-price rationing is used at the existing site, the value of expansion of capacity to OD is the area ECD.

b) Benefits accruing to non-residents of the jurisdictional area-

For non-residents, the direct benefits from participation in recreational activities are irrelevant except to the extent that they affect resident incomes through revenue received from licence fees, indirect taxes, and expenditures on gas, food and accommodation. In other words, whether evaluating an existing or a proposed recreational site, the relevant question is: What will be the net increase in resident incomes resulting from allowing non-resident access to the site?

The total net benefits arising from non-resident access to a recreational site (B) can be expressed in functional form:

\[ B = R + T + E + A \]

where

- \( R \) = total revenues from access fees and/or licences net of costs incurred to provide non-resident access to the recreational site,
- \( T \) = total revenues from indirect taxes arising out of non-resident expenditures net of collection costs,
- \( E \) = total non-resident expenditures (excluding indirect taxes) on goods and services within the jurisdictional area net of the costs of providing the goods and services,
- \( A \) = total net benefits arising out of any interjurisdictional agreements involving recreational access privileges.

25 It is also possible that direct interjurisdictional agreements would be arranged to provide access privileges to non-residents on a reciprocal basis or in exchange for interjurisdictional transfer payments.
To estimate both revenue from user-fees and benefits from other non-resident expenditures, it is necessary to derive the demand schedule that indicates the number of non-resident recreationists forthcoming at any given fee. Hence, the demand schedule that is relevant for non-residents is the market or "uncompensated" demand schedule (cell D) that reflects both income and quality effects of imposing access fees. If fees are charged on a per visit basis, then the individual curves corresponding to f2D in Figure 3 should be adjusted for the quality effect and horizontally summed. If fees are charged on an annual basis, then an array of the maximum amounts the recreationists are willing to pay for annual fees is relevant. For the individual in Figures 2 and 3, this corresponds to Y2X in the upper diagram and the area Of2J in the lower diagram which must still be adjusted to reflect the quality effect.

26 It has been implicitly assumed herein that there are no net benefits from resident expenditures attributable to any one specific site. This implies that elimination of a recreational site would divert resident users to alternatives that involved similar expenditure patterns.
Chapter Three

Techniques for Evaluating Non-Marketed Recreational Resources

A. Introduction:

The most common approaches to the problem of quantifying recreational benefits are presented in this Chapter. They have been allocated to three categories. First, a group of "misdirected" techniques that have one flaw in common: they do not value the recreation, but rather provide evaluational rules of thumb that sidestep the issue. Accordingly, these techniques are reviewed very briefly. The second category is reserved for techniques that are theoretically acceptable, but because of practical limitations are unlikely to be applied. There is only one entry in this category. The third category contains five market simulation techniques that appear sufficiently promising, both conceptually and practically, to justify critical examination. In this category are four variants of an indirect technique that use differences in travel costs as proxies for prices to simulate a market for access to a recreational site, and a direct interview technique that relies on interviews with recreationists to establish their behavior in a hypothetical market for recreational access.

Each of the techniques in the third category is stripped down to its theoretical skeleton in a search for relative structural strengths and weaknesses. Empirical tests of some of the basic assumptions of the techniques are devised and applied in Chapters Four and Five.
B. **Spurious Techniques:**

1) **Benefits equal project costs:**

Used mainly to evaluate proposed developments, this approach estimates the cost of the recreational project and then would assign a value to the expected recreational benefits equal to this estimated cost (or some multiple of the cost). Hence without any direct consideration of the recreational benefits, this method assigns all recreational projects a benefit-cost ratio of one (or the benefit multiple), conceivably justifying all proposed developments and rendering them all equally desirable. As a result such a technique is irrelevant as a basis for allocative decisions.

2) **Butcher-shop valuation:**

For application to existing hunting or sport fishing resources, it has been suggested that an estimate of worth can be found by calculating the market value for the fish or game caught. However, while a successful hunter or angler does significantly lower his annual food costs through his participation in these activities, it is unrealistic to regard "meat" as the sole objective of either hunting or sport fishing. The basic objection to this technique is that it evaluates meat, not recreation.

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1 Examples of this approach as used up to 1958 by the Bureau of Reclamation and the National Park Service in the U.S., are given in Andrew H. Trice and Samuel E. Wood, "Measurement of Recreation Benefits", *Land Economics*, August 1958, pp. 196-207.

2 For an example, see British Columbia, Department of Recreation and Conservation, Game Management Division, Fish and Game Branch, "Inventory and Evaluation of the Wildlife Resource of British Columbia", in *Inventory of the Natural Resources of British Columbia*, D. B. Turner, editor, published by the British Columbia Natural Resources Conference, 1964, pp. 560-574.

3) **Benefits equal gross expenditures:**

One of the more common methods of evaluation is based on equating the gross expenditures users make to visit an existing recreational site with the benefits generated by the recreational resource. Yet, regardless of the level of gross expenditures, the recreational opportunity itself is enjoyed free even though the recreationist would likely be willing to pay some positive price rather than be excluded from the site. Again, the recreational benefits themselves are not valued. If a recreational resource was eliminated, the intramarginal recreationists using it would suffer a welfare loss as a result of being forced to their second choices. It is this welfare loss that measures the value of recreational benefits to the recreationists and it cannot be measured by gross expenditure techniques.

4) **Benefit equals foregone earnings:**

Assuming that a recreationist has the choice between recreation and working, it has been suggested that the value of the time spent participating in an outdoor activity could be calculated on the basis of the recreationist's foregone income. Were all work and recreational activities perfectly divisible, the marginal value of the last hour spent in the

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4Average expenditure per angler-day is the measure of the economic value of a day of sport fishing used by D. E. Pelgen, "Economic Values of Striped Bass, Salmon and Steelhead Sport Fishing in California", *California Fish and Game*, Vol. 41, No. 1, 1955. A gross expenditure approach was also used by L. Mahoney, "An Economic Evaluation of California's Sport Fisheries", *California Fish and Game*, Vol. 46, No. 2, 1960.


pursuit of each activity (net of associated costs) would be equal to the hourly wage rate. In the short run, the use of foregone income as an evaluational technique for recreation ignores the indivisibilities inherent in recreationists' consumption possibilities resulting from fixed work weeks, and the highly significant investments of time and money necessary to reach many recreational sites. The former inhibits marginal adjustments between working and leisure, while the latter inhibits marginal adjustments among the various types of recreation (at least those pursued at different sites). As the time period under consideration lengthens, these indivisibilities tend to disappear and at the margin, foregone income and recreational benefits would move towards equality. However, the problem of valuing the intramarginal units of recreational activity would remain.

A variant of this technique claims that recreation is a complementary factor to labor and therefore should be credited with a portion of the value of real production equal to the proportion of total time spent in leisure activities. Once more, the basic flaw is that this variant is not directed to evaluating direct recreational benefits and allocating them to specific sites and activities.

This implies that the number of hours worked affects an individual's welfare only through the effect on his income and on the number of hours available for non-work activities. However, in the model developed in Chapter II work is explicitly included as a variable in the individual's utility function. Equation (5) in Chapter II indicates that the utility loss from reducing the number of hours worked by one is $\lambda_1 w^1 - \lambda_2$. As long as $\lambda_2 > 0$, $\lambda_1 w^1 - \lambda_2 < \lambda_1 w^1$ and the "price" of an additional hour of leisure is less than the wage rate. In other words, at the margin the utility of one hour of leisure is equal to the utility of the income derived from one hour of work minus the disutility of one hour's work. If it is valid to assume that work at the margin involves some direct disutility for the individual, the use of foregone income to value time spent in recreational pursuits could lead to significant overstatements of recreational benefits.

5) **Benefits expressed in merit-weighted user-days:**

Recreational resources are rated according to the number of merit-weighted user-days they produce. The merit-weights are subjective and based on such factors as availability of alternatives in the area, the income groups served, density of population in the area, and so on. In spite of the problems of subjective weighting, this technique may have some potential in terms of ranking competing recreational projects. However, the major objection here is that approaches of this nature still provide no basis for a priority ranking of competing recreational and non-recreational developments.

C. **Techniques of Limited Applicability:**

**Use of Values Arising from Comparable Private Recreational Resources:**

A value for recreational benefits offered by a public site could be estimated on the basis of an analysis of recreationists' reactions to the existing prices established for privately owned recreational resources. However, while this technique has some merit conceptually, there are two basic obstacles to overcome. First, for many major recreational areas, finding an acceptable degree of correspondence between the public and private recreational sites may be difficult. Secondly, prices at private sites will often be largely determined by pricing policies at competing public sites. But if the number of private recreation sites comparable to public sites increases in the future, so will the number of situations in which this technique may be applicable.

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10 This possibility is mentioned by both Crutchfield, *op. cit.* , and by R. A. Spargo, *op. cit.*
D. Market Simulation Techniques:

Indirect Travel Cost Techniques:

The idea of using differences in the travel costs incurred by recreationists to value recreational benefits was first suggested by Harold Hotelling in 1947. Hotelling's basic approach has been considerably modified by other researchers and four variants of this technique are analysed below.

1) The Hotelling-Clawson Variant:

a) The Conceptual Framework:

The Hotelling-Clawson variant evolved directly from the original Hotelling proposal. In its simplest form, this variant defines concentric geographic zones around the recreational site, and the users are grouped according to the zone in which they reside. The visitation rate for each zone is calculated and plotted against the travel cost that the average visitor from that zone incurs when visiting the site. The result can be graphically presented as in Figure 7.

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Assuming for purposes of illustration that Figure 7 refers to a sport fishery, then AA' is the angler-visititation rate for the first zone which has an average travel cost of OA for a trip to the fishery. Similarly, BB' is the angler-visititation rate for zone two whose residents incur an average travel cost of OB to reach the site, and so on for all eight zones. The curve HA' (assumed linear for diagrammatic simplicity) can be regarded as an estimate of the demand curve for zone one. If zone one users were charged a licence fee of AB dollars, they would then incur a total cost of $AB + OA = OB$, the current cost of zone two users. As long as the only factors that vary from zone to zone are distance and population, the visitation rate for zone one should be the same as for zone two if the costs involved in getting to the site are the same in both cases, i.e. the difference in distances is adjusted for. Thus zone one users would be willing to purchase BB' licences per 100,000 population at a fee of AB. A licence fee of AC dollars would result in an angler-visititation rate of CC' for the first zone, and so on. Through similar reasoning, HB' is an estimate of the zone two demand curve, HC' is an estimate of the zone three demand curve, and so on. The horizontal axis of Figure 7 is converted to normal quantity units by multiplying by the population of the zone divided by the size of the population unit used. The aggregate demand curve for all zones is equal to the horizontal summation of the zonal demand curves.

In the concentric zone version, one zone often includes many heterogeneous areas, but the averaging process implicit in the formation of the zones "washes out" the differences in socio-economic characteristics among the zones. However, the use of political subdivisions such as
Figure 7: Relationship Between Travel Costs and Visitation Rates for a Hypothetical Recreational Resource

Source: Adapted from Scott, op. cit., p. 28.
counties for zones, allows greater precision in isolating the impact of the various socio-economic factors. In the more sophisticated applications of this technique, the boundaries of the geographic zones are chosen to conform with borders of administrative units so that information on socio-economic variables such as income, population density, family size, and so on can be obtained for each zone. A multiple regression analysis is used to estimate a visitation prediction equation wherein the annual number of visits from a zone is "determined" by the zonal population, the distance to the site, and the socio-economic characteristics of the zonal residents. This visitation prediction function is then used to estimate the number of recreationists that would be forthcoming from each zone for various hypothetical changes in distance and hence travel costs. Aggregating the number of visits over all zones for each travel cost increment yields the demand schedule for access to the site.

b) **Analysis of the Weaknesses:**

(i) **The identification problem:**

The theoretical framework developed in Chapter Two is based on a model wherein consumer behavior is determined by a desire to maximize utility within the context of a given preference function subject to constraints on time and income. With respect to the consumption of recreation at a specific site \( j \), the behavior of the \( i \)th individual was summarized in the general demand function reproduced below from Section A of Chapter II:
Aggregation of the individual demand functions yields the market demand function.

Empirically, to begin with the estimation of individual demand functions is an almost impossible task given the constraints facing most researchers. The Hotelling-Clawson variant starts, instead, by defining geographical zones and trying to estimate a group demand function for the people residing within each zone. In order to estimate these group or zonal demand functions, the observed behavior of residents of one zone is used to predict how residents of another zone would respond to a hypothetical situation (the imposition of an access fee on the recreational site in question). To be valid, this "transfer of behavior" requires that there be the same pattern of preferences within every zone. This point can be demonstrated by reviewing the steps involved in the Hotelling-Clawson approach.

Information is collected on visitation rates, socio-economic characteristics and travel costs for a number of zones using a specific site j. On the basis of this information, a visitation rate prediction function for all zones is estimated (for simplicity, income is the sole socio-economic characteristic used in this example);

\[(25) \quad Q^z_j = f(Y^z, a^z_j)\]

where \(Q^z_j\) = the annual visits per unit of population from zone z to site j,

\[Y^z = \text{median family income in zone } z,\]
\[ a_j^z = \text{average travel cost per visit incurred by residents of zone } z \text{ in order to use site } j. \]

Now, if \( e_j \) is defined as the hypothetical access fee at \( j \), the demand function for residents of zone one can be estimated by inserting the appropriate value for \( Y^1 \) in the visitation rate prediction function (25), while substituting \( (a_j^1 + e_j) \) for \( a_j^1 \) and using various values of \( e_j \). Following this procedure for each zone and horizontally summing the results yields the total demand schedule.

Note that the same functional relationships between income and visitation rates, and between travel costs and visitation rates are assumed to hold for all zones. This is apparent in the derivation of the visitation rate prediction function wherein all the observations from the various zones are regarded as arising from one set of functional relationships. Hence the same visitation rate prediction function is used to generate all of the zonal demand curves.

There are at least three reasons why this approach could face a serious identification problem, the first of which is the assumption of similar preferences among zones. As the above discussion demonstrates, the assumption of similar preferences among zones is a crucial one for the Hotelling-Clawson variant to ensure the observed data did not arise from a number of different zonal demand functions. If zonal demand functions did differ in terms of either their form or the coefficients (as would be the case with differing preferences among zones), it would obviously be inappropriate to try and fit a single visitation rate function to the observed data and then use this
function to estimate zonal demand functions all with the same form and coefficients. Yet there is reason for doubting the validity of the assumption of similar preferences. An individual's tastes are one determinant of where he lives. Accordingly, people seek environments that they find attractive and the proportion of outdoor recreation enthusiasts in the population should increase as we move towards a major recreation area. To the extent this occurs, the simulated demand schedule will be biased downward (if all other factors remain constant). Furthermore, the concentration of enthusiasts near a recreation site will tend to be strengthened over time by the direct relationship between present opportunity and future demand discussed in Chapter One. A minimum level of skill or habituation is a prerequisite for many forms of outdoor recreation. These skills will be more highly developed and more widely spread in the zones near recreational areas where the opportunities to practice such skills are readily available. Therefore, demands for recreation in areas near recreational sites may be greater than would otherwise be expected as a result of the availability of recreational opportunities. Again, this would bias the simulated demand curve downward. On the other hand, demands for outdoor recreation amy be higher in highly urbanized areas if the intensity of the desire to visit an area is directly related to the degree of difference between the physical characteristics of the recreational area and the residential area.
The second reason for an identification problem arises out of the present incomplete state of our knowledge regarding individual recreational decision-making. Limited understanding of how consumers formulate their recreational plans raises the possibility of significant variables being omitted during the estimation of the visitation rate prediction function. For example, many applications of the Hotelling-Clawson approach have not included variables reflecting the availability of alternative recreational sites. This implies either that all zones face similar spectra of alternate sites or that there are no good substitutes for the site in question. If alternate sites do exist, then the fact that recreational sites are often geographically clustered in areas possessing the requisite natural attributes makes it likely that the alternatives available to the various zones will differ with respect to both quality and distance. Even if there are no recreational sites comparable to the one being evaluated, it should not be assumed that substitutes for a visit to one recreational site are restricted to visits to similar sites for similar activities.

13 A number of studies have included proxies for the number of alternative recreational sites facing zonal residents as a variable in the visitation prediction function. For example, see Leonard Merewitz, op. cit., and Herbert W. Grubb and James T. Goodwin, "Economic Evaluation of Water-Oriented Recreation in the Preliminary Texas Water Plan", Report No. 84 of the Texas Water Development Board, Austin, Texas, September 1968.
As is apparent in the general demand function represented by equation (15), substitutes for visits to recreational sites may involve entirely different types of commodities. Thus, possible substitutes for a day of sport fishing at a particular lake may not just include fishing at other sites, but may include golfing, or attending an art auction. In addition to alternatives or substitutes, zonal visitation rates may also be affected by the availability of goods and services complementary to outdoor recreation such as boats, camping gear, and so on. Were there to be differences in the availability of substitutes and/or complements among the various zones, the omission of variables designed to reflect these influences could invalidate the estimated visitation rate prediction function.

Finally, an identification problem could also arise because residents of different zones are not consuming precisely the same commodity when they visit the same site. Recreationists formulate recreational travel plans within the context of the total recreational experience - anticipation, travel to the site, on-site experiences, travel home, and recollection. Residents of different areas visiting the same site will enjoy different total recreational experiences, even though all on-site characteristics of the visit are the same, simply because their trips to and from the site differ. Consequently, the Hotelling-Clawson technique yields inaccurate values for recreational sites because it is based on the observed behavior of  

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of recreationists whose trip decisions do not reflect considerations of site characteristics alone, but the total recreational experience which differs for residents of different zones. This problem becomes more severe as the travel experience to and from the site increases in importance. Where a major travel component exists, visitation rate data for any one site may have to be viewed as information regarding consumption of a variety of different commodities for residents of the various zones.

(ii) Assumption of Rationality with Respect to Fees:

Implicit in the Hotelling-Clawson approach is the assumption that recreationists will regard increases in travel costs and fees for access that are equal in value as being equivalent. Due to the North American tradition of free or nominally priced access to outdoor recreation, there may be some adversion to the concept of charging fees for access. Since the need for market simulation techniques exists only as long as outdoor recreation is not marketed, the external diseconomies involved in using fees as allocative devices are irrelevant as long as the fees are not actually imposed.

However, section D of Chapter Two identified two situations when an evaluation of a recreational site must consider the quality effect of imposing fees. The first involved resident use at a site where strong interaction between the intensity of use and the recreational quality necessitated rationing of use through fees in order to determine maximum potential value of the site. The second situation arose when
evaluating use of a recreational site by people who are not resident within the jurisdictional area of the agency concerned. All indirect travel cost techniques generate quality-compensated demand schedules reflecting the current level of utilization, but with the income effects included since they are based on differentials in travel costs actually incurred. The result is a cell B demand function.

(iii) **Choice of Zonal Boundaries:**

Before this technique can be applied, it is necessary that the recreationists be dispersed over a sufficiently wide geographical area to allow meaningful differences in travel costs to exist. As long as the only factor affecting visitation rates is the distance to the site, and the visitation rate is a continuous function of distance, then the concentric zone and the administrative sub-division versions of the Hotelling-Clawson techniques will both give the same results. If distance is the only significant variable but the relationship between distance and visitation rates is discontinuous, then for either version the zones would have to be small enough to locate the discontinuities. However, distance is not the sole factor influencing the degree of participation in outdoor recreation, but rather distance is simply one of a wide spectrum of variables that are potentially relevant.

15 Such as may be the case if employment opportunities are indivisible and the income opportunity cost of time is incorporated in the travel cost estimates - see A. D. Scott, op. cit., pp. 32-35.

Since the concentric zones combine areas that may be hundreds of miles apart, they tend to average out the differences among the zones - even though there could be considerable heterogeneity within each zone. As a result, the concentric zone version is likely to be a less effective method of isolating the influence of factors other than distance. The version using administrative sub-divisions as zones can more readily measure the influence of such socio-economic variables as income, population density, and so on since these data are usually available for sub-divisions such as counties and census divisions. As the number of administrative zones increases in any area, more variation in the characteristics of the zones is likely and the influence of such variations on visitation rates can be observed. Accordingly more variables may be included in the visitation prediction function. However, since the zonal boundaries must coincide with the borders of political units, the degree of discretion that can be exercised in the selection of zonal boundaries is severely circumscribed; and there may be a considerable spread in travel cost necessary to reach the site from within one zone.

(iv) Choice of a Travel Cost Coefficient:

Suppose the cash travel cost (T) a recreationist incurs is a simple function of the distance he must travel in miles (D) such that

\[ T = cD \]

where c is a constant cost per mile in dollars. The estimation of c is

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of considerable importance since any change in c causes a proportionately equal change in the height of the demand curve (see Figure 7).

When determining c within the context of the Hotelling-Clawson variant, expenditures en route are of interest only to the extent that they represent purchases of "intermediate" goods, i.e. goods necessary to reach the site. Any additional expenses incurred unnecessarily in order to drive on a more scenic road or to dine in luxury are not relevant. Expenses incurred during the trip that would have been incurred anyway should also be ignored. An example here would be part or all of the trip food expenditures. Thus, actual costs could exceed the minimum necessary costs by a considerable margin, but c should be based on the latter. The matter is further complicated by the fact that decisions to visit a recreational site are based on costs recreationists anticipate incurring. The definition of c used should reflect only those cost components actually considered by recreationists when making trip decisions. For sites with a high proportion of users making their first visit, the demand schedule could be biased up or down depending on whether recreationists tend to under or over estimate travel costs.

Another problem facing proponents of travel cost techniques is the fact that individuals face both income and time constraints. Hence, in Chapter Two the cost to individual i of visiting site j is made up of a cash component \( a_{ij} + e_j \) and a time component \( r_{ij} \). The difficulty arises when one tries to empirically derive cash equivalents of time costs to enable both costs to be expressed in monetary units.
Several researchers have used the wage rate as the individual's opportunity cost of time. The problems with this approach revolve around possible differences in the individual's attitude toward travel and work, and around the indivisibilities resulting from the fixed nature of many employment opportunities (at least in the short run) and the significant travelling time necessary to reach many recreational sites. Both factors inhibit marginal adjustments in the amount of time worked and raise questions about the validity of this approach. Yet there is no superior alternative available and to work only with cash costs of travel introduces a significant downward bias in the demand schedule estimated by the travel cost techniques.

(v) **Inability to Handle Multiple-Purpose Trips:**

The use of the Hotelling-Clawson technique should be limited to sites which are primarily used by recreationists on single purpose trips. Thus this technique is most applicable for hunting areas, sport fisheries, and general recreational sites used mainly for day or week-end visits. The Hotelling-Clawson approach should not be used where a site is heavily utilized by recreationists making multiple-purpose trips, i.e. trips in the course of which they visit more than one recreational site, and/or have non-recreational objectives. In the case of multiple-

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19 In terms of the type of model presented in Chapter Two, entering work and travel time as explicit variables in the utility function would mean that the wage rate represents the recreationist's opportunity cost of travel time only if the marginal disutility of work and travel were equal.

20 See Scott, *op. cit.*
purpose trips, the visit to one site is part of a "joint product" and
the problem of correctly allocating joint travel costs among the various
trip objectives has not been solved. To allocate all of the travel
costs incurred on a multiple-purpose trip to any one site could seriously
bias the estimated demand schedule upward.

The extent of the bias introduced by treating all users as single-
purpose visitors is estimated in an empirical context in Chapter Five.

(c) **Empirical Testing:**

As was indicated in Chapter One, direct empirical testing of the
demand functions obtained by the Hotelling-Clawson variant is not
possible. However, this variant is applied in Chapter Four in order
to provide information on the validity of some of the basic assumptions
of the Hotelling-Clawson approach.

The application of the Hotelling-Clawson variant in Chapter Four
is used to illustrate the sensitivity of the approach to the decision
regarding the type and number of zones to be utilized, and to the
possibility of differences between the travel costs a recreationist
remembered incurring and those he anticipated incurring.

In Chapter Five, the results of the other techniques provide the
basis for additional comparative testing of assumptions. Here the
sensitivity of the Hotelling-Clawson approach to the existence of
recreationists making multiple-purpose trips is examined in an empirical

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21 One exception arises when the visit to a site is a side-trip which did
not form part of the original trip plans. In this case, the increment
in total trip costs attributable to the side-trip can be used. However,
this implies a need for vastly increased amounts of data on individual
recreationists.
context. The results of the interview approach allow testing of the basic assumption of similar preferences. This assumption implies that recreationists who are similar in all respects except for their place of residence would view access to a site as equally valuable if there were no differences in distance and hence travel costs. Accordingly, there should be a strong inverse relationship between the distance recreationists travel and the maximum amount they are willing to pay for access to the site (other things being equal). Wherever this inverse relationship does not exist, the Hotelling-Clawson variant cannot be accepted as a valid evaluational technique. Therefore, the relationship between distance travelled and willingness-to-pay is empirically investigated in Chapter Five.

2) The Pearse Variant:

a) The Conceptual Framework:

While the Pearse Variant uses travel cost differentials as proxies for prices, this approach works with income groups rather than distance zones. Users are divided into income groups and, within each income group, the recreationists are assumed to have highly similar preferences with respect to the site in question. Thus two recreationists who belong to the same income group but who live different distances from the site, can be depicted on the same indifference map. Figure 8 represents two such individuals, "m" and "x", both of whom make only one trip per year.

Both m and x have an annual income of OY and face parallel price lines, PmRm and PxRx respectively, whose slopes represent the daily on-

See Pearse, op. cit.
Figure 8: Two Recreationists with the Same Income

Expenditure on all other goods ($)

\[ Y - P_x = T_x \]
\[ Y - P_m = T_m \]

Source: adapted from Pearse, op. cit., p. 90.
site costs such as food and lodging. Since accommodation, food, rental equipment, and so on are all available at a variety of prices (implying a variety of possible slopes for the price lines), the assumption of similar preferences must be extended to ensure both m and x chose to incur similar daily on-site costs. The travel costs incurred reaching the site are \( Y_{px} = T_x \) and \( Y_{pm} = T_m \) for x and m respectively, where the latter resides further from the site. Recreationist x consumes \( Q_x \) angler-days on his visit while m consumes \( Q_m \). Recreationist m is a marginal user in that if his travel cost exceeded \( Y_{pm} \), he would not consume any recreation at the site. Consumer x, on the other hand, would be willing to pay an additional \( P_m P_x \) in travel costs or, presumably, as a fee for access to the site rather than forego his trip. Accepting the above assumptions, the maximum any user would be willing to pay for a licence (F) can be determined by subtracting his actual travel cost from that incurred by the marginal user in the relevant income group (Tm):

\[
F = T_m - T_x
\]

If the above equation is applied to each member of the income group, the demand schedule for the group is obtained. Horizontal summation of the group demand schedules yields the aggregate demand schedule.

b) Analysis of the Weaknesses:

(1) The Identification Problem:

There were three reasons why an identification problem could arise using the Hotelling-Clawson Variant: invalidity of the assumption of similar preferences, omission of significant variables, and differences
in the commodity consumed by different zones. These problems also face users of the Pearse Variant albeit in a modified form.

The Pearse Variant avoids the assumption implicit in the Hotelling-Clawson approach that residents of different zones will have similar preference patterns. However, in order to avoid this assumption, the Pearse technique substitutes an assumption of similar preferences within each income group which implies a uniform level of gross benefit within each group (YPm in Figure 8). Yet, the greater the enthusiasm for an activity the greater the willingness to incur high travel costs. Therefore within any income group, the recreationist coming from the greatest distance (who, as "marginal user", sets the uniform level of gross benefit for his group equal to his travel costs) is likely to be an unusually avid recreationist. To assume all other individuals in his income class are equally enthusiastic about the sport could introduce a significant upward bias in the estimated demand schedule. With respect to the second reason an identification problem might arise, the lack of knowledge regarding recreationists' decision-making raises the possibility of omission of important variables affecting decisions within income groups. Finally, members of the same income group residing in different regions consume different total recreational experiences due to the difference in the trip to and from the site.

Even though both the Hotelling-Clawson and the Pearse Variants are based on assumptions regarding similarities in preferences, the implications of the assumptions differ because in the former variant

22aOn the other hand, the most distant user may not in fact be a marginal user and to treat him as such introduces a downward bias.
similar preferences are assumed among geographically distinct groups while in the latter variant similar preferences are assumed for the individuals within an income group. In one sense, the assumption of similar preferences is weaker (and therefore preferable) in the Hotelling-Clawson approach than under the Pearse technique. The Hotelling-Clawson variant averages behavior over the zonal recreationist population, whereas the Pearse Variant relies on individual behavior to set a uniform level of gross benefit within each income group. As a result, the latter technique is more sensitive to the assumption of similar preferences than is the former variant. If both versions of this assumption are valid, then the two techniques should give similar results since both register the effects of differences in distance and in income on the decision whether or not to visit a recreational site.

(ii) **Delineation of Income Groups:**

When estimating the demand schedule for any income group, the key element is the travel cost incurred by the most distant user since this cost is assumed equal to Tm in equation (27):

\[
F = T_m - T_x
\]  

(27)

The estimates of Tm for the various income groups could be quite sensitive to the choice of income class limits. If a direct correlation between income and Tm is observed over all groups, a direct relationship can also be expected to hold within each group. Under these circumstances, the recreationists travelling the greatest distance within each income
group will tend to have incomes at or near the upper limit of the group. Referring back to Figure 8, if x's income were OZ and m's OY, both would be marginal users (i.e. willing to pay no additional cost or fee). But if m and x were in the same income group, the Pearse technique would indicate x was a marginal user (travel cost ZPₓ) and imply a willingness on the part of m to pay an additional fee of ZPₓ - YPₘ > 0. In other words, if there is a direct correlation between Y and D, it introduces an upward bias in the demand schedule that increases in size as the "width" of the income classes expands (i.e. number of groupings is decreased). Limiting the size of income classes and expanding their number to minimize the importance of this problem necessitates increasing the sample size to allow for a reasonable number of observations in each class to ensure capturing the marginal users.

(iii) Other Limitations:

The limitations imposed on the Hotelling-Clawson technique because of its inability to cope with multiple-purpose recreationists also applies to the Pearse Variant as does the need for a sufficiently wide geographical dispersion of users to create meaningful differences in travel cost. Since both variants assume recreationists would react the same way to fees and to travel cost changes of equivalent value, both ignore the possibility that fees act as a demand shifter because they ration use and thereby affect the quality of the recreational experience.

²³ZPₓ - YPₘ > 0 as long as the income elasticity of demand is positive, see footnote number 15 in Chapter Two.
Finally, both variants are sensitive to any systematic error recreationists make when estimating their travel costs in the process of deciding whether or not to visit a site.

c) **Empirical Testing:**

As was the case with the Hotelling-Clawson variant, the assumption of similar preferences in the Pearse technique implies a strong inverse relationship between willingness-to-pay for access and distance travelled for the recreationists within each income group. This relationship is empirically tested in Chapter Five.

It was noted above that a direct relationship between Y and D within income groups meant the demand schedule would rise as the range of income covered by one income group increased. One test for the presence of this bias is to check the relationship between distance travelled and duration of the trip. In Figure 8, if both m and x have incomes of OY, the greater the distance travelled, the shorter the trip (due to the income effect of increased travel costs). So we would expect a strong inverse relationship between D and Q. However, if the more distant users have higher incomes, then this will tend to offset the income effect of increased travel costs. For example, giving x an income of OZ yields a longer visit for x even though he travels further than m (travel cost now = ZP\_x). A direct relationship between D and Q within an income group likely indicates a high degree of sensitivity to the choice of group boundaries - an essentially arbitrary decision. Therefore, the application of the Pearse variant
in Chapter Four requires an investigation of the relationship between distance travelled and the duration of the trip for the recreationists within each income group.

Finally, the significance of anglers making multiple-purpose recreational trips and households containing varying numbers of recreationists is explored in terms of the effect on expressed willingness-to-pay in Chapter Five.

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3) The Ullman-Volk Variant:

a) The Conceptual Framework:

Both the Hotelling-Clawson and the Pearse Variants have been applied only to existing recreational resources. However, the Ullman-Volk Variant can impute values to either existing or proposed recreational developments. Further, the Ullman-Volk Variant involves no "transfer of behavior" either among zones or within income groups.

For existing sites, this technique assumes that each recreationist carefully considers all available sites and the costs associated with visiting each of them before he decides which site he will use. If the particular site he selects as his first choice is not available, then he is diverted to his second choice which is assumed to be more distant. The extra costs he must incur as a result of this diversion to the second site represents a locational rent attributable to the first site. The summation of these locational rents over all recreationists yields the value of the first site.

This concept of estimating locational rents was originally applied by Ullman and Volk to a hypothetical recreational site serving one major urban center (St. Louis). An attendance prediction model was derived from observed relationships between distance from St. Louis and attendance at similar recreational sites, all of which were more distant from the city than the hypothetical site. This model was used to estimate the number of "potential" St. Louis recreationists, those recreationists willing to travel far enough to reach the hypothetical site but not far enough to visit any of the existing sites. Since many of these "potential" recreationists were intra-marginal, they were willing to travel further than was necessary to reach the proposed site. The difference between the distance to the hypothetical site and the maximum distance they were willing to travel was the locational rent in mileage terms attributed to

the proposed site. Summed over all "potential" recreationists, this figure represents the distance saving to this group that would result from the development of the new site.

However, there is another source of demand for the proposed site - the existing recreationists. Interviews at the existing recreational sites cast light on the extent to which the hypothetical site would divert users from the existing sites. The estimated number of diverted visits from each existing site was multiplied by the distance saving per visit and summed over all sites. This figure represents the total distance saving to the current recreationists that would result from the development of the new site.

The distance saving of "potential" recreationists was added to the distance saving of current recreationists and the total was multiplied by an estimate of travel cost per mile (covering both cash and time costs) to obtain a monetary value for the proposed site. This value represents a rent attributable to the site as a result of its location.

b) Some of the Weaknesses:

(1) The Implicit Assumption That All Sites are Equal Except for their Location:

Implicit in the Ullman-Volk approach of attributing locational rents to recreational sites is the assumption that all sites offering the same types of activities are equal except with respect to their location. This implies, for example, that all sites offer recreation of equal quality. If however, differences in quality existed and if people are willing to incur higher costs to enjoy higher quality recreation, the following possibilities arise:
(1) Visitors of high quality sites may have passed their second choice en route, resulting in a negative travel saving attributed to the site being evaluated;26

(2) Recreationists whose second best alternative is more distant than the site being evaluated may be partially compensated for the extra travel costs that would result from the diversion to their second choice by higher quality recreation at this site; or conversely;

(3) Recreationists who would be diverted to a more distant site may suffer a loss greater than the increase in travel costs if second choice sites offer lower quality recreation.

It would appear that the Ullman-Volk technique is limited to applications where the difference in quality between the recreational site being evaluated and the alternative sites is not significant. Even in cases where this condition is satisfied, the Ullman-Volk technique could still face a serious obstacle. The assumption that all sites are equivalent except for location implies that a recreationist will visit only one site for each type of activity in which he participates. Yet the desire for variety may well lead him to utilize several sites in succession. This raises the possibility that the recreationist may pass an alternative of equal quality en route to the site being evaluated indicating he was willing to pay the additional travel costs for the sake of variety.

The role of variety and the importance of differences in quality in the decisions of recreationists need to be investigated prior to extensive

\[26\] Spargo (1964) op. cit., found that the prime alternative for many recreationists was one they passed en route to the site being evaluated.  

\[27\] Spargo (1965) op. cit., p. 68.
(ii) Other Limitations:

While the Ullman-Volk Variant can be applied regardless of the geographical dispersion of the recreationists, it does have other limitations in common with the Hotelling-Clawson and Pearse Variants. The Ullman-Volk technique ignores the possibility that recreationists are making multiple-purpose trips. Nor can this technique allocate benefits to various activities at one site unless the participants in these activities are completely different groups. Like all indirect travel cost techniques, the Ullman-Volk Variant is sensitive to the method chosen to convert differences in distance into travel cost savings. Finally, the Ullman-Volk technique also ignores the consequences of the interaction between the intensity of use at a site and the quality of recreation offered.

Although there are no studies that consider the relative quality of alternatives, there has been some very interesting attempts made to determine the effect of changes in the quality of recreation offered at the site being evaluated. One example is Joe E. Stevens, "Recreation Benefits from Water Pollution Control", Water Resources Research, 2nd Quarter, 1966, pp. 167-182 (corrected by the author in the same journal, first quarter, 1967, pp. 63-64), wherein the effect of changes in the physical characteristics of water on the fish population and hence on angler-success is expressed in terms of influences on recreational benefits generated by the sport fishery as measured by application of a modified Hotelling-Clawson technique. See also Davison, Adams, and Seneca, op. cit.. The latter article estimates the effect of quality changes on participation in water activities in user-days. The economic evaluation is then based on an arbitrary schedule of values ranging from $1 to $5 per user-day. An attraction index for state parks was developed by Carlton S. Van Doren, "A Comparative Evaluation of Gravity and System Theory Models for State-wide Recreational Traffic Flows", Journal of Regional Science, Vol. 6, No. 2, 1966, pp. 57-70. However, the attraction index suffers from neglect of features external to each park such as nearness to other parks and attractions.
c) **Empirical Testing:**

The crucial assumptions for the Ullman-Volk Variant are that quality differences among the sites are not significant and that the desire for variety does not play a role in recreationists' behavior. An attempt was made to apply the Ullman-Volk Variant in the evaluation of the Kootenay Lake sport fishery. This attempt was unsuccessful due to the large number of anglers who indicated that their next best alternative fishing area was closer to their place of residence than was Kootenay Lake. The interview responses indicated that the major reasons for this willingness to travel the extra distance to Kootenay Lake was the higher quality of fishing available there plus a desire for variety. Difficulties also arose with respect to anglers who used the Kootenay Lake sport fishery exclusively because it was found that their preferences were often inchoate.

4) **The Laub Variant:**

a) **The Conceptual Framework:**

Each of the three indirect travel cost techniques discussed up to this point are based on assumptions of doubtful validity. The previous discussion has especially questioned the assumptions of similar preferences implicit in the Hotelling-Clawson and Pearse Variants, and the assumption of similar quality at all sites implied by the Ullman-Volk approach. However, aside from any questions of conceptual weakness noted above, all three Variants are severely restricted in terms of their applicability to the types of problems likely to be of interest to provincial or state governments in North America. These governments are concerned with management and development decisions for a "network" of recreational sites. Accordingly, there is a need for evaluational techniques that
reflect the interdependencies among all of the recreational sites within one jurisdiction. While the three preceding travel cost Variants are all oriented towards evaluating a single site, the Laub Variant presented below is an attempt to develop a technique which includes the availability, quality, and prices of all sites as variables in the evaluational model. This technique combines elements of both the Hotelling-Clawson and the Ullman-Volk approaches to expand the range of applicability to cover not only evaluations of single non-priced recreational sites, but also questions of how changes in quality or fees at one site affect attendance at that site and at other sites.

The geographical area within one jurisdiction is divided into a grid of population zones numbered 1 to n. The recreation sites within the area are numbered from 1 to m. If the number and origin of recreationists using each site is known, then a matrix V with n rows and m columns can be constructed with entries \( v_{ij} \) where \( v_{ij} \) represents the number of recreationists from zone \( i \) visiting site \( j \) per unit of time. Each row total of \( V \) represents the consumption of recreation at all sites within the area by residents of one zone, while each column total of \( V \) represents the levels of attendance at one site by residents of the various zones.

In a similar fashion, information on travel costs incurred by recreationists could be presented as a matrix \( C \) with entries \( c_{ij} \) where \( c_{ij} \) is the cost of reaching site \( j \) from zone \( i \).

At this point, it is possible to estimate a simple visitation prediction function for each zone to compare the Laub and Hotelling-Clawson techniques:
\( \hat{v}_{1j} = f_1(c_{1j}) \quad j = 1 \text{ to } m \)
\( \hat{v}_{2j} = f_2(c_{2j}) \quad j = 1 \text{ to } m \)
\[ \vdots \]
\( \hat{v}_{nj} = f_n(c_{nj}) \quad j = 1 \text{ to } m \)

In the evaluation of a specific site "k", the above functions are used to estimate the number of recreationists forthcoming from each of the \( n \) zones for various hypothetical increments in travel costs over and above \( c_{ik} \). Summing over all zones for each increment in costs would generate a demand schedule for access to site \( k \). For example, the number of recreationists who would visit "k" at a fee of \$y\) is estimated by:

\[
(29) \quad \hat{v}_{ik} = \sum_{i=1}^{n} f_i(c_{ik} + y)
\]

Note that the reaction of residents of each zone to the fee is predicted by a visitation function based on the observed behavior of the recreationists from that zone.

In contrast to this, the demand schedule estimated by the Hotelling-Clawson technique for site "k" would be based solely on the \( k^{th} \) columns of matrices \( V \) and \( C \) which would be used to estimate the function:

\[
(30) \quad \hat{v}_{ik} = h(c_{ik}) \quad i = 1 \text{ to } n
\]

(For simplicity, it is assumed all zones have the same population). This function is applied to each zone to estimate the reaction to various hypothetical changes in \( c_{ik} \), and the summation of these reactions over all zones yields a point on the demand schedule. For example, the total estimated visitation at a fee of \$y\) would be:
Since the same function is applied to each zone, the Hotelling-Clawson technique implies the residents of all zones have similar preferences (bearing in mind that the influence of differences in income, population density, and so on can be isolated by the Hotelling-Clawson Variant). If this is true, then
\[ h(c_{ik}) = f_1(c_{1k}) = f_2(c_{2k}) = \ldots = f_n(c_{nk}) \]
and the Laub Variant and the Hotelling-Clawson Variant both obtain the same results.

It should be possible to incorporate variables reflecting the influences of the quality of the site being evaluated as well as the availability, quality and price of alternative sites. A great deal of empirical research into the decision-making process of recreationists is necessary before such variables can be defined with confidence. However, a relative quality index could be devised based on the physical characteristics of the site. For example, a first approximation quality index for sport fisheries could be based solely on relative angler-success statistics pending research on the importance of the level of congestion, the beauty of the surrounding scenery, the facilities, the climate, and so on. Once defined, the quality index could be represented as a vector \( \mathbf{Q} \) with entries \( q_j \) where \( q_j \) is the

\[ \text{See Van Doren, op. cit.} \]
relative quality of site \( j \) \((\sum_{j=1}^{m} q_j = m)\). Some insight into the alternative possible formulations of the quality index may be obtained by investigating their explanatory power in visitation prediction functions of the form:

\[
\begin{align*}
\hat{v}_{1j} &= f_1(c_{1j}, q_j) & j &= 1 \text{ to } m \\
\hat{v}_{2j} &= f_2(c_{2j}, q_j) & j &= 1 \text{ to } m \\
&\vdots & & \vdots \\
\hat{v}_{nj} &= f_n(c_{nj}, q_j) & j &= 1 \text{ to } m
\end{align*}
\]

Finally, a measure of the availability, quality and cost of alternatives is necessary. Again, extensive empirical research is required to establish what recreationists regard as alternatives.

There are a number of complex problems here - for example, determining the extent to which sites offering one type of activity compete with sites offering another type. However, there are a number of first approximations that could be used to generate a matrix \( A \) with entries \( a_{ij} \) where \( a_{ij} \) is the number of alternatives to site \( j \) facing visitors from zone \( i \). Some possible definitions for alternatives to a site \( k \) are:

1) let \( a_{ik} \) equal the number of alternative sites that can be visited by residents of zone \( i \) at a cost of \( c_{ik} \) or less;

30 While it is not necessary for the quality index to be in relative terms, I believe a relative index is easier to interpret in that it relates the level of quality to that of the average site instead of some arbitrarily defined scale.

31 An iterative procedure based on maximizing the explanatory power of a visitation prediction function was used to estimate the relative attractiveness of parks in William R. Catton, Jr. and Lennart Berggren, "Intervening Opportunities and National Park Visitation Rates", *The Pacific Sociological Review*, Fall 1964, pp. 66-73.
2) same as 1) above except that the alternatives are weighted according to their $q_j$'s;

3) let $a_{ik}$ equal the number of alternative sites weighted by their $q_j$'s and the relative distance from zone $i$ with respect to site $k$, i.e.:

$$a_{ik} = \sum_{j=1}^{m} q_j \left[ \frac{c_{ik}}{c_{ij}} \right] \text{ for } j = 1 \text{ to } m \text{ excluding } k;$$

4) Same as 3) above except that the alternatives are weighted according to their $q_j$'s relative to $q_k$, i.e.:

$$a_{ik} = \sum_{j=1}^{m} \left[ \frac{q_j}{q_k} \times \frac{c_{ik}}{c_{ij}} \right] \text{ for } j = 1 \text{ to } m \text{ excluding } k.$$

Once a definition of alternatives has been selected, visitation prediction functions can be estimated:

$$(33) \quad \hat{v}_{1j} = f_1(c_{1j}, q_j, a_{1j}) \quad j = 1 \text{ to } m$$

$$\hat{v}_{2j} = f_2(c_{2j}, q_j, a_{2j}) \quad j = 1 \text{ to } m$$

$$\vdots$$

$$\hat{v}_{nj} = f_n(c_{nj}, q_j, a_{nj}) \quad j = 1 \text{ to } m$$

Again, these functions can be used to generate demand schedules for a single site by introducing hypothetical changes in $c_{ij}$. Further, not only can the impact of price or quality changes at site $k$ on the number of visits to site $k$ be estimated, but also the impact that changes at other sites have on visitation at site $k$, and vice versa. This can best be illustrated with a hypothetical example.

Consider an area that has been divided into four population zones and that contains six recreational sites. Information on the number of visits to each site from the various zones is presented in the matrix below:
The sum along any row represents the total number of visits to all sites made by residents of one zone, while the sum down any column represents the total number of visits to one site by residents of all four zones.

The costs of visiting each site from the four zones provide the entries for matrix C:

\[
C = \begin{bmatrix}
1 & 2 & 3 & 4 & 5 & 6 \\
1 & 20 & 10 & 15 & 20 & 30 & 40 \\
2 & 10 & 20 & 25 & 30 & 40 & 50 \\
3 & 40 & 30 & 25 & 20 & 10 & 20 \\
4 & 30 & 20 & 15 & 10 & 20 & 30 \\
\end{bmatrix}
\]

The relative quality of the sites is reflected in the following ratings:

\[
Q = \begin{bmatrix}
1 & 2 & 3 & 4 & 5 & 6 \\
1.0 & 0.5 & 1.0 & 1.5 & 0.5 & 1.5 \\
\end{bmatrix}
\]

Note that presenting Q as a vector of \(q_j\)'s rather than as a matrix of \(q_{ij}\)'s implies some objective measure of quality is involved.

The definition of alternatives selected is that for any site \(k\):

\[
a_{ik} = \frac{m}{\sum_{j=1}^{m} \left[ \frac{q_{ij}}{q_{ik}} \times \frac{c_{ik}}{c_{ij}} \right]} \quad j \neq k.
\]
This definition was chosen because the $c_{ik}/c_{ij}$ term reflects the importance of the relative distance between site "k" and its substitutes, and the $q_{ij}/q_{ik}$ term reflects the quality of alternatives relative to the quality of site k. Thus the matrix A indicates the number of quality and distance weighted alternatives to each site for users from each zone:

<table>
<thead>
<tr>
<th></th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>4.9</td>
<td>4.9</td>
<td>3.4</td>
<td>2.9</td>
<td>16.8</td>
<td>6.9</td>
</tr>
<tr>
<td>2</td>
<td>1.6</td>
<td>9.3</td>
<td>5.4</td>
<td>4.2</td>
<td>19.6</td>
<td>7.6</td>
</tr>
<tr>
<td>3</td>
<td>10.3</td>
<td>15.9</td>
<td>6.0</td>
<td>2.8</td>
<td>4.6</td>
<td>2.8</td>
</tr>
<tr>
<td>4</td>
<td>9.5</td>
<td>13.0</td>
<td>4.3</td>
<td>1.3</td>
<td>13.0</td>
<td>6.0</td>
</tr>
</tbody>
</table>

For each zone, a visitation prediction function is estimated with the functional form chosen for this illustration being:

$$v_{ij} = b_{i0}c_{ij} + a_{ij}q_{j}$$

To illustrate the range of applications possible with the Laub variant, a demand schedule for site number six is estimated below. Then the effect of varying the cost of access and the quality of recreation offered for other sites is measured in terms of their impact on the demand schedule for site six.

For example, the number of alternatives to site 1 facing residents of zone 1 is:

$$a_{11} = \left[ 0.5 \times 20 \right] + \left[ 1.0 \times 20 \right] + \left[ 1.5 \times 20 \right] + \left[ 0.5 \times 20 \right] + \left[ 1.5 \times 20 \right] + \left[ 1.0 \times 30 \right] + \left[ 1.0 \times 40 \right] = 4.9$$
The first step is the estimation of zonal visitation prediction functions:

\[
\hat{V}_{ij} = 15034 \cdot c_{1j}^{-1} \cdot a_{1j}^{-5} \cdot q_j^5
\]

\[
\hat{V}_{2j} = 1281 \cdot c_{2j}^{-0.33} \cdot a_{2j}^{-1} \cdot q_j^3
\]

\[
\hat{V}_{3j} = 3784 \cdot c_{3j}^{-0.5} \cdot a_{3j}^{-1} \cdot q_j^{33}
\]

\[
\hat{V}_{4j} = 6801 \cdot c_{4j}^{-1} \cdot a_{4j}^{-5} \cdot q_j^2
\]

The demand schedule for any site k is calculated by introducing hypothetical changes in the costs of using site k for residents of each zone. Thus, the number of recreationists willing to pay \$x or more for access to site k is estimated by raising all cost entries used in the above functions by \$x (i.e. \(c_{ik} + x\)). The change in \(c_{ik}\)'s also affects the \(a_{ik}\)'s since the definition of alternatives used for this demonstration is one that reflects relative costs. Thus, each new fee considered implies a change in \(c_{ik}\) and a change in \(a_{ik}\):

\[
a_{ik} = c_{ik} \sum_{j=1}^{m} \left( q_{ij}/q_{ik} \times 1/c_{ij} \right) (j \neq k)
\]

so:

\[
\frac{\Delta a_{ik}}{a_{ik}} = \frac{a_{ik}}{c_{ik}}
\]

therefore, for any \(\Delta c_{ik}\) the effect on \(a_{ik}\) is:

\[
\Delta a_{ik} = \frac{a_{ik}}{c_{ik}} \cdot \Delta c_{ik}
\]
The zonal and aggregate demand schedules for access to site 6 are presented below:

<table>
<thead>
<tr>
<th>fee</th>
<th>zone 1</th>
<th>zone 2</th>
<th>zone 3</th>
<th>zone 4</th>
<th>total</th>
</tr>
</thead>
<tbody>
<tr>
<td>$0</td>
<td>175</td>
<td>155</td>
<td>345</td>
<td>206</td>
<td>881</td>
</tr>
<tr>
<td>10</td>
<td>126</td>
<td>122</td>
<td>189</td>
<td>135</td>
<td>572</td>
</tr>
<tr>
<td>20</td>
<td>97</td>
<td>99</td>
<td>123</td>
<td>97</td>
<td>416</td>
</tr>
<tr>
<td>30</td>
<td>79</td>
<td>82</td>
<td>88</td>
<td>75</td>
<td>324</td>
</tr>
</tbody>
</table>

To illustrate the differences between the Laub and Hotelling-Clawson approaches, the latter technique was also applied to this problem using the same definition of alternatives. This time only the sixth columns of the V, C and A matrices were used to generate one visitation prediction function applicable to all four zones using site six (all zones are assumed to have the same population). The resulting estimate of the visitation function is:

\[
\hat{v}_{16}^H = 1570 \cdot c_{16}^{-0.33} \cdot a_{16}^{-0.50}
\]

Again, by introducing hypothetical changes in the costs of using site 6 and adjusting \(a_{16}\) accordingly, zonal and total demand schedules were obtained:

<table>
<thead>
<tr>
<th>fee</th>
<th>zone 1</th>
<th>zone 2</th>
<th>zone 3</th>
<th>zone 4</th>
<th>total</th>
</tr>
</thead>
<tbody>
<tr>
<td>$0</td>
<td>175</td>
<td>155</td>
<td>345</td>
<td>206</td>
<td>881</td>
</tr>
<tr>
<td>10</td>
<td>146</td>
<td>133</td>
<td>246</td>
<td>162</td>
<td>687</td>
</tr>
<tr>
<td>20</td>
<td>125</td>
<td>117</td>
<td>194</td>
<td>135</td>
<td>571</td>
</tr>
<tr>
<td>30</td>
<td>109</td>
<td>105</td>
<td>161</td>
<td>116</td>
<td>491</td>
</tr>
</tbody>
</table>

\[33\text{ Since all observations regarding visitation are for the same site (the sixth), there is no need for a } q_j \text{ variable.}\]
In this case, it can be seen that the Hotelling-Clawson demand estimates are considerably higher than the Laub estimates at all fee levels. If the assumption of similar preferences implicit in the Hotelling-Clawson approach is valid, if the only significant variables affecting recreational decisions are costs, quality, and availability of alternatives (and the measure used for $a_{1j}$ is appropriate), and if the total recreational experience is similar for all zones (Hotelling-Clawson) and for all sites (Laub), then the two techniques will yield similar results, tending to

$$\hat{v}_{ij}^H = \hat{v}_{1j} = \hat{v}_{2j} = \hat{v}_{3j} = \hat{v}_{4j}$$

The applicability of the Laub Variant is not limited to the evaluation of a specific site under prevailing conditions. An agency making an allocational decision with respect to site six should be able to incorporate the effects of anticipated changes in the current situation. Two such examples are considered here:

**problem 1:** Site four is privately owned and it is known that the operator intends to raise his fees by $10. The estimation of demand for site six above is based on the current costs of using the alternative site, yet the allocational decision affecting future use of site six should reflect the value of site six under the expected future conditions (which include higher costs at site four). The change in the cost of visiting site four will affect its importance as an alternative to site six. Consequently, the level of visitation at site six will be affected.
The impact that a $10 increase in $c_{14}$ has on $a_{16}$ and hence on $v_{1j}$ is shown below for different fee levels at site six:

<table>
<thead>
<tr>
<th>zone</th>
<th>fee = $0</th>
<th>fee = $10</th>
<th>fee = $20</th>
<th>fee = $30</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>$a_{16}$ before cost increase</td>
<td>$a_{16}$ after cost increase</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>6.9</td>
<td>8.6</td>
<td>10.4</td>
<td>12.1</td>
</tr>
<tr>
<td>2</td>
<td>7.6</td>
<td>9.1</td>
<td>10.6</td>
<td>12.2</td>
</tr>
<tr>
<td>3</td>
<td>2.8</td>
<td>4.2</td>
<td>5.6</td>
<td>7.0</td>
</tr>
<tr>
<td>4</td>
<td>6.0</td>
<td>8.0</td>
<td>10.0</td>
<td>12.0</td>
</tr>
</tbody>
</table>

Re-estimating the zonal and total demand schedules for site six using the $a_{16}$'s adjusted for the $10$ increase in $c_{14}$ yields:

<table>
<thead>
<tr>
<th>fee @ #6</th>
<th>zone 1</th>
<th>zone 2</th>
<th>zone 3</th>
<th>zone 4</th>
<th>total</th>
<th>deviation from original demand schedule</th>
</tr>
</thead>
<tbody>
<tr>
<td>$0</td>
<td>185</td>
<td>163</td>
<td>388</td>
<td>238</td>
<td>974</td>
<td>+10.6%</td>
</tr>
<tr>
<td>10</td>
<td>132</td>
<td>128</td>
<td>213</td>
<td>156</td>
<td>629</td>
<td>+10.0%</td>
</tr>
<tr>
<td>20</td>
<td>102</td>
<td>105</td>
<td>140</td>
<td>112</td>
<td>459</td>
<td>+10.3%</td>
</tr>
<tr>
<td>30</td>
<td>84</td>
<td>87</td>
<td>99</td>
<td>87</td>
<td>357</td>
<td>+10.2%</td>
</tr>
</tbody>
</table>

Problem 2: The government has committed itself to a project designed to raise the quality of recreation offered by site two such that $q_2$ will be increased to 1.5 from 0.5. Raising the quality of site two renders it a more competitive alternative for site six, consequently altering the sixth column of matrix $A$ and hence affecting the demand for site six. The impact on $a_{16}$ for various fee levels at site six is presented below:

<table>
<thead>
<tr>
<th>zone</th>
<th>fee @ #6 =</th>
<th>$a_{16}$ after q$_2$ increase</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>$0$</td>
<td>$10$</td>
</tr>
<tr>
<td>1</td>
<td>9.6</td>
<td>11.9</td>
</tr>
<tr>
<td>2</td>
<td>9.3</td>
<td>11.1</td>
</tr>
<tr>
<td>3</td>
<td>3.2</td>
<td>4.9</td>
</tr>
<tr>
<td>4</td>
<td>7.0</td>
<td>9.3</td>
</tr>
</tbody>
</table>

Again, re-estimating the zonal and total demand schedules for site six.
using these new values for $a_{16}$ yields:

<table>
<thead>
<tr>
<th>fee @ #6</th>
<th>zone 1</th>
<th>zone 2</th>
<th>zone 3</th>
<th>zone 4</th>
<th>total</th>
<th>deviation from original demand schedule</th>
</tr>
</thead>
<tbody>
<tr>
<td>$0</td>
<td>149</td>
<td>127</td>
<td>303</td>
<td>190</td>
<td>769</td>
<td>-12.7%</td>
</tr>
<tr>
<td>10</td>
<td>107</td>
<td>99</td>
<td>161</td>
<td>125</td>
<td>492</td>
<td>-14.0%</td>
</tr>
<tr>
<td>20</td>
<td>83</td>
<td>82</td>
<td>105</td>
<td>89</td>
<td>359</td>
<td>-13.7%</td>
</tr>
<tr>
<td>30</td>
<td>67</td>
<td>67</td>
<td>76</td>
<td>69</td>
<td>279</td>
<td>-13.9%</td>
</tr>
</tbody>
</table>

As the above examples illustrate, the Laub Variant has a wider range of applicability in terms of the questions it can answer than the other travel cost approaches presented here.

This technique can also be utilized to estimate the demand for a proposed site if the quality rating of the new site can be estimated. The calculation of the cost of visiting the site from each zone and the number of quality and distance weighted alternatives proceeds in the same manner as before. The values obtained for these variables are then substituted into each of the zonal visitation prediction functions previously derived from observed use of the existing sites. The zonal demand schedules for the site are estimated by varying the cost coefficients to incorporate hypothetical fees at the new site. The zonal demand schedules are horizontally summed to yield the total demand schedule. Furthermore, the introduction of the new site changes all the values in the A matrix and new $a_{ij}$'s must be calculated for the existing sites. The impact of the new site on the $a_{ij}$'s for existing sites invalidates the demand schedules for all the existing sites. Re-estimation of the demand schedules for the existing sites is necessary since some of their users will be diverted to the new site (i.e. an increase in the number of substitutes available should decrease
demand for the existing sites at all fee levels). For recreationists diverted to the new site from existing sites, the value of access to the new site is the increase in welfare attributable to the new site's introduction. Therefore, the decision whether or not to introduce the new site should be made on the basis of its net addition to the value of the whole network of sites. In other words, the net value of the new site is the area beneath its demand curve minus the decrease in the consumers' surpluses generated by the existing sites (assuming zero fees everywhere). Thus far, the discussion has abstracted from the problem of the different demand concepts identified in Section D of Chapter Two. Most of the other indirect travel cost techniques generate a cell B type of demand schedule reflecting constant utilization at existing levels (and therefore constant quality), but reflecting the income effect of fees since actual travel costs are used as proxies for prices. In this case, the demand schedule will deviate from the cell B concept to the extent that the level of congestion varies among the sites used by any one zone.

b) Some of the Weaknesses:

While the Laub Variant does not rely on assumptions of similar preferences either within income groups or among geographical zones, this technique does imply similar preferences exist among the recreationists within any one zone and if this assumption is violated an identification problem arises. The demand function for access to site j by residents of zone i is estimated from data in the use of all sites by residents of i. If the various sites offer different recreational experiences and preferences differ within zone i, it is possible that each site is used

34If the recreational experience was identical at all sites, only the closest to zone i would be used.
only by one subset of the recreationists from \( i \) with these subsets being mutually exclusive. In such a case, data derived from different sites (and therefore from different subsets of recreationists, albeit all from \( i \)) would provide no basis for the estimation of a demand function for any one site. Each site's observation would be relevant to a different subset's demand function.

In addition, the Laub Variant is still subject to a number of limitations that affect all of the indirect travel cost techniques. First is the assumption that user-fees are viewed in the same way as equivalent changes in travel cost. Secondly, none of the indirect travel-cost techniques can be regarded as satisfactory without an acceptable means of quantifying time costs of travel in monetary terms.

Finally, all of the foregoing approaches ignore the income effects of fee changes. The income effects could be significant if massive changes in the pricing policies with respect to recreational sites were introduced. This is particularly relevant for the Laub Variant since it could be used to estimate total recreational activity

\[
\sum_{i=1}^{n} \sum_{j=1}^{m} v_{ij}
\]

Hence, this approach is most useful when only minor fee adjustments are contemplated.

c) Empirical Testing:

One of the greatest practical drawbacks of this technique is the greatly increased data needs relative to the data requirements of the other indirect travel-cost variants. The lack of sufficient data prevented the application of the Laub Variant in this thesis. It should also be noted that the initial applications of this technique will have to cope with the problems of formulating definitions and measurements of quality and of alternatives.
E. Interview Techniques:

a) The Conceptual Framework:

The travel cost techniques are indirect attempts to predict how recreationists would behave in a hypothetical market for access to a recreational site. It is possible to take a more direct route of describing the hypothetical market to the recreationists and then asking them how they would react to it.

In Chapter Two, it was noted that the definition of the measure of value of access to a recreational site varied depending on the nature of the evaluational problem. Figure 4 is reproduced here as Figure 9. The recreationist has income $OY_2$ and faces price line $Y_2L_1$. As pointed out in Chapter Two, the minimum annual cash payment required to reimburse this recreationist for loss of access to the site is $Y_3Y_2$. However, the maximum amount he would be willing to pay for an annual licence to retain access is $Y_2X$, the difference arising from the income effect. Both the recreationist's maximum willingness-to-pay for access and the minimum payment required to compensate him for its loss can be estimated by direct interviews during which recreationists are asked to indicate these measures.
Figure 9: Individual Consumption Decisions Regarding Recreation

Expenditure on all other goods ($)

visits per annum
b) **Some Weaknesses:**

i) **The Possibility of Biased Responses:**

Two questions arise whenever direct interview techniques are employed: did the respondents go to the trouble of thinking the problem through since it is hypothetical; and if they did, did they answer truthfully?

To ensure that respondents carefully consider a hypothetical problem posed in an interview, the interview should include questions that encourage the respondent to discuss the implications of the various alternatives open to him in the hypothetical problem. His reaction to the problem should be consistent with the implications of this reaction as perceived by the respondent (and revealed in the interview).

With respect to the truthfulness of the responses, the recreationists may purposely misrepresent their preferences. If a recreationist is asked how much he is willing to pay for access to a site, he may interpret the question as an indication that he will, in fact, be charged in the future. This could prompt him to understate his willingness-to-pay in hopes this would lower the future fee schedule. On the other hand, the respondent may be confident that he will not be charged in the future and bias his answer upward to help "protect" the site by exaggerating its value.

In a study by Robert Davis, recreationists were interviewed on

---

the site to determine how they would react to hypothetical changes in the travel cost they incurred in reaching the area. Phrasing the questions in terms of travel costs rather than willingness-to-pay a fee may have the advantage of eliminating any incentive for the respondent to intentionally misrepresent his preferences. However, the reference to travel costs could introduce a bias since changes in travel costs would also affect the costs of visiting alternatives to the recreational site being evaluated. This is equivalent to imposing fees, not only on the site in question, but on all recreational sites with the fee varying directly with the distance from the user's residence to the resource. Therefore, Davis's assumption that equivalent changes in travel costs and user-fees would both elicit the same response from users is questionable.

ii) **Limited in Application:**

Because the hypothetical market must be described to the respondent during the interview, the greater the number of variables he is asked to assume have changed, the more complex the interview form, and the greater the number of possible combinations the respondent must consider. This increases the probability of misinterpretation of the questions and/or incomplete consideration of the problem. Since each new variable added to the hypothetical problem introduces an additional level of abstraction from reality, it will tend to reduce the level of confidence that can be placed on the responses.

c) **Empirical Testing:**

In Chapter Four, an interview approach is used to estimate both recreationists' willingness-to-pay and compensation-required for an existing sport fishery. In addition, an attempt is made to use the
interviews to establish the significance of congestion as a determinant of quality and to quantify the costs of congestion in monetary terms. The results of the interviews cast considerable light on some of the underlying assumptions of the indirect travel cost techniques in Chapter Five.

F. Alternative Decision-Making Methods:

The evaluational techniques discussed thus far have their major application in the planning process wherein choices are made among competing uses of scarce resources. It is apparent that economists have not yet found fully acceptable means of quantifying recreational benefits in monetary terms. It has been suggested that pending the development of an acceptable evaluational technique, a short-cut could be used for solving specific kinds of planning problems. The suggested alternative turns the evaluational problem around and asks what the value of recreational benefits would have to be in order to justify displacing a competing non-recreational use of the resources. Then on the basis of available evaluational techniques and/or subjective judgements, a decision could be made on the likelihood of the recreational benefits reaching or exceeding this figure. As Krutilla, et. al. demonstrate, this approach can provide a very helpful decision-making framework where the time streams

36See Krutilla, Cicchetti, Freeman III, and Russell, op. cit., especially sections II and III.

37This approach is most applicable when one of the competing uses for the natural resources involves: the use of the resources entering directly into the individual utility functions (eg. recreation), while the others involve the resources as productive inputs yielding a separable final product (eg. power) that could be produced using alternative inputs. See Krutilla, et. al., Section I.
of benefits (costs) generated by the competing alternatives differ in terms of rates of growth and probability of occurrence.
Chapter Four:
Application of Techniques

A. Introduction:

Unless fees are directly imposed on a recreational site, it is impossible to actually test the "predictive" powers of a simulated market demand function. However, as noted in Chapter One, it is possible to "test" such a function by ensuring that the method by which it was derived is both logically consistent and realistic in terms of the assumptions upon which it proceeds. With several techniques for estimating demand functions, comparative application can play the role of using one approach's results to test another method's assumptions. In this Chapter, the Hotelling-Clawson, the Pearse and the interview techniques are each used to estimate the demand for access to a specific recreational site. The test area, the Kootenay Lake sport fishery, is described briefly below, followed by a discussion of the hypothetical pricing system implied by the evaluational techniques applied herein. The procedures followed in applying each of the techniques are then presented along with the results obtained. The results are used in Chapter Five to test the validity of the assumptions underlying the three techniques.

Chapter Two also contains a discussion of the importance of the point of view chosen when estimating benefits. Since the Kootenay Lake sport fishery is provincially owned and regulated, the point of view selected for the evaluation is that of the province of British Columbia. With respect to anglers residing in B.C., focus is on measuring the value of the recreational experience that accrues directly to the
fishermen, i.e. the contribution Kootenay Lake fishing makes to the anglers' welfare (consumers' surplus). For non-residents, the direct benefits from sport fishing accruing to the anglers are irrelevant and do not enter into the evaluation of the fishery except to the extent that they affect non-residents' willingness to incur costs (such as licence fees, travel expenses and so on) in order to gain access to the fishery. In accordance with the point of view chosen for the evaluation, the estimation of resident and non-resident demands proceeds separately under each approach.

B. A Physical Description of the Kootenay Lake Sport Fishery:

Located about 270 miles due east of Vancouver, Kootenay Lake is a long narrow body of water running in a north-south axis with a single arm extending to the west (see Figure 10). The lake lies between the Selkirk and the Purcell Mountain Ranges and is well-known for the scenic beauty of its extensive shoreline and mountainous setting.

Kootenay Lake is a multiple-species sport fishery within which the major species are: rainbow or Kamloops trout, Dolly Varden, kokanee, whitefish, and ling (burbot). The lake is a highly productive fishery in terms of the abundance and quality of food available, and the fish

---

1The evaluation of the non-resident aspect of the fishery herein is incomplete since it does not address itself to the question of measuring the net benefits from non-resident expenditures in B.C. attributable to the Kootenay Lake fishery (other than licence fees). This aspect is neglected here since the emphasis is on techniques of demand estimation, but the net benefits derived from non-resident use of the fishery are estimated in Peter H. Pearse and Michael E. Laub, The Value of the Kootenay Lake Sport Fishery, Study Report No. 3 on the Economics of Wildlife and Recreation, Fish and Wildlife Branch of the Department of Recreation.
Figure 10: Map of Kootenay Lake Showing the Four Creel-Census Areas

The Creel Census Area boundaries are marked with a double red line, while the names of the areas are in parentheses.
populations maintain themselves through natural reproduction rather than by artificial stocking. The major attractions of the Kootenay Lake sport fishery are the unusually large rainbow trout along with the wide range of species and types of fishing available. These characteristics of the fishery have given it an excellent reputation.

C. Pricing Schemes Used:

The provincial licencing policy for inland sport fisheries in 1967 set the price for access to each specific fishery at zero, but required users to purchase a B.C. angler's licence which conveys the right to fish all sport fisheries. Table I presents the fee schedule by licence category that prevailed in 1967.

The right to fish each specific fishery can be regarded as a separate and distinct commodity. However, in B.C. all of these commodities are "packaged" together as one conglomerate product and sold in the form of a B.C. angler's licence.

In order to apply the evaluational techniques discussed in Chapter Three, it is necessary to devise an alternative licencing system under which access to the Kootenay Lake sport fishery would be separately priced. The alternative pricing schemes considered herein involve only annual licences. When planning his recreational activities at Kootenay Lake, the angler is presumed to be maximizing his utility

\(^2\)For additional information on the Kootenay Lake region, the pattern of fishing activity, and the socio-economic characteristics of the fishermen see Pearse and Laub, op. cit.
Table I: The 1967 B.C. Angler's Licence Fee Schedule

<table>
<thead>
<tr>
<th>Licence category</th>
<th>Fee</th>
<th>Type</th>
</tr>
</thead>
<tbody>
<tr>
<td>Resident (age 18 and over)</td>
<td>$2.00</td>
<td>annual</td>
</tr>
<tr>
<td>Non-resident alien</td>
<td>10.00</td>
<td>annual</td>
</tr>
<tr>
<td>Non-resident Canadian</td>
<td>3.50</td>
<td>annual</td>
</tr>
<tr>
<td>Non-resident short-term</td>
<td>2.00</td>
<td>three-day</td>
</tr>
<tr>
<td>Non-resident minor</td>
<td>1.00</td>
<td>annual</td>
</tr>
</tbody>
</table>

*aValid for three consecutive days only with just one non-resident short-term licence a year allowed to any person.
(subject to his time and income constraints) through the pattern of use he selects in terms of the frequency and duration of his fishing trips. If he wishes to change the total number of angler-days consumed per year he can modify either the number of trips or their duration or both. His decision here will depend upon the incremental costs of the different adjustments in his pattern of use balanced against the utility trade-offs (i.e. the relative attractiveness of increasing the trip frequency as opposed to increasing trip duration). When an angler purchases an annual licence, the fee is a fixed cost with respect to the yearly use of Kootenay Lake and should not significantly affect the number or length of visits to the fishery over the year as long as the fee is small relative to the user's annual income (although even a small fee change could affect the number of anglers). In other words, the only impact an annual fee has on the pattern of use arises from the income effect since the cost trade-off between changing trip frequency and changing trip duration (holding total angler-days consumed constant) has not been affected. Many of the applications of the indirect travel cost techniques have been based on differentials in travel cost per recreation-day consumed but have assumed that the observed pattern of consumption would not be affected by the imposition of fees even though fees will affect the number of recreationists. The consequences of pricing access to the Kootenay

\[3^a\]Davis, op. cit., justifies this assumption of the grounds that time constraints prevented the recreationists he interviewed from adjusting the duration of their trips in response to changes in costs. This question is discussed later in this Chapter.
Lake fishery by charging a fee per angler-day, or for each visit, were not explored since using a fee per day or per visit would have required knowing the angler's reaction to such fees in terms of the number and duration of visits. This would have greatly increased the data requirements and hence have further complicated the interview form used.

While only annual licences are considered, the implications of both individual and household forms of such licences are investigated. The need for the differentiation is indicated by the fact that 25% of the non-resident households fishing Kootenay Lake in 1967 contained more than one B.C. angler's licence holder, and anglers in the same household often differ considerably in their enthusiasm for the sport.

Under the alternative licencing policy considered in the chapter, the B.C. angler's licence would still be required for all provincial sport fisheries except Kootenay Lake. Access to the Kootenay Lake fishery would be available to the individual (household) only through purchase of an annual Kootenay Lake angling licence.

3b This point has been made by Pearse, op. cit..

4 The 1967 fee schedule would still apply to all categories of the B.C. angler's licences.
D. Application of the Hotelling-Clawson Technique:

In order to determine how recreationists would react to hypothetical changes in the cost of access to a site, the Hotelling-Clawson technique first involves estimating a function with the capacity of "explaining" (in a statistical sense) the observed pattern of visitation rates. Since acceptable data on the numbers of anglers using the Kootenay Lake sport fishery were available only for 1967 (see Appendix A), this was the sole year selected for study.

1) Non-resident use of the fishery:

(a) The visitation rate prediction function:

The geographic area supplying the non-resident Kootenay Lake anglers was divided into 36 zones. Both the number of anglers and the number of angling households per 100,000 population who visited Kootenay Lake in 1967 were calculated for each of the 36 zones. Appendix C lists the zones and their visitation-rates.

Among the zonal characteristics considered as potential explanatory variables for the zonal visitation rates were:

a) distance (D) - one-way, based on road-mileage from the zone to Kootenay Lake;

b) median zonal family income (Y);

c) population density (U) - number of residents per square mile;

d) urbanization (C) - the percentage of the population living in centers with a population of 2500 or more;\(^5\)

e) median age (A) of zonal residents; and

f) median family size (F).

\(^5\)Population density and urbanization were not as strongly collinear as might have been expected (correlation coefficient = .61) due to the range in county size and pattern of population dispersion.
Several forms of multiple regression equations were fitted to the observed individual angler visitation rates ($VR_I$) and angling household visitation rates ($VR_H$). In all cases, the only variables found to be significant at the 5% level were the distance variables ($D, D^2, \log D$).

The regression equations chosen for predicting visitation rates were:

\[
\begin{align*}
\log \hat{VR}_I &= 3.73415 - .00590D - .00010Y - .00064U + .0000025D^2 \\
\log \hat{VR}_H &= 3.60780 - .00595D - .00010Y - .00062U + .0000025D^2
\end{align*}
\]

\[
\begin{align*}
R^2 &= .72 \\
R^2 &= .72
\end{align*}
\]

Equations (43) and (44) can be used to predict how the visitation rate for any zone would react to changes in distance from the zone to Kootenay Lake:

\[
\begin{align*}
\frac{\partial \log \hat{VR}_I}{\partial D} &= -.00590 + 5.00^{-6}D \\
\frac{\partial \log \hat{VR}_H}{\partial D} &= -.00595 + 5.00^{-6}D
\end{align*}
\]

For example, Figure 11 represents Stevens County in Washington (zone one), and indicates the visitation rate for individual anglers that would be expected from this county if the distance between Kootenay Lake and the county were progressively increased. Assuming that

---

6 The regression equations are both significant at the 1% level ("F" test based on the analysis of variance). The numbers in parentheses beneath the regression coefficients are their standard errors. Visitation rate is used as the dependent variable rather than the number of visits to avoid problems of heteroscedasticity. If the dependent variable is the number of visits with zonal population as one of the independent variables, the absolute variation in the number of visits will increase as the population of the zone increases even though the relative variation is the same for zones of all sizes.

7 Y and U are held constant at $4462$ and 7.0 respectively for zone one.
travel costs are perceived here to be linearly related to distance, a hypothetical increase in D implies a proportional change in the cost of visiting Kootenay Lake. Consequently, the distance axis in Figure 11 can be converted into a price axis by multiplying by the travel cost per mile. This conversion is shown in Figure 12 for a travel cost estimate of $0.16 per mile (one way).

(b) Estimation of the travel cost coefficient:

A measure of the minimum necessary travel cost is obtained by calculating the cost per mile of operating an automobile. The basic operating cost was estimated at 4 cents per mile assuming that:

i) premium gas is burned at 20 miles per gallon and a quart of oil every 1,000 miles

ii) a set of five tires lasts 36,000 miles

iii) maintenance

No allowance is made for accommodation costs en route on the grounds that 32 of the 36 zones were within one day's drive of Kootenay Lake and most of the visitors from the furthest four zones had trailers or campers. Nor was any allowance made for food costs en route since

---

8 The empirical evidence supports this assumption of linearity for cash travel costs. Stepwise multiple regressions were run on the travel costs that anglers remembered incurring, and on the travel costs they anticipated incurring. In both cases, the addition of $D^2$ did not significantly affect the regression equations' ability to explain the variation in the travel cost observations as measured by the $R^2$'s and the F statistics based on the analysis of variance. Further, $D^2$ was not found to be a significant variable at the 20% level when multiple regression analysis was used to find an explanatory function for the stated willingness-to-pay of non-resident anglers (see section F of this Chapter).

9 Based on an interview with the service manager of a car-leasing agency.
Figure 11: Relationship between Distance and Visitation Rate for Stevens County, Washington
Figure 12: Stevens County Demand Curve for Individual
Kootenay Lake Angling Licences per 100,000
Population - Hotelling-Clawson Technique

$
the anglers would probably have made similar food expenditures even if they hadn't travelled.

As was noted in Chapter Three, it is expected that actual expenditures during the trip exceed the minimum necessary costs since some unnecessary expenses may have been incurred and some expenses would have been necessary even without the trip (e.g. part or all of the food expenditures). A multiple regression analysis applied to the responses from a mailed expenditure questionnaire (see Appendix B) yielded a cost per mile of $0.16 for cash costs only:

$$RC = -85.04 + 0.16D + 24.98Q + 14.43P$$

$$R^2 = .62$$

where RC = remembered costs for the trip as a whole,

D = one-way distance from Kootenay Lake to place of residence (in miles),

Q = number of days spent fishing on site, and

P = number of members of household on the trip.

However, the questionnaire data reflects only costs the respondents remember incurring and, since several months may have passed between the angler's last trip and the time he filled out the questionnaire, actual and remembered costs could differ considerably.

In Chapter Three, it was argued that the recreationist's decision to come to Kootenay Lake is based on the costs he anticipates incurring, and anticipated costs may vary from both remembered and actual costs. The interview responses regarding anticipated costs (see Appendix B) indicate that the "remembered" and "anticipated" cost coefficients for D are not significantly different:
\[ AC = -72.27 + .17D + .0036Y + 13.25Q + 13.64P - (0.02)(0.0008)(0.54)(4.92) \]

\[ R^2 = .92 \]

where \( AC \) = anticipated trip costs
\( Y \) = annual household income.

The anticipated costs obtained here appear to reflect the anticipated total expenditures for the trip rather than being confined to the minimum necessary costs arising from the trip. For this reason, the minimum cost coefficient of 4 cents per mile derived above is used rather than the anticipated cost coefficient of 8.5 cents per mile. The question of how recreationists perceive travel costs and the relationship between actual and anticipated minimum necessary costs needs considerable further study. However, since the major thrust herein is one of comparing techniques, any error in the choice of a travel cost coefficient will be equally reflected in all of the indirect travel cost approaches. Finally, there is the question of time costs of travel.

The median non-resident angler's household income was $7800 a year which is equivalent to a wage rate of about $4 an hour or 8¢ per mile at 50 mph. However, to use $4 an hour to convert time costs into monetary terms could involve an overstatement of time costs. First, as noted in Chapter Two, the wage rate is probably greater than the price of leisure. The wage rate will also be greater than the time cost of travel as long as travel time is more enjoyable (less tedious).
than working (87% of the non-resident anglers interviewed indicated that they enjoyed the drive to and from Kootenay Lake). Secondly, the income responses were in terms of gross income, not after-tax income. Further, the prevalence of the fixed work week has limited opportunities for additional work. On the other hand, the time costs must be calculated for more than just the driver. Few anglers drove to Kootenay Lake alone. The average angler brought one other member of his household with him. While other members of the angling households may not have held jobs, and therefore did not forego potential financial income to make the trip, the fact remains that their travel time could have been spent pursuing other activities.

See Oort, op. cit., for a complete discussion of this point. It should be noted that valuation of travel time on the basis of the wage rate is only one possible approach. It is also possible to estimate the money cost of travel time by observing actual choices involving a trade-off between travel time and cash travel costs. P. J. Claffey in "Characteristics of Travel on Toll Roads and Comparable Free Roads for Highway User Benefit Studies", Highway Research Board, Bulletin No. 306, 1961, based his estimates on observed choices between toll roads and freeways. Studies have also based value estimates for travel time on observed choices between public and private transportation. For examples of this latter approach see D.A. Quarmby, "Choice of Travel Mode for the Journey to Work", Journal of Transport Economics and Policy, September 1967; and M.E. Beesley, "The Value of Time Spent in Travelling", Economica, May 1965, pp. 174-185.

This problem is further complicated by some of the angling households having more than one income recipient.
and therefore has some positive opportunity costs. Where anglers did not bring another member of their household, they often travelled with friends.

In recognition of the above difficulties, two time cost coefficients are applied herein: 4¢ per mile and 8¢ per mile implying time cost of $2.00 and $4.00 per hour respectively. Adding the time costs to the operating costs of the vehicle yields cost coefficients of 8¢ and 12¢ per mile. It should be noted that this approach assumes that the proportional relationship between cash and time costs of travel is fixed or constant for all distances. The validity of this assumption would appear to be open to question. As more time is absorbed by recreational travel, and hence not available for other uses, the marginal value of time in these other uses can be expected to rise if the rule of diminishing marginal utility applies. In this case, even with speed held constant, the monetary equivalent of the travel time costs per mile would rise as distance increases. It was not possible to make any meaningful adjustment for this possibility here, but the point is raised to emphasize the need for extensive research on the question of converting time travel costs into monetary units.

As long as anglers view licence fees as they would changes in travel costs, Figure 12 represents zone one's demand curve for individual annual Kootenay Lake angler's licences per 100,000 population. The quantity axis is transformed into normal units

\[12\text{The average speed is assumed to be 50 miles per hour.}\]

\[13\text{Where one-way mileage is used these coefficients are doubled becoming 16¢ and 24¢ respectively.}\]
by multiplying by .174 (population of zone one is 17,400). In 
this manner, demand schedules for each of the 36 zones can be 
estimated for both individual and household Kootenay Lake angling 
licences. Horizontal summation of the zonal demands at each fee 
level yields the aggregate demand schedule.

(c) Choice of zonal boundaries:

Since the demand schedules estimated in this application 
of the Hotelling-Clawson technique are based on 36 zones which were 
arbitrarily selected, it is relevant to ask what effect changing 
the number and/or size of the zones would have on the demand estimates. 
Accordingly, the Hotelling-Clawson technique was also applied 
using a modified concentric zone approach with ten zones. Only 
the results for individual angling licences are presented herein. 
The visitation rate prediction function for the alternative set of 
zones was:

\[
(47) \quad V_R = 8884.65 - 1.41D - 0.0495Y + 0.0007D^2 \\
\quad I \quad (0.57) \quad (0.1387) \quad (0.0003) \\
R^2 = 0.57 
\]

\[14\] The modification referred to involved following administrative 
boundaries wherever possible while outlining the concentric zones 
to facilitate estimation of population figures and to allow inclusion 
of some socio-economic variables such as income in the visitation 
rate prediction functions. These alternative zones and their 
characteristics are described in Appendix C.

\[15\] The demand estimates for household licences were sensitive to 
the selection of zonal boundaries to a similar extent.
The dissimilarities in the visitation rate prediction functions based on the two sets of zones are reflected in the resulting demand estimates. The magnitude of these discrepancies and the main reason for their existence are outlined in sub-section (e) below.

(d) **Multiple-purpose trips:**

Of the 247 non-resident angling households interviewed at Kootenay Lake in 1967, 75% were making trips which had the sole objective of fishing at Kootenay Lake. The remainder were making multiple-purpose trips wherein they either combined other leisure activities with their fishing, or fished elsewhere in addition to Kootenay Lake. In such cases, part or all of the travel costs can be regarded as joint costs of attaining multiple trip objectives, and consequently the problem of allocating the appropriate share of these joint costs to any one objective or site is a complex one indeed. In this application, multiple-purpose and single-purpose anglers are treated alike. This procedure implies that the proportion of multiple-purpose anglers is similar for all zones (or at least is not correlated with distance). Unfortunately, the evidence contradicts this assumption. As the distance travelled by anglers increases, the probability of any angler being on a multiple-purpose trip increases:

<table>
<thead>
<tr>
<th>Distance from residence to Kootenay Lake (non-resident anglers)</th>
<th>Percentage of interview respondents in distance class making multiple-purpose trips</th>
</tr>
</thead>
<tbody>
<tr>
<td>less than 300 miles</td>
<td>10%</td>
</tr>
<tr>
<td>300 to 500 miles</td>
<td>20%</td>
</tr>
<tr>
<td>500 to 800 miles</td>
<td>50%</td>
</tr>
<tr>
<td>over 800 miles</td>
<td>60%</td>
</tr>
</tbody>
</table>
Consequently, the visitation rates of the more distant zones reflect a high level of multiple-purpose users and a demand schedule derived therefrom will be biased upwards. The number of observations was insufficient to allow estimation of a separate single-purpose and multiple-purpose demand schedule. While this application of the Hotelling-Clawson technique does not discriminate between single-purpose and multiple-purpose users, the interview results presented in section F are used to investigate the differences in willingness-to-pay between single and multiple purpose anglers.

(e) **Results:**

The demand curves estimated by applying the Hotelling-Clawson technique are presented in Figures 13 and 14 for individual and household angling licences respectively.

The sensitivity of demand functions derived by the Hotelling-Clawson technique to changes in the zonal definitions is illustrated in Figure 15 for individual Kootenay Lake angling licences. In this application, the sensitivity noted in Figure 15 is due to the fact that the non-resident users of the Kootenay Lake fishery were not continuously distributed throughout the population either within or among zones. Instead, the anglers appeared to be clustered so that two adjacent counties having similar characteristics with respect to income, population,

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\[\text{Even this procedure would not have eliminated the problem. To estimate a separate multiple-purpose demand schedule would have required the assumption that the proportion of the trip attributable to Kootenay Lake was not itself a function of distance travelled. However, the interviews suggest that not only does the probability of an angler being on a multiple-purpose trip increase as distance travelled increases, but that the importance of Kootenay Lake as a trip objective declines as distance increases.}\]
Figure 13: Estimated Demand for Non-Resident Individual Kootenay Lake Angling Licences in 1967: Hotelling-Clawson Technique
Figure 14: Estimated Demand for Non-Resident Household Kootenay Lake Angling Licences in 1967: Hotelling-Clawson Technique
Figure 15: Sensitivity of the Hotelling-Clawson Technique to Changes in the Number and Size of the Zones (non-resident)

Demand for Individual Licences (c = 16c)

Fee ($)

36 Zones

10 Zones

No. of Licences
distance to the site, and so on would have vastly different visitation rates due to a cluster of anglers being located in one county. As a result of these clusters, a slight change in zonal boundaries could result in a large change in zonal visitation rates as the shift in boundaries moved some of the "clusters" of anglers from one zone to another.

While the apparent distribution of anglers could have reflected faulty sampling techniques, interviews with the anglers indicated two other possible reasons for such clustering. The first was the impact of word-of-mouth "advertising" where a successful fishing trip to Kootenay Lake by one household last season results in a large number of friends and acquaintances making independent decisions to visit Kootenay Lake this season. Naturally, this implies that knowledge of the existence and characteristics of the Kootenay Lake fishery is unevenly distributed both within and among the zones. The greater the imperfection in information possessed by potential anglers, the less valid will application of the Hotelling-Clawson technique be.

A second possible cause for clustering was the practice of friends and/or relatives deciding to travel as a group. In this case, the trip destination is a group decision and individual participation in the trip may depend on social factors in addition to the factors considered by the Hotelling-Clawson approach.

2) **Resident use of the fishery:**

The Hotelling-Clawson technique was also utilized to estimate a

---

17 Where anglers possess imperfect information, there is also the possibility that recreationists would interpret the imposition of a fee as an indicator of high quality. In other words, price would be used as an indicator of quality, and thus price could act as a demand shifter. This could be a relevant factor in determining the potential benefits from non-resident use if fees were actually going to be imposed.
demand function for residents for annual Kootenay Lake fishing licences. None of the possible zone definitions considered were really acceptable due to the heavy concentration of anglers in nearby towns. The zones used were the ten British Columbia Census Districts (see Figure 16). However, as Table II indicates, residents of only three of the Census Districts made significant use of the fishery. The visitation rates were calculated and, following the procedure outlined in Chapter Three with respect to Figure 7, a demand curve for resident access to the Kootenay Lake fishery was estimated. The travel costs for each zone were based on the basic operating cost for an automobile of 4¢ per mile. The resulting demand curve is presented in Figure 17. Due to the limited geographical dispersion of the resident anglers, the results of this application of the Hotelling-Clawson technique must be viewed as tentative and used only with the greatest caution.

Only individual licences were considered since fewer than 10% of the resident households interviewed contained more than one angler. Anglers making multiple-purpose trips (15% of all resident anglers) are treated as though they came only to fish at Kootenay Lake. The validity of this assumption is investigated in Chapter Five.

No allowance was made for time costs on the grounds that most resident anglers lived within an hour's drive of their fishing spot. The estimate of 4¢ per mile is consistent with the anticipated cost of resident anglers as revealed in the interviews:

\[ AC = -10.02 + 0.0005Y + 0.077D - 0.27N + 6.5Q + 1.10P \]

\[ AC = -10.02 + 0.0005Y + 0.077D - 0.27N + 6.5Q + 1.10P \]

Where \( AC \) = anticipated cost, 
\( Y \) = annual household income, 
\( D \) = one-way distance from residence to area fished on Kootenay Lake, 
\( N \) = average number of fishing trips to Kootenay Lake per year, 
\( Q \) = number of days spent fishing the site, 
\( P \) = number of household members on the trip.

The dotted demand curve in Figure 14 does incorporate a time cost of 4¢ per mile and again demonstrates the sensitivity of the Hotelling-Clawson technique to the choice of a travel cost coefficient.
Figure 16: Map of British Columbia Showing the Ten Census Districts
Table II: Geographical Distribution of Resident Fishermen

<table>
<thead>
<tr>
<th>B.C. Census District</th>
<th>No. of Angler-Days</th>
<th>No. of Anglers</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>973</td>
<td>223</td>
</tr>
<tr>
<td>2</td>
<td>34,283</td>
<td>1,278</td>
</tr>
<tr>
<td>3</td>
<td>489</td>
<td>36</td>
</tr>
<tr>
<td>4</td>
<td>1,808</td>
<td>329</td>
</tr>
<tr>
<td>5</td>
<td>148</td>
<td>24</td>
</tr>
<tr>
<td>6</td>
<td>22</td>
<td>4</td>
</tr>
<tr>
<td>7</td>
<td>11</td>
<td>2</td>
</tr>
<tr>
<td>8</td>
<td>8</td>
<td>1</td>
</tr>
<tr>
<td>9</td>
<td>65</td>
<td>9</td>
</tr>
<tr>
<td>10</td>
<td>29</td>
<td>4</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>37,836</strong></td>
<td><strong>1,910</strong></td>
</tr>
</tbody>
</table>

a See Figure 16.

b See Appendix A for source.
Figure 17: Estimated Demand for Individual Resident Kootenay Lake Angling Licences in 1967: Hotelling-Clawson Technique
One of the weaknesses of the Hotelling-Clawson technique is that it requires a reasonably wide geographical dispersion of recreationists. If use of a site is limited to local residents only, use of the Hotelling-Clawson approach will result in a negligible value being assigned to the site. However, local use only is consistent with high site values for recreation in at least two cases:

(1) There may be widespread ignorance of the site's existence or its characteristics. In this case, the apparent demand for access to the site may be small, but the potential value could be great and easily realized through advertising.

(ii) Most of the recreationists attracted to the site may have moved to the area immediately adjacent to the site in order to pursue their activities more conveniently. Again while use would be local in nature, elimination of the site would impose significant welfare losses.
E. Application of the Pearse Technique:

While the Hotelling-Clawson technique and the Pearse technique have conceptual similarities, the results obtained using these two techniques differed greatly. Due to the limited geographical dispersion of resident anglers for which income data was collected in the interviews (see Table VI), the Pearse technique was applied to non-resident anglers only.

(a) Delineation of income groups:

In the Pearse approach, anglers are grouped according to their income, and demand schedules can be estimated for each income group. The willingness of an individual angler to pay an annual fee for access to the Kootenay Lake fishery ($F$) is estimated using the equation:

\[(27) \ F = T_m - T_x\]

where $T_m$ is the gross benefit accruing to all members of the relevant income class (estimated by taking the actual travel cost incurred by the most distant user in that class), and $T_x$ is the travel cost incurred by the angler in question. It is apparent that the delineation of the income grouping is a key element in the use of the Pearse technique since the definitions of $T_m$ for the various income groups could be quite sensitive to the choice of group boundaries.

Seven income groups were defined for the purposes of this application and they are indicated in part A of Table III. The estimates of $T_m$ in the last column of Table III are the travel costs ($T$) of the anglers living furthest from the Lake as estimated by:

\[(26) \ T = c \cdot D\]

where $D$ is the one-way mileage from the place of residence to Kootenay
Table III: Relationship Between Income Groups and Estimates of Tm

<table>
<thead>
<tr>
<th>A. Original income groups</th>
<th>No. of interviews</th>
<th>Estimate of Tm</th>
</tr>
</thead>
<tbody>
<tr>
<td>#1 ($0 - 4999)</td>
<td>34</td>
<td>$88</td>
</tr>
<tr>
<td>#2 (5000 - 7499)</td>
<td>47</td>
<td>93</td>
</tr>
<tr>
<td>#3 (7500 - 9999)</td>
<td>56</td>
<td>187</td>
</tr>
<tr>
<td>#4 (10000 - 14999)</td>
<td>43</td>
<td>190</td>
</tr>
<tr>
<td>#5 (15000 - 19999)</td>
<td>21</td>
<td>262</td>
</tr>
<tr>
<td>#6 (20000 + )</td>
<td>15</td>
<td>259</td>
</tr>
<tr>
<td>#7(^a) (young retired)</td>
<td>10</td>
<td>253</td>
</tr>
</tbody>
</table>

B. Regroupings

(1) #1 and #2 ($0 - 7499) 81 93 139

#3 and #4 (7500 - 14999) 99 190 285

#5, #6 and #7 (15000 + ) 46 262 393

(ii) #2 and #3 ($5000 - 9999) 103 187 280

#4 and #5 (10000 - 20000) 64 262 393

\(^a\)Group seven is composed of respondents less than 65 years of age who indicated they were retired. These individuals were separated since they could not or would not define their income group, but gave the impression of being well-off financially.
Lake and $c$ is the travel cost per mile. Both estimates of $c$ (16$c$ and 24$\ell$) selected in section D of this Chapter are used.

It can be seen that these seven income groups could be reduced to three by combining groups 1 and 2 together; and 5, 6, and 7 together without significantly affecting the results (see section B(i) of Table III). However, combining groups 2 and 3, or 4 and 5 would have quite a pronounced effect on the estimated demand schedules for groups 2 and 4 (see section B(ii) of Table III).

Consequently, it is desirable to have a testable means of defining the "correct" income grouping to be used in the Pearse technique. Since income data were collected for only one set of income groups, a complete analysis of the sensitivity of the approach to adjustments in the income classes used is not feasible. However, it is possible to consider another indicator of sensitivity discussed in Chapter Three.

In Figure 8, if both $m$ and $x$ have incomes of $0Y$, the greater the distance travelled, the shorter the trip due to the income effect of increased travel costs. So a strong inverse relationship between distance travelled ($D$) and the duration of the trip ($Q$) would be anticipated within one income group. However, as noted in Chapter Three, direct correlation between income and distance both among the income groups and within each group would mean the more distant users within any group have higher incomes and this will tend to offset the income effect of increased travel costs. Such a situation would imply that there is a systematic bias in the Pearse technique such that the demand schedule rises as the "width" of the income classes expands.
To investigate this possibility, the members of each income group with sufficient observations were ranked according to the distance travelled to Kootenay Lake (D) and the duration of their visits at the lake (Q). A Spearman rank correlation coefficient ($r_s$) was calculated for each income group.

An $r_s$ of zero implies no relationship between D and Q, an $r_s$ of minus one implies a complete inverse relationship, while an $r_s$ of plus one implies a perfect direct relationship. When $n$ is greater than 20, the sampling distribution is close enough to normality that the normal area table can be used to test whether any given sample rank correlation coefficient is significantly different from zero.

<table>
<thead>
<tr>
<th>income group</th>
<th>$r_s$</th>
<th>level of significance</th>
</tr>
</thead>
<tbody>
<tr>
<td>$0-4999$</td>
<td>.26</td>
<td>.17</td>
</tr>
<tr>
<td>5000-7499</td>
<td>.19</td>
<td>.25</td>
</tr>
<tr>
<td>7500-9999</td>
<td>.15</td>
<td>.30</td>
</tr>
<tr>
<td>10000-14999</td>
<td>.26</td>
<td>.18</td>
</tr>
<tr>
<td>15000-19999</td>
<td>.16</td>
<td>.25</td>
</tr>
</tbody>
</table>

None of the $r_s$'s in Table IV are large enough to reject the null hypothesis that the population rank correlation coefficient is zero, yet the fact that all the $r_s$'s are positive is disquieting and indicates that the anticipated systematic bias is present. This would explain the positive coefficients since higher incomes imply both willingness

---

19a Only single-purpose anglers who came from single-angler households were used.

20 Income groups #6 and #7 had insufficient observations remaining after elimination of multiple-purpose and multiple-angler households.
to travel further (higher D's) and to stay longer at the site (higher Q's). Thus combining income groups should produce stronger direct relationships between D and Q:

<table>
<thead>
<tr>
<th>income group</th>
<th>( r_s )</th>
<th>significance</th>
</tr>
</thead>
<tbody>
<tr>
<td>#1 &amp; #2 combined</td>
<td>.16</td>
<td>.22</td>
</tr>
<tr>
<td>#2 &amp; #3 combined</td>
<td>.25</td>
<td>.11</td>
</tr>
<tr>
<td>#3 &amp; #4 combined</td>
<td>.45</td>
<td>.01</td>
</tr>
</tbody>
</table>

The latter two combinations in Table V both show much stronger direct relationships between D and Q than was observed in the groups individually in Table IV, i.e. given that the population rank correlation coefficient is zero, the probability of finding the indicated \( r_s \) is much lower. In fact, this effect of combining groups #3 and #4 is pronounced enough to cast doubt upon the conclusion drawn from Table III that combining these two groups would not affect the resulting demand schedule for Kootenay Lake angling licences. Specifically, it would appear doubtful that the estimated values for \( T_m \) were valid for one or both of the income groups, i.e. for at least one of the groups the most distant user interviewed was not marginal.

On the other hand, combining groups #1 and #2 seems to have little effect on either the demand schedule (see Table III) or the strength of the relationship between D and Q. This can be explained by the inclusion in group #1 of a) young respondents who expect to improve their financial position in the future and whose expectations affect their present consumption decisions, and b) retired respondents (over 65) whose general financial situation may not be accurately represented by their
current income.

The income groupings used in this application of the Pearse technique are fairly wide. Consequently, because of the direct correlation noted between income and distance, there would appear to be a significant upward bias built into the results obtained.

(b) **Multiple trip anglers:**

It is not true that all users make only one trip per year as was implied by Figure 8. Particularly for single-purpose anglers, the number of trips per year appears to be inversely related to the distance travelled, while the duration of the trip is directly related to the distance travelled. The latter relationship dominates the observed pattern of non-resident use of the fishery. To be viable, the model of angler behavior implicit in the Pearse technique must explain these relationships. One possible hypothesis is outlined below.

Figure 8 represents an instant in time when "m" and "x" are contemplating their consumption options with respect to fishing Kootenay Lake. While their annual incomes, and the price lines they face can be expected to remain fairly stable over the year, their indifference maps will change with the passage of time. Since the desire to fish Kootenay Lake can be regarded as a satiable want, it is reasonable to expect the intensity of the desire to be at its lowest level immediately following a fishing trip, and to increase as the length of time since the last fishing trip.

For single-purpose non-resident anglers the simple correlation coefficient between the number of trips to Kootenay Lake per year and distance travelled was -0.218 while the coefficient between the duration of the trip and distance was +0.537 (n = 173).
fishing trip increases. Accordingly, this implies that the form of the angler's indifference map is affected by the temporal pattern of past consumption, and that the map shifts with the passage of time.

To exemplify these temporal trends, assume the identical utility functions of m and x reflect the type of temporal interdependence discussed above. In other words, the utility derived from a trip to Kootenay Lake is directly related to the length of time that has lapsed since the angler's last fishing trip. Figures 18a, 18b, and 18c represent three instants in time for m and x wherein the only difference is the length of time that has passed since the last fishing trip. Both m and x have money incomes of 0Y dollars, incur travel costs of YTm and YTx respectively, and face price lines TmRm and TxRx respectively. Figure 18a captures an instant in time immediately following the completion of a visit to the fishery. Neither angler would make another trip in this time period since position Y is preferable to any point on the price line facing either individual. However, as time passes the desire to fish grows again and the indifference map shifts accordingly. Thus, as one moves from Figure 18a to 18b to 18c, two effects are noted. First, the level of utility associated with any given quality of recreation (income constant) increases, i.e. any consumption point with the same coordinates represents a higher level of welfare in 18c than in 18b, and higher in 18b than in 18a. Secondly, for given quantities of both money income and angling, the marginal rate of substitution between income and angling rises as the time between
Figures 18a, b, c: The Effect of Temporal Consumption Pattern on Demand

18a: immediately after last trip

18b: 6 months after last trip

18c: 12 months after last trip
fishing trips increases. The example denoted in Figures 18a, 18b, and 18c indicates that individual m would not visit Kootenay Lake more than once a year, and that even with only one visit a year he is a marginal user (point A in Figure 18c is on indifference curve I - a level of wellbeing also attainable at point Y where m does not visit the site at all). Individual x, however, is an intra-marginal user and must choose between at least two possible patterns of use. As illustrated in Figure 18b he can attain indifference curve II at point C every six months or, he can attain a higher level of utility represented by indifference curve III less frequently (i.e. once a year as indicated by point B in Figure 18c). If x were actually charged his full willingness-to-pay, i.e. TmTx, he would become a marginal user and would make no more than one trip a year. However, in section C of this Chapter, it was argued that an annual licence fee would be unlikely to affect patterns of use (number and duration of trips) since the fee represents a small fixed cost for the year. The existence of multiple-trip anglers implies that patterns of use may be sensitive to even small annual fees.

The assumption of similar preferences within each income group is consistent with the existence of multiple-trip anglers under the above hypothesis. However, two complicating factors do arise. First, the

\[22\] If m's indifference map continued to shift after a year had lapsed showing a continually growing desire to fish, he could be an intra-marginal user with a trip frequency of less than once a year.
assumption of similar preferences still implies identical trip frequencies among the members of any one income group residing similar distances from the site (i.e. the assumption of similar preferences includes similar inter-temporal effects on their utility functions). The evidence for Kootenay Lake indicates trip frequency differs considerably even for anglers in the same income group travelling the same distance. For example, for non-resident, single-purpose anglers travelling between 160 and 180 miles (one-way) to reach Kootenay Lake, the annual trip frequencies were:

<table>
<thead>
<tr>
<th>Income Group $5000-7499</th>
<th>Trip Frequency</th>
<th>No. of Responses</th>
<th>Income Group $10,000-14,999</th>
<th>Trip Frequency</th>
<th>No. of Responses</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>8</td>
<td></td>
<td>1</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>2</td>
<td></td>
<td>2</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>4</td>
<td></td>
<td>3</td>
<td>2</td>
<td></td>
</tr>
<tr>
<td>Over 3</td>
<td>1</td>
<td></td>
<td>Over 3</td>
<td>2</td>
<td></td>
</tr>
<tr>
<td></td>
<td>15</td>
<td></td>
<td></td>
<td>8</td>
<td></td>
</tr>
</tbody>
</table>

This evidence casts some doubt on the validity of the assumption of similar preferences within each income group that is basic to the Pearse technique. Furthermore, the fact that different trip frequencies arise within groups who have both similar incomes and distances to travel (i.e. reside in the same zone - in fact, most of these observations are from the city of Spokane), raises doubt about the assumption underlying the Hotelling-Clawson technique that similar preferences exist among the various population zones.

The second complicating factor arises when some anglers have a trip frequency of less than once a year. Obviously, if the most distant

23Based on the interview responses.
angler in any income group visits the site only once every four or five years, using his willingness to incur travel costs as an estimate of the annual gross value of access to the site could introduce a serious upward bias in the resulting demand schedule for members of his income group. In the application of the Pearse technique to Kootenay Lake, this problem did not arise to any significant extent. Out of the 226 non-resident households successfully interviewed, only four indicated specific trip frequencies of less than one per year, two others indicated they intended to revisit Kootenay Lake on an irregular basis in the future, and sixteen households that they did not intend to return (almost all were first-trippers). None of these households were used to provide estimates of Tm.

c) Multiple-angler households:

A problem arises where there is more than one angler per household involved in the visit to Kootenay Lake. Three alternative ways of adjusting the data to cope with this problem can be suggested. First, the analysis can be applied to individual anglers by dividing the travel cost incurred by the household by the number of anglers making the trip. Under this approach, the willingness-to-pay of an individual angler \( F_a \) is:

\[
F_a = T_m - \frac{T_x}{n}
\]

where \( T_m \) is the travel cost incurred by the marginal angler in the relevant income group, \( T_x \) is the travel cost incurred by the household to which the angler in question belongs, and \( n \) is the number of anglers in the household who are making the trip. This is designated as approach \( P_a \). However, there are serious objections to such an approach. A household does not normally share costs in this manner, nor is it necessarily true that all anglers of a multiple-angler household are

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24 This is the path followed by Andrew H. Trice and Samuel E. Wood, "Measurement of Recreation Benefits", Land Economics, August 1958, pp. 196-207.
equally involved in the sport as this approach implies. Accordingly, there is little reason to expect that two members of a two-angler household travelling 300 miles to Kootenay Lake would each react in the same fashion as a single angler in the same income group who resided 150 miles from the fishery. It must also be noted that $F_a$ increases as $n$ increases and since the total willingness-to-pay of the household is $n \cdot F_a$, the total household willingness-to-pay increases more than proportionally for any increase in the number of household members participating in the fishing trip. This relationship should be questioned since the increase in household cost when additional members make the trip would tend to reduce the willingness of individual members to pay for access when $n$ increased.

An alternative approach would be to apply the Pearse technique to households rather than individual anglers, i.e. "$m\$" and "$x\$" in Figure 8 would represent households rather than individuals. This would imply that a multiple-angler household would react the same as a single-angler household within the same income group if both households resided equal distances from Kootenay Lake. One interpretation of such behavior (designated approach $P_b$) would be that there is only one dominant angler in any household and that the enjoyment gained by any additional anglers in the family is just sufficient to justify the

25 Such a relationship would exist only if the utility functions of the household members were interdependent in such a way that an increase in the welfare of one member enhanced the level of wellbeing enjoyed by the other members.

26 Unfortunately, the number of interviews was not sufficient to classify households by both income and the number of anglers to see if multiple-angler households travelled further.
additional expense of allowing them to accompany the dominant angler on his trip to Kootenay Lake. Thus, if individual Kootenay Lake angler's licences were required, approach $P_b$ implies that all "additional" anglers would be marginal and that the greatest number of such licences that could be sold at any positive price would be equal to the number of households (1777). In $P_b$, the willingness-to-pay of the household $(F_b)$ is:

\[ F_b = T_m - T_x \]

where $T_m$ is the travel cost incurred by the marginal household in the relevant income group, and $T_x$ is the travel cost incurred by the household in question. With respect to individual willingness-to-pay one angler will pay up to $F_b$ for a licence, the other anglers being marginal and being willing to pay no positive fee.

A third alternative also uses the household instead of the individual as the unit of analysis again implying households react the same regardless of the number of anglers they contain as long as their other characteristics are similar. However in this case, designated $P_c$, the behavior is not interpreted as a result of there being one dominant angler with additional anglers being marginal, rather all members are assumed to be equally enthusiastic about the sport - or at least to have equal willingness-to-pay. Thus, household willingness-to-pay for access is identical to $F_b$, but each individual angler in the household is willing to pay $\frac{F_b}{n}$ for access to the fishery.

Since the interviews indicated that the average non-resident house-

\[ \text{Under this approach, the demand schedules for both individual and household are identical for all fees greater than zero.} \]
hold contained 1.43 Kootenay Lake anglers, the decision whether to use $P_a$, $P_b$, or $P_c$ could be a crucial one for this method. For each of the 586 multiple-angler households the difference between what the household would be willing-to-pay under approach $P_a$ (the sum of the individual members' willingness-to-pay) and what the household would pay under approach $P_b$ or $P_c$ ($F_b$ in both cases) is equal to:

$$(50) \quad n \cdot F_a - F_b = (n - 1)T_m$$

where $n =$ the number of anglers in the household, and $T_m =$ the travel cost of the marginal user within the income group.

Since none of the three approaches are completely acceptable, all three are applied herein and the question of how additional anglers in a household affects willingness-to-pay is examined in the next.

For approaches $P_b$ and $P_c$ the maximum the household will pay for a Kootenay Lake angling licence ($F_b$) is:

$$(49) \quad F_b = T_m - T_x$$

However, for a household containing $n$ anglers, approach $P_a$ indicates the household would be willing to pay $n \cdot F_a$ for the licence where:

$$n \cdot F_a = n(T_m - \frac{T_x}{n})$$

The difference between $F_b$ and $F_a$ is:

$$n \cdot F_a - F_b = nT_m - T_x - T_m + T_x$$

$$(50) \quad n \cdot F_a - F_b = (n - 1)T_m$$

But if the most distant household in any income group is a multiple-angler household, switching from one approach to the other will change the estimate of $T_m$ for that income group. Using $T_m$ to represent the marginal travel cost for approach $P_b$ and $T'$ for approach $P_a$, the difference between $F_a$ and $F_b$ in this case would be:

$$n \cdot F_a - F_b = n(T' - \frac{T_x}{n}) - (T_m - T_x)$$

$$= nT' - T_x - T_m + T_x$$

$$n \cdot F_a - F_b = nT' - T_m$$
Chapter on the basis of the interview responses with multiple-angler households.

(d) **Multiple-purpose trips:**

The Hotelling-Clawson approach deals with groups of people residing in the same geographical area and uses the observed behavior of one such group to predict the reaction of another such group when placed in an hypothetical market. The Pearse technique relies on observations of individual behavior to set the level of gross benefit within each income group, and as a consequence is more sensitive to bias by inclusion of "extreme" individual observations. Accordingly, the existence of anglers making multiple-purpose trips to Kootenay Lake has greater significance for the Pearse approach. It was noted earlier that as the distance travelled by anglers increases, the probability of any angler being on a multiple purpose trip increases. This implies that the most distant angler in some income groups may be making a multiple-purpose trip and thus allocating 100% of his travel costs to fishing Kootenay Lake would bias the estimate of $T_m$ for that income group.

The multiple-purpose non-resident anglers interviewed attributed an average of 36% of the motivation of the trip to the desire to fish Kootenay Lake. For the purposes of this application of the Pearse technique, it was assumed that the average multiple-purpose angler would be willing to pay 36% of the amount a comparable single-purpose angler would pay. Thus for multiple-purpose anglers, willingness-to-pay is estimated by $M \cdot F$ where

---

29 This assumption is tested in Chapter Five.
and $M$ is the proportion of the motivation to make the trip that the angler assigns to the desire to fish Kootenay Lake. Where the most distant angler in an income group is making a multiple-purpose trip, his travel cost ($T_1$) is not used as an estimate of $T_m$ unless his cost multiplied by $M$ exceeds the next highest travel cost incurred in that income group in which case $M \cdot T_1$ is used as an estimate of $T_m$.

(e) **Results:**

The interview respondents were arrayed by their willingness-to-pay as estimated by the Pearse technique. The array was cummulatively summed to give the number of anglers willing to pay any given fee or more, thereby yielding the demand schedule for the interview sample. On the assumption the sample is representative of the total non-resident user population with respect to its income composition, the sample demand schedule was expanded to account for the estimated non-resident angling population in 1967. The results are presented in Figure 19 for individual licences and in Figure 20 for household licences. In each case, all three approaches $P_a$, $P_b$ and $P_c$ have been applied.

**F. Application of an Interview Approach:**

The preceding two approaches were indirect in two senses. First, they used differences in travel costs as surrogates for market prices. Secondly, they used the costs one individual or group was willing to pay to reach Kootenay Lake as an indicator of what others would be willing to pay in terms of travel costs plus licence fee. It is possible to use are approaches that are indirect in only the first sense, either by asking anglers to indicate the maximum additional travel cost they
Figure 19: Estimated Demand for Individual Non-Resident Kootenay Lake Angling Licences in 1967:
Pearse Technique

(c = 16c)
Figure 20: Estimated Demand for Household Non-Resident Kootenay Lake Angling Licences in 1967: Pearson Technique
\[ c = 16c \]
would be willing to incur and still come to Kootenay Lake, or by using the Laub Variant. However, the interview technique applied herein is direct in both aspects.

1) **Non-resident use of the fishery:**

Non-resident anglers were interviewed at Kootenay Lake and asked to estimate the maximum annual licence fees they would be willing to pay for both individual and household Kootenay Lake angling licences. A total of 226 non-resident households representing 307 anglers were successfully interviewed.

To ensure proper consideration of the willingness-to-pay questions, each respondent was asked to consider where he would go if the Kootenay Lake fishery were not available to him, and how he would rate this alternative relative to Kootenay Lake. The willingness-to-pay question was then asked again (see Appendix B). Respondents took considerable time to answer the willingness-to-pay questions and often discussed alternative fisheries in some detail. In general, respondents appeared to carefully consider the hypothetical problem presented to them. Where the willingness-to-pay response was relatively low and the alternatives were ranked very inferior to Kootenay Lake, or a high response was coupled with superior quality alternatives, the respondent was asked to explain the discrepancy. Replies were rejected where the explanation did not seem logical, or where the respondent did not seem to be making a sincere attempt to cooperate.

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31 See Appendix B.
With respect to the truthfulness of the responses, it was apparent that some of the anglers felt the interviews were an indication that fees may be charged in the future. In such cases, it is rational for the respondent to bias his willingness-to-pay answers downward in order to minimize a potential future cost. It is within the possibilities for strategic misrepresentation of preferences by respondents that the most serious objections to direct interview methods lie.

Several multiple regressions were run on the willingness-to-pay responses of non-resident anglers in an attempt to find an explanatory function. Two such regression equations are presented below, the first for single-purpose non-resident anglers and the second for multiple-purpose non-resident anglers:

\[
(51) \quad W_g = -3.313 - .0001Y + .0034D + .2721A + 1.0829N + .0129Q + 1.2084P \\
\quad \quad \quad (-.0002) (.0064) (.1024) (.6097) (.1628) (1.3512) \\
\quad \quad \quad -.3786E_1 - 4.4115E_2 - 2.0488V_1 - .6030V_2 + 10.2169V_3 - 3.5254V_4 \\
\quad \quad \quad (2.8288) (4.0450) (3.1724) (3.1251) (2.8067) (3.0845) \\
\quad \quad \quad -1.2740V_5 - 3.2700V_6 \\
\quad \quad \quad (3.3146) (3.0940) \\
\quad R^2 = .224
\]

\[
(52) \quad W_m = .982 + .0006Y - .0099D + .1824A - .7996N + .0850Q - .7669P \\
\quad \quad \quad (.0003) (.0055) (.1583) (2.643) (.1916) (2.098) \\
\quad \quad \quad -.7688M - 6.4458E_2 - 9.2642V_1 - 5.0950V_2 + 13.6731V_3 + 1.2864V_4 \\
\quad \quad \quad (8.423) (6.6479) (5.7267) (5.55047) (6.0568) (5.4466) \\
\quad R^2 = .342
\]

where \( W_g \) = the maximum annual individual fee a single-purpose angler is willing to pay,
\( W_m \) = the maximum annual fee a multiple-purpose angler is willing to pay,
\( Y \) = annual household income,
\( D \) = one way mileage from residence to Kootenay Lake,
\( A \) = age of the head of the household,
\( N \) = number of trips to Kootenay Lake per year,
\( Q \) = number of days spent fishing at Kootenay Lake on the average trip,
\( P \) = number of members of the household on the trip,
\[ M = \text{proportion of the trip motivated by the desire to fish Kootenay Lake}, \]

\[ E_1 \text{ and } E_2 \text{ are dummy variables reflecting the number of years of experience the angler has in the Kootenay Lake area where both } E_1 \text{ and } E_2 \text{ are zero unless the angler has } 1 \text{ to } 5 \text{ years of previous experience (then } E_1 = 1) \text{ or greater than } 5 \text{ years of experience (} E_2 = 1). \text{ The effect of anglers with no experience prior to 1967 is included in the constant term.} \]

\[ V_1 \text{ and } V_2 \text{ are dummy variables reflecting the direction travelled to reach Kootenay Lake where both } V_1 \text{ and } V_2 \text{ are zero unless the angler is from the south (in which case } V_1 = 1) \text{ or east (in which case } V_2 = 1). \text{ The effect of anglers from the west or north appears in the constant term.} \]

\[ V_3 \text{ and } V_4 \text{ are dummy variables reflecting the quality evaluation of Kootenay Lake by the respondent where both } V_3 \text{ and } V_4 \text{ are zero unless the quality rating was excellent to unique (in which case } V_3 = 1) \text{ or the rating was above average to very good (in which case } V_4 = 1). \text{ The effect of quality ratings of average to below average appears in the constant term.} \]

\[ V_5 \text{ and } V_6 \text{ are dummy variables reflecting the species sought by the respondents where both } V_5 \text{ and } V_6 \text{ are zero unless the angler was not seeking any particular species (in which case } V_5 = 1) \text{ or the angler was seeking ling only (in which case } V_6 = 1). \text{ Again the effect of anglers specifically seeking rainbow trout, kokanee or Dolly Varden appears in the constant term.} \]

The only variable significant at the 5% level in both regressions is \( V_3 \), a dummy variable which reflects the increased willingness-to-pay of anglers who rated the quality of Kootenay Lake fishery from excellent to unique. The results of the analysis of willingness-to-pay responses are considered further in Chapter Five in terms of their implications regarding the assumptions underlying the indirect travel cost techniques.

The interview responses with respect to willingness-to-pay were arrayed according to size and cumulatively summed to obtain a schedule indicating the number of respondents willing to pay any given fee (or more) for both individual and household licences. These schedules were then expanded to cover the entire non-resident angler population of
2,531 (1,777 households). The resulting demand curves for 1967 Kootenay Lake angling licences are presented in Figures 21 and 22 for individual and households respectively.

2) Resident use of the fishery:

Resident anglers were interviewed on the site (see Appendix B) and asked to estimate both the maximum they would be willing to pay for an annual Kootenay Lake fishing licence, as represented by \( Y_2 X \) in Figure 9, and the minimum annual compensation that would be required to reimburse them for the loss of access to the fishery, represented by \( Y_3 Y_2 \) in Figure 9. Over 140 resident households were interviewed on the site with 120 households representing 128 anglers successfully completing the interview with respect to indicating their willingness-to-pay.

In the case of the compensation-required question, many of the respondents were unable or unwilling to cooperate fully. However, 64 households successfully completed all stages of the interview. The geographical distributions of the resident Kootenay Lake anglers and of the respondents to the interviews are given in Table VI.

As is apparent from Table VI, Kootenay Lake is very much a local sport fishery with less than 10% of the total number of resident angler-days being consumed by non-local anglers, even though the non-locals accounted for almost a third of the total number of resident fishermen estimated to have visited Kootenay Lake in 1967.

Figures 23 and 24 graphically portray the results of the willingness-

\(^{32}\)Of the resident anglers interviewed, 11% objected to the idea of being charged a fee to fish Kootenay Lake and refused to cooperate in that part of the interview. The corresponding figure for non-resident anglers was 5%.
Figure 21: Estimated Demand for Individual Non-Resident Kootenay Lake Angling Licences in 1967:

Interview Approach

\[\text{Fee (\$/year)}\]

\[\text{No. of Licences}\]

Pears and Laub, \textit{op. cit.}, Figure C1
Figure 22: Estimated Demand for Household Non-Resident Kootenay Lake Angling Licences in 1967:

Interview Approach

Fee ($) vs. No. of Licences

*Pearse and Laub, op. cit., Figure C2
Table VI: Geographical Distribution of Resident Fishermen and Interview Respondents using the Kootenay Lake Sport Fishery in 1967

<table>
<thead>
<tr>
<th>B.C. Census District</th>
<th>(2)(^b) No. of Angler-days</th>
<th>(3)(^b) No. of Anglers</th>
<th>(4)(^c) No. of Willingness-to-pay respondents</th>
<th>(5)(^c) No. of Compensation-required respondents</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>973</td>
<td>223</td>
<td>10</td>
<td>3</td>
</tr>
<tr>
<td>2(^a)</td>
<td>34,283</td>
<td>1,278</td>
<td>96</td>
<td>54</td>
</tr>
<tr>
<td>3</td>
<td>489</td>
<td>36</td>
<td>5</td>
<td>2</td>
</tr>
<tr>
<td>4</td>
<td>1,808</td>
<td>329</td>
<td>8</td>
<td>5</td>
</tr>
<tr>
<td>5</td>
<td>148</td>
<td>24</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>6</td>
<td>22</td>
<td>4</td>
<td></td>
<td></td>
</tr>
<tr>
<td>7</td>
<td>11</td>
<td>2</td>
<td></td>
<td></td>
</tr>
<tr>
<td>8</td>
<td>8</td>
<td>1</td>
<td></td>
<td></td>
</tr>
<tr>
<td>9</td>
<td>65</td>
<td>9</td>
<td></td>
<td></td>
</tr>
<tr>
<td>10</td>
<td>29</td>
<td>4</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>TOTAL</strong></td>
<td><strong>37,836</strong></td>
<td><strong>1,910</strong></td>
<td><strong>120</strong></td>
<td><strong>64</strong></td>
</tr>
</tbody>
</table>

\(^a\) Kootenay Lake is located in Census District #2, see Figure 16.

\(^b\) See Appendix A.

\(^c\) Measured in households. The 120 households in Column (4) represented 128 anglers while all 64 households in Column (5) contained only one angler.
to-pay and the compensation-required questions in the interviews. A comparison of Figures 23 and 24 reveals that the difference between the willingness of residents to pay for access and the compensation they

Several multiple regressions were run in an attempt to find explanatory functions for both the willingness-to-pay and the compensation-required responses. The regression equations with the highest coefficients of multiple determination are presented below:

\[(53)\] 
\[C = 143.654 + 0.0098Y + 2.9306D - 0.9504N - 56.8988Q - 294.5588P + 299.1141E_2 + 1160.7828V_3 + 191.5669V_4\]
\[(385.2563) (560.3804) (494.3811)\]
\[R^2 = 0.243\]
\[n = 64\]

\[(54)\] 
\[W_S = -1.378 + 0.0010Y - 0.0209D + 0.0098A + 0.1503N + 2.7321Q - 1.0897P - 5.4076E_1 - 3.2823E_2 + 13.3313V_3 + 0.1054V_4\]
\[(3.0991) (5.4990) (4.5264) (5.9948) (4.5827)\]
\[R^2 = 0.220\]
\[n = 102\]

\[(55)\] 
\[W_m = 11.302 - 0.0004Y + 0.0164D - 0.2167A + 0.5581N - 0.1270Q - 1.9699P + 3.5852M + 6.8808E_2 + 3.9602V_4\]
\[(3.0503) (11.699) (7.473) (5.342)\]
\[R^2 = 0.597\]
\[n = 18\]

where \(C\) = compensation required,
\(W\) = willingness-to-pay (single-purpose anglers = \(W_S\); multiple-purpose anglers = \(W_m\)),

\(Y\) = annual household income,
\(D\) = one-way mileage from residence,
\(A\) = age of head of household,
\(N\) = number of trips to Kootenay Lake per year,
\(Q\) = average number of days spent at the site per trip,
\(P\) = number of household members on the trip,
\(M\) = portion of the trip motivated by the desire to fish Kootenay Lake,

\(E_1\) and \(E_2\) are dummy variables where both are zero unless the angler has from 1 to 5 years experience in the area (then \(E_1 = 1\)) or more than 5 years experience in the area (then \(E_2 = 1\)).

\(V_3\) and \(V_4\) are dummy variables where both are zero unless the angler rated Kootenay Lake fishery from excellent to unique (then \(V_3 = 1\)) or from above average to very good (then \(V_4 = 1\)).

As was the case with the non-resident responses, only \(V_3\) is significant at the 5% level.
Figure 23: Results of Interview Question Regarding Resident Willingness-to-Pay for Access to Kootenay Lake

Annual Fee ($)

% of Households Interviewed Willing to Pay a Given Amount or Less
Figure 24: Interview Results Regarding Resident Compensation-Required for Loss of Access to Kootenay Lake

Annual Compensation ($) 1000 2000

Percentage of Respondents Requiring Given Payment of More 0 20 40 60 80 100%

Pease and Laub, op. cit., Figure 3.
demand for loss of access is very great. The median willingness-to-pay was $10 while the median compensation-required was $135. Referring back to Figure 9, the difference between $Y_3Y_2$ and $Y_2X$ is due to the positive income elasticity of demand that is one of the characteristics of the individual's indifference map. It would appear highly unlikely that the income elasticity of demand could explain differences between willingness-to-pay and compensation-required of the magnitude found in the interview results.

There are three possible causes for the unexpected size of the differences between the willingness-to-pay and the compensation-required responses:

i) It is possible that the respondents purposely misrepresented their preferences for strategic reasons. This could prompt an angler to understate his willingness-to-pay because he wished to minimize a potential cost, i.e. the licence fee, that he felt he might actually incur in the future. At the same time he may exaggerate his compensation-required response either because he feels that the compensation might actually be forthcoming, or because he feels an exaggeration of his valuation might help to "protect" the fishery.

ii) The second explanation recognizes the fact that most resident anglers using Kootenay Lake reside in the immediate area. Somewhat less than 20% of the local respondents completing the interview

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34 The reaction of a number of the respondents indicated that they believed the interviews were, in effect, a market survey which the government would use in setting actual user fees. These suspicions were sometimes stated outright and sometimes revealed by asking the interviewer when the fee would be imposed, or how the revenues would be used. It appears that strategic misrepresentation was very likely a factor influencing the willingness-to-pay replies.
voluntary indicated that they chose to live close to Kootenay Lake at the cost of incomes lower than they felt they could have earned elsewhere. This decision, whether it was to move to the area or to remain in it, was prompted to a large extent by the desire to fish Kootenay Lake. Figure 25 represents an individual who has chosen to live near Kootenay Lake because of the fishing, and who feels he could have done better financially elsewhere. At some point in the past, the individual represented in Figure 25 had to choose between two alternative paths of action, one of which he anticipated would eventually lead to position A and the other to position C. The characteristics of these two choices prior to the decision are outlined below:

<table>
<thead>
<tr>
<th>Characteristic</th>
<th>position A</th>
<th>position C</th>
</tr>
</thead>
<tbody>
<tr>
<td>a) cash income</td>
<td>( OY_1 )</td>
<td>( OY_2 )</td>
</tr>
<tr>
<td>b) price line</td>
<td>( Y_1L_1 )</td>
<td>( Y_2L_3 )</td>
</tr>
<tr>
<td>c) indifference curve</td>
<td>IV</td>
<td>III</td>
</tr>
</tbody>
</table>

35 One of the shortcomings of the interview questionnaire used was the neglect of a systematic check of respondents to see how many considered the Kootenay Lake fishery to be a significant influence in their choice of a place of residence. See Jack Lessinger, "Measurement of Recreation Benefits: A Reply", Land Economics, November 1958, pp. 369-370.

36 The slopes of the price lines represent the variable cost incurred by the angler under the two alternatives. The slope of \( Y_2L_3 \) exceeds the slope of \( Y_1L_1 \) reflecting the higher travel and on-site accommodation costs associated with position C. The travel costs are treated as variable here since the unit of measurement along the horizontal axis is angler-days per annum and the angler is assumed to vary the number and length of trips during the year to minimize total trip costs for any given number of angler-days consumed. On-site accommodation costs for local users are assumed to be negligible implying that local residents make day-trips to Kootenay Lake returning home the same evening.
Figure 25: An Angler's Choice of a Place of Residence
At the decision point in the past, the angler chose the path of action he anticipated would lead to position A since A is preferred to C. It is assumed that the individual's expectations are realized and that his chosen path of action has placed him at position A. If this past decision is irreversible, then the maximum the individual is willing to pay for an annual Kootenay Lake angler's licence is $Y_1X$ and the payment he would demand to compensate him for the loss of his Kootenay Lake fishing is $Y_4Y_1$. However, if the past decision could be costlessly reversed, then he could shift from A to position C at will - or to any other position available on the alternative path of action such as $Y_2$. Now the maximum fee he would be willing to pay is $Y_1Z$ since this enables him to reach position D on indifference curve II, which is also the level of welfare available to him through the alternative path of action at position $Y_2$. Similarly, the compensation payment he would require is reduced to $Y_4Y_2$ since this payment plus a switch to the alternative path of action yields a level of welfare represented by indifference curve IV at point $Y_4$.

The individual made his decision regarding the desired path of action in the past and there is likely to be some uncertainty as to whether he can shift to position $Y_2$ now. If he knows the probability of being able to reverse the decision is $P$ then he can incorporate this risk into his estimation of willingness-to-pay and compensation-required. The maximum amount he will pay for access to the site ($W$) is now:

$$W = (1 - P)(Y_1X) + P(Y_1Z).$$

The minimum compensation payment he would require to reimburse him for exclusion from the site ($C$) is now:
\( C = (1 - P) (Y_4Y_1) + P(Y_4Y_2). \)

A wrong assumption by the individual regarding the probability of being able to shift to \( Y_2 \) could cause him to suffer a welfare loss. For example, if the shift is assumed to be impossible (i.e. \( P = 0 \)) when in fact it isn't, the angler will indicate a willingness-to-pay of \( Y_1^X \) which will place him at position B when he could shift to the preferred position \( Y_2 \). During the interview, individuals can eliminate the possibility of such a loss by assuming \( P = 1 \) (i.e. the shift is possible) for the purpose of the willingness-to-pay question and consequently refusing to pay more than \( Y_1^Z \). Conversely, for the compensation-required question he assumes that \( P = 0 \) (i.e. a shift to \( Y_2 \) is not possible) and demands payment of \( Y_4Y_1 \). Thus, he will understate his actual willingness-to-pay and/or over-state the compensation he requires.

A similar type of reaction could be expected from respondents who are uncertain as to the quality of the alternative sport fisheries available to them. Thus, for the purpose of determining their willingness-to-pay in the interview they would assume they could shift to good alternatives and therefore give a low response. For the purpose of determining the payment required for compensation they would assume the alternatives available were of inferior quality and therefore demand a high compensation payment.

iii) Finally, the compensation-required responses may be higher than anticipated due to the effect the elimination of the sport fishery could have on real estate values around Kootenay Lake. Elimination of

fishing at Kootenay Lake would reduce the number of tourists visiting the area (or at least reduce their length of stay) thereby lowering the demand for accommodation, food, and other commodities and services provided for tourists in the area. This, in turn, would lower the derived demand for and hence value of commercial property presently providing these services. Resident anglers would find their summer homes or fishing cottages, or even their permanent residences, would fall in value if the fishery were eliminated and would wish to protect themselves against such a capital loss. Therefore, for some respondents there may be a "real estate" factor that increases the compensation-required response. Similarly, if the respondents felt the imposition of fees would reduce the level of fishing activity, and therefore the derived demand for real estate, they would lower their willingness-to-pay accordingly.

The relative frequency distribution of the compensation-required responses is highly skewed. It was indicated above that these responses may be biased upward. Further, it appeared that this upward bias was strongest in the larger compensation-required responses.

It would be very difficult to measure the extent to which the value of site access becomes incorporated into real estate values around the site when access is not directly priced. However, it can be stated that, as long as ownership of land at the site is not a necessary prerequisite for using the site (Kootenay Lake has several public access points), the demand for access is unlikely to be fully transferred to real estate demands. The obstacle that inhibits land values from fully reflecting the value of the site lies in the unidimensional nature of the land's locational advantage, i.e. it is adjacent to a fishery but may be further from employment, shopping, and cultural opportunities. When an angler considers purchasing land near the site, he must balance the potential decrease in recreational travel costs against possible increases in other costs.

mean = $300, median = $135, mode = $100.
hence this bias accentuates the degree of skewness. This might be expected because the size of the compensation-required response would tend to be directly related to the intensity of the individual's interest in Kootenay Lake, and the more intense the interest, the greater the incentive to misrepresent preferences and the greater the importance of Kootenay Lake in the type of decision represented in Figure 23.

3) Congestion costs:

To the extent that non-residents crowd the Kootenay Lake fishery itself, they impose a real economic cost on the province by lowering the quality of the fishing experience available to both themselves and to resident anglers. If the crowding imposes significant costs, it

One indication that the bias in compensation-required responses accentuated the skewness of the compensation-required distribution was the relationship between (i) the relative difference between compensation-required and willingness-to-pay, i.e. compensation required minus willingness-to-pay compensation required and (ii) the size of the compensation required response. (i) and (ii) were ranked by size and a Spearman rank correlation coefficient \( r_s \) was calculated:

\[
r_s = 1 - \frac{6 \Sigma d^2}{n(n^2 - 1)}
\]

where \( d \) = the difference between the ranks of (i) and (ii) above, and \( n \) = the number of observations.

An \( r_s \) of zero implies no relationship between (i) and (ii), while an \( r_s \) of -1 implies a complete inverse relationship, and a \( r_s \) of +1 implies a perfect direct relationship. In this case, the \( r_s = .73 \) with an \( n = 64 \) and is significant at the 1% level. This direct relationship between the relative difference between the two responses and the size of the compensation-required response cannot be attributed to the marginal utility of income diminishing at an increasing rate since the multiple regression analyses run in an attempt to find an explanatory function for the compensation-required responses indicated that income was not a significant variable at the 5% level.
may mean that maximizing the total value of the fishery requires the rationing of access through fees. Price discrimination between residents and non-residents is possible, and while imposing fees on resident anglers may not be politically acceptable, no such constraints should arise with respect to non-residents. Therefore, an attempt was made to measure the congestion costs imposed on resident anglers because of non-resident use by utilizing data collected during the interviews with resident anglers on the lake.

As fishing pressure increases on the lake, there are two different aspects of fishing quality that can be adversely affected. The most obvious is the average catch per unit of fishing effort, since the level of angler activity influences the numbers and size-age distributions of the fish populations. It appears that the current level of utilization of the Kootenay Lake sport fishery is well below the threshold at which angling has a significant effect on the fish population.

The second facet of quality is a question of congestion. Even with the average catch per unit of effort constant, an increase in the number of anglers can decrease the level of fishing enjoyment offered by the lake. There are a number of reasons for this, ranging from frustration caused by tangled or cut lines and boat traffic problems to the loss or impairment of the sense of isolation and serenity that some anglers

41 Only 5% of the non-resident anglers indicated they would knowingly be affected by a reduction in the number of fishermen. However, the non-residents most sensitive to congestion may already have been diverted to other fishing areas. This possibility implies that an attempt to estimate the reduction in benefits from non-resident use of the Kootenay Lake fishery due to congestion should also take into account the non-residents who were diverted to other B.C. fisheries.

42 This was the subjective opinion held by D. Sinclair, the regional fisheries biologist in 1967.
consider to be the most important characteristic of the sport. Increasing fishing pressure lowers quality, and as the quality of the recreational experience deteriorates, fewer anglers will be attracted to the fishery at any given price.

Resident anglers were asked to estimate the maximum annual fee they would be willing to pay rather than be excluded from the Kootenay Lake sport fishery. Their replies indicated that a perfectly discriminating monopolist could extract a total of $22,500. Respondents were then asked to indicate if halving the number of anglers using the lake would increase their fishing pleasure, given a constant level of angler-success. Only 20% of the residents interviewed indicated they would knowingly be affected by a reduction in the number of fishermen. These pressure-sensitive fishermen were further requested to estimate the percentage increase in their willingness-to-pay that would arise from a halving of fishing pressure. The average increase indicated was 80%. As long as sensitivity to fishing pressure is not correlated with any of the other determinants of willingness-to-pay, it would appear that halving the number of anglers on Kootenay Lake in 1967 would have increased total willingness-to-pay by:

\[ $22,500 \times .20 \times .80 = $3,600 \]

If the relationship between congestion and quality is inversely proportional, elimination of the non-resident use of the fishery

Other important influences, which are ignored above, are the relative levels of congestion at alternative fisheries; and the possibility that crowding is a subjectively perceived phenomenon to which people gradually become accustomed. In the latter case, a constant but gradual increase in the level of utilization may not affect the "quality" of the fishing experience at all.

To establish the actual nature of this relationship would require more than the two points "observed" on the congestion scale through the interviews.
(which is responsible for one-third of the total number of angler-days consumed) would have increased resident willingness-to-pay by:

\[ \$3,600 \times .67 = \$2,400 \]

That is, it would have been possible for a hypothetical monopolist to have collected an additional $2,400 from resident users if all non-resident use of the Kootenay Lake fishery had been eliminated; yet the residents would have been just as well off as they were in 1967 when the lake was available to non-residents (neglecting benefits from non-resident expenditures).

This figure represents the cost of congestion to resident anglers attributable to the non-resident use of the Kootenay Lake sport fishery in 1967. However, the costs imposed on the non-fishing residents are omitted, as is the effect of congestion on the level of resident and non-resident use of the fishery.

There has been some attention given to the implications of recreational sites having a set capacity beyond which congestion causes quality to deteriorate. However, it has usually been assumed that access to the site would be rationed to prevent over-capacity utilization. This approach implies no congestion costs until capacity is reached, and if rationing takes place the costs of imposing the capacity constraint depend on the rationing mechanism used.

\[ \text{The imposition of non-resident fees would reduce the level of fishing pressure, but by less than the amount that is anticipated since it is possible additional anglers would be attracted by the lower levels of congestion. These additional anglers would partially offset the direct impact of imposing the fees.} \]

\[ \text{See Krutilla, Cicchetti, Freeman III, and Russell, op. cit., wherein it is assumed that user fees or prices are used to ration access once demand (at current prices) reaches the capacity of the site.} \]

\[ \text{The welfare implications of using non-price rationing mechanisms are discussed in Chapter Two, based on Seneca, op. cit.} \]
Chapter Five:
Comparisons of Results and Conclusions

The fundamental difficulty faced by researchers attempting to evaluate recreational sites is that outdoor recreation is seldomly marketed. Techniques must be developed that can simulate the behavior of a market for recreation and hence generate market values for the direct recreational benefits offered by a site. Where there are market imperfections, for example externalities, the simulated market values are only one component of the complete evaluation. Once a technique is applied it is desirable to test the validity of the results. The lack of recreational markets that creates the need for simulation techniques also implies the impossibility of directly testing demand estimates without instituting a market when none currently exists. But if outdoor recreation remains a predominantly non-marketed commodity, how can the validity of evaluational techniques be determined? The researcher must rely on investigations of (i) the validity of the assumptions underlying the technique, and (ii) the consistency of the internal logic of the theoretical model on which the technique is based. The testing of the assumptions should provide an indication of when a given technique is most likely to be applicable, i.e. under what circumstances the underlying assumptions are valid. Further, similarities in the results obtained by techniques based on different assumptions can be used as mutually supporting evidence if and only if the assumptions for each technique have been investigated and judged to be valid.
A. Comparison of the Three Techniques Applied:

1) Comparison of results:

   (a) Estimates of non-resident demands:

   Figures 26 and 27 present the demand curves estimated by the three market simulation techniques applied in Chapter Four for individual and household licences respectively. For both the Hotelling-Clawson and Pearse techniques, high and low estimates are given in accordance with the sensitivity of these techniques to the assumptions made when applying them. Even so, the range of estimate graphically presented in Figures 26 and 27 is based on a travel cost coefficient of 16 cents per mile (one way). For both the Hotelling-Clawson and Pearse results, a 10% increase (decrease) in the travel cost coefficient (c) will vertically shift both the high and low estimates of demand at each fee level up (down) by 10%.

   For both individual and household demands, the Pearse estimates appear to be most inelastic, while the interviews resulted in the most elastic demand estimates. The range covered by the various demand estimates increases quite substantially as fee levels rise. This can be illustrated by comparing the fees that would generate the maximum level of revenue under the various demand estimates and the resulting total revenue figures:
Figure 26: Comparison of Demand Estimates for Non-Resident Individual Licences (1967)
Figure 27: Comparison of Demand Estimates for Non-Resident Household Licences (1967)
<table>
<thead>
<tr>
<th>Technique used to obtain demand estimate</th>
<th>Individual Licences</th>
<th></th>
<th>Household Licences</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Revenue max. fee</td>
<td>Total revenue (to nearest $100)</td>
<td>Revenue max. fee</td>
</tr>
<tr>
<td>Hotelling-Clawson&lt;sup&gt;a&lt;/sup&gt;</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>high estimate&lt;sup&gt;b&lt;/sup&gt;</td>
<td>$32</td>
<td>$31,500</td>
<td>$32</td>
</tr>
<tr>
<td>low estimate&lt;sup&gt;c&lt;/sup&gt;</td>
<td>26</td>
<td>16,800</td>
<td>22</td>
</tr>
<tr>
<td>Pearse&lt;sup&gt;a&lt;/sup&gt;</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>high estimate&lt;sup&gt;d&lt;/sup&gt;</td>
<td>$136</td>
<td>$114,900</td>
<td>$144</td>
</tr>
<tr>
<td>low estimate&lt;sup&gt;e&lt;/sup&gt;</td>
<td>64</td>
<td>78,100</td>
<td>120</td>
</tr>
<tr>
<td>Interview</td>
<td>$12</td>
<td>$14,300</td>
<td>$22</td>
</tr>
</tbody>
</table>

<sup>a</sup>Travel cost coefficient of 16 cents per mile (one way) is used in all cases.

<sup>b</sup>Based on application using 10 zones.

<sup>c</sup>Based on application using 36 zones.

<sup>d</sup>Based on $P_a$ estimates wherein each angler in a multiple-angler household is assumed to have the same willingness-to-pay.

<sup>e</sup>Based on $P_b$ estimates wherein each multiple-angler household is assumed to contain only one non-marginal angler.
(b) Estimates of resident demand:

Only the Hotelling-Clawson and Interview techniques were utilized in an attempt to estimate resident demands, and there is some question as to whether the geographical dispersion of resident anglers was sufficiently wide for application of the former technique to be regarded as valid. The results are presented in Figure 28, wherein both high and low estimates of the travel cost coefficient (c) are incorporated into the Hotelling-Clawson approach. While the demand curve as estimated by the interviews falls entirely within the range of estimates covered by the Hotelling-Clawson approach, it must be recognized that this range of estimates is relatively wide and, as will be indicated in the following section, this "conformity" cannot legitimately be used as mutually supporting evidence to increase the level of confidence placed on the Hotelling-Clawson and Interview techniques. The differences in the demand estimates are further illustrated by comparing the measures of consumers' surplus that they generate, i.e. the areas under the demand curves:

<table>
<thead>
<tr>
<th>Technique used to estimate demand</th>
<th>Consumers Surplus</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hotelling-Clawson</td>
<td></td>
</tr>
<tr>
<td>high estimate (c=16c)</td>
<td>$27,100</td>
</tr>
<tr>
<td>low estimate (c=8c)</td>
<td>13,050</td>
</tr>
<tr>
<td>Interview</td>
<td>22,500</td>
</tr>
</tbody>
</table>

(c) A cautionary note regarding the relevant angler population:

The estimated demand schedules all assume the relevant angler population is composed of all non-residents or residents who fished Kootenay Lake in 1967. However, even with no charge for access to Kootenay Lake specifically, all adult anglers in 1967 still incurred a provincial licence fee of at least $2 in order to fish the Lake (see
Figure 28: Comparison of Demand Estimates for Resident Licences (1967)
Table I). Therefore, it is possible that the number of anglers who would have fished Kootenay Lake under separate licencing with a zero fee exceeded 2,531 non-residents and 1,910 residents for 1967. This implies the estimated demand schedules are all biased downward for fees between $0 and $2. Presumably, few additional anglers would be involved at licence fees above $2 since the fishery was already available to them for this price in 1967.

2) **Comparative testing of assumptions:**

(a) The relationship between distance and willingness-to-pay:

Both the Hotelling-Clawson and the Pearse techniques are indirect approaches that rely on differences in travel costs to simulate markets for recreational access. Their conceptual frameworks imply an inverse relationship between distance and willingness-to-pay, all other things being equal.

It is possible to use the interview results to test this assumption by examining the relationship between the distance travelled by the interview respondents and their stated willingness-to-pay. As indicated in Table VII, the application of multiple regression analysis to the interview responses indicated that distance and willingness-to-pay were not significantly related at the 5% level. In the case of the multiple purpose, non-resident anglers, the inverse relationship between \( D \) and \( W_m \) observed is significant at the 8% level but appeared to be due, in large part, to the more distant multiple-purpose users viewing Kootenay

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\[\text{Even if there is a general bias either upward or downward in the interview results, the relationship between stated willingness-to-pay and distance is a valid test for the travel-cost techniques. This test is not valid if there is a systematic bias in the interview responses that is related to distance travelled.}\]
Table VII: Relationship Between Distance and Willingness-to-Pay

<table>
<thead>
<tr>
<th></th>
<th>Sample Regression</th>
<th>Standard Error</th>
<th>Level of Significance</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Coef. for D</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Non-resident anglers</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Willingness-to-pay</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>(single-purpose) a</td>
<td>.0034</td>
<td>.0064</td>
<td>60%</td>
</tr>
<tr>
<td>Willingness-to-pay</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>(multiple-purpose) b</td>
<td>-.0099</td>
<td>.0055</td>
<td>8%</td>
</tr>
<tr>
<td>Resident anglers</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Willingness-to-pay</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>(single-purpose) c</td>
<td>-.0209</td>
<td>.0271</td>
<td>45%</td>
</tr>
<tr>
<td>Willingness-to-pay</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>(multiple-purpose) d</td>
<td>.0164</td>
<td>.0161</td>
<td>34%</td>
</tr>
<tr>
<td>Compensation-required</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>e</td>
<td>2.9306</td>
<td>1.8804</td>
<td>12%</td>
</tr>
</tbody>
</table>

\[ a \text{See equation (51)} \\
\[ b \text{See equation (52)} \\
\[ c \text{See equation (54)} \\
\[ d \text{See equation (55)} \\
\[ e \text{See equation (53)} \]
Lake as an unplanned side-trip in the course of an extended journey.

The lack of a significant inverse relationship between distance and stated willingness-to-pay among the interview responses means any similarity between the demand estimates of either the Hotelling-Clawson or Pearse approaches and the estimates obtained by the interview technique cannot be regarded as mutually supporting evidence. Such similarity as does exist is artificial and may very well be the result of a "fortunate" choice of zonal boundaries and/or estimates of travel cost coefficients. Furthermore, the fact that a strong inverse relationship between distance and stated willingness-to-pay failed to appear suggests that the Hotelling-Clawson and Pearse applications herein involved serious identification problems - a possibility noted in Chapter Three.

(b) The significance of multiple-purpose trips:

The question addressed here is one of how anglers differ in their willingness-to-pay for access to a fishery if some are making multiple-purpose trips and some are making single-purpose trips (but are similar in all other respects). For the purposes of applying the Hotelling-Clawson technique, this distinction was, in fact, ignored implying that there is no effect on willingness-to-pay. For the Pearse technique, it was assumed the willingness-to-pay for an angler on a multiple-purpose trip was reduced relative to the willingness-to-pay of a comparable single-purpose angler by the extent to which the fishing trip was motivated by considerations other than fishing at Kootenay Lake.

2Jack L. Knetsch and Robert K. Davis, in "Comparisons of Methods for Recreation Evaluation", (Water Research, edited by Kneese and Smith, op. cit.), compared interview and travel cost results, and found no relationship between distance travelled and stated willingness to incur additional travel costs. However, they still appear to feel that the similarity in the results of the two approaches can be used as evidence of the validity of the interview responses.
Since the interviews collected information on both the proportion of the trip motivated by the desire to fish Kootenay Lake and the willingness of the anglers to pay for access to the fishery, the results may be useful in estimating the significance of the presence of multiple-purpose users for the demand estimates. The regressions run on the willingness-to-pay responses indicated that the variable M, the proportion of the trip motivated by the desire to fish Kootenay Lake, was not significantly related to the willingness-to-pay for either residents or non-residents (see Table VIII). Apparently then, the form in which the adjustment was made in the Pearse technique to account for multiple-purpose anglers is inappropriate.

The regression equations derived from the willingness-to-pay responses of the single-purpose anglers were used to estimate what the representative multiple-purpose resident and non-resident anglers would be willing to pay. The results are presented in Table IX, where they are compared with the average responses from multiple-purpose anglers. Thus, the representative multiple-purpose non-resident angler was willing to pay $8.30 a year for access to Kootenay Lake, whereas a single-purpose angler with identical characteristics would have been willing to pay $9.50. Similarly, the resident multiple-purpose angler would only be willing to pay $5.90 compared to $14.00 for his single-purpose counterpart. The significance of multiple-purpose trips appears much greater for resident anglers—a situation that may be partially explained by differences in the nature of the multiple-purpose trips. Most non-residents making multiple-purpose trips were doing so in order to fish in areas other than Kootenay Lake, while most residents making multiple-purpose trips were combining
Table VIII: Relationship Between M and Willingness-to-Pay for Multiple-Purpose Anglers

<table>
<thead>
<tr>
<th>Willingness-to-pay of:</th>
<th>Sample Regression Coef. for M</th>
<th>Standard Error</th>
<th>Level of Significance</th>
</tr>
</thead>
<tbody>
<tr>
<td>Non-resident multiple-purpose</td>
<td>-.7688</td>
<td>8.4233</td>
<td>89%</td>
</tr>
<tr>
<td>Resident multiple-purpose</td>
<td>3.5852</td>
<td>11.6988</td>
<td>76%</td>
</tr>
</tbody>
</table>

\(^a\) See equation (52)

\(^b\) See equation (55)
fishing with other recreational pursuits (mainly visiting relatives, swimming and water-skiing) at the same site.

On the basis of Table IX, it would appear that the multiple-purpose assumption used in the application of the Pearse technique in Chapter Three introduces a general downward bias in the demand estimates. On the other hand, assuming multiple-purpose trips had no influence on willingness-to-pay, apparently introduced a slight upward bias to non-resident demand as estimated by the Hotelling-Clawson Variant. However, these inferences must be regarded as inconclusive due to the size of the standard errors of estimate for regression equations (51) and (54).

(c) Relationship between willingness-to-pay and number of anglers to household:

In the application of the Pearse technique, a problem arose as a result of multiple-angler households. Table X summarizes the three alternative methods of treating this problem.

It is apparent in Table X that individual willingness-to-pay is directly related to \( n \) under \( P_a \), inversely related under \( P_c \), and unrelated under \( P_b \). For the household, total willingness-to-pay is unaffected by changes in \( n \) for both \( P_b \) and \( P_c \) but directly related to \( n \) under \( P_a \). An analysis of the interview responses of multiple-angler households indicated that no one of these three approaches was wholly satisfactory. However, as indicated in Table XI, there was no relationship between the individual willingness-to-pay responses by household heads and the number of anglers in the household (\( P \)). This would indicate that approach \( P_b \) is preferable—except that there were some cases where households had more than one angler who was willing-to-pay a positive fee for an individual licence. It would appear that in this application, approach \( P_b \) is an acceptable compromise.
Table IX: Influence of Multiple-Purpose Trips on Willingness-to-Pay

<table>
<thead>
<tr>
<th></th>
<th>Non-Resident</th>
<th>Resident</th>
</tr>
</thead>
<tbody>
<tr>
<td>Average willingness-to-pay response by single-purpose anglers:</td>
<td>$11.25</td>
<td>$13.14</td>
</tr>
<tr>
<td>Representative multiple-purpose anglers were willing-to-pay:</td>
<td>$8.30</td>
<td>$5.90</td>
</tr>
<tr>
<td>Proportion of trip motivated by desire to fish Kootenay Lake:</td>
<td>36%</td>
<td>44%</td>
</tr>
<tr>
<td>If they had been single-purpose anglers, they would have been willing-to-pay:</td>
<td>$9.50&lt;sup&gt;a&lt;/sup&gt;</td>
<td>$14.00&lt;sup&gt;b&lt;/sup&gt;</td>
</tr>
<tr>
<td>Apparent reduction in willingness-to-pay attributable to multiple-purpose classification:</td>
<td>$1.20</td>
<td>$8.10</td>
</tr>
<tr>
<td>Standard error of estimate</td>
<td>$13.34</td>
<td>$8.12</td>
</tr>
</tbody>
</table>

<sup>a</sup> Estimate is based on equation (51)
<sup>b</sup> Estimate is based on equation (54)
Table X: Alternative Approaches Toward Multiple-Angler Households in the Pearse Technique

<table>
<thead>
<tr>
<th>Approach</th>
<th>Individual Willingness-to-pay</th>
<th>Household Willingness-to-pay</th>
</tr>
</thead>
<tbody>
<tr>
<td>P_a</td>
<td>$F_a = T_m - \frac{T_x}{n}$</td>
<td>$n \cdot F_a = nT_m - T_x$</td>
</tr>
<tr>
<td>P_b</td>
<td>$F_b = T_m - T_x$</td>
<td>$F_b = T_m - T_x$</td>
</tr>
<tr>
<td>P_c</td>
<td>$\frac{F_b}{n} = T_m - T_x$</td>
<td>$F_b = T_m - T_x$</td>
</tr>
<tr>
<td></td>
<td>Sample Regression</td>
<td>Standard Error</td>
</tr>
<tr>
<td>--------------------------------</td>
<td>-------------------</td>
<td>----------------</td>
</tr>
<tr>
<td></td>
<td>Coef. for P</td>
<td></td>
</tr>
<tr>
<td>Non-Residents</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Willingness-to-pay (single-purpose)²</td>
<td>1.2084</td>
<td>1.3512</td>
</tr>
<tr>
<td>Willingness-to-pay (multiple-purpose)³</td>
<td>-0.7669</td>
<td>2.0988</td>
</tr>
<tr>
<td>Residents</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Willingness-to-pay (single-purpose)ί</td>
<td>-1.0897</td>
<td>3.0951</td>
</tr>
<tr>
<td>Willingness-to-pay (multiple-purpose)λ</td>
<td>-1.9699</td>
<td>3.0503</td>
</tr>
<tr>
<td>Compensation-required</td>
<td>-294.5588</td>
<td>222.3831</td>
</tr>
</tbody>
</table>

²See equation (51)
³See equation (52)
ίSee equation (54)
λSee equation (55)
εSee equation (53)
4) **Relevance of the demand concepts generated:**

In Chapter Two, it was argued that there were two concepts of demand that were relevant. The market demand function reflecting both the income and quality effects (cell D in Chart I on page 27) indicates the numbers of recreationists that will be forthcoming at any level of fee actually imposed. This concept is relevant when estimating potential revenues available from non-resident use or the fee level necessary to ration resident access to a site to maintain a given level of quality. The compensated demand function from which both the income and quality effects have been removed (cell A in Chart I on page 27) is relevant when attempting to value resident use of either an existing or a proposed recreational site.

The interview technique is the only approach that can estimate a fully compensated demand function (cell A concept) through the use of annual compensation-required or willingness-to-pay questions on an all-or-nothing basis. Interviews could also be used to estimate market functions (cell D) if the questions related to marginal willingness-to-pay (per day or per trip) and the quality implications in terms of intensity of use were explicitly outlined during the interviews. Unfortunately, this approach is expensive, sensitive to strategic misrepresentation of preferences by recreationists, and requires a fairly high level of sophistication on the part of the respondents.

The indirect travel cost techniques all generate demand functions that incorporate the income effect (since actual travel costs differentials are used as proxies for prices), but reflect the existing level of utilization (and hence quality) for all fee levels - a cell B concept (Chart I, page 27). Therefore, the demand estimates generated by the indirect travel cost techniques should tend to understate actual demand at each fee level since they ignore the quality effects (see Section B of Chapter Two).
B. A Partial Catalogue of Evaluational Problems Indicating the Relevant Techniques:

1) Evaluation of a single existing site:

Each of the five techniques discussed at length in Chapter Three can be applied to this type of evaluational problem. The question as to which approach will generate results most likely to be valid is answered through consideration of the characteristics of the site and the recreationists using it within the context of the basic assumptions underlying the different techniques. Some of the more critical site and user characteristics are listed below along with a brief outline of the implications for each of the five techniques.

(a) geographical dispersion of users -

Both the Hotelling-Clawson and Pearse techniques require a fairly wide geographical dispersion of recreationists. Accordingly, as the dispersion becomes narrower, these techniques become less appropriate. The Ullman-Volk-Spargo approach is well-designed for circumstances where all users come from the same population center (i.e. there is no significant dispersion of users) as long as the recreationists visit or are willing to visit several sites. In fact, a locational rent can be estimated as long as there is at least one alternative site. The Laub variant also can handle a single site evaluation where there is limited dispersion of users as long as those users do participate in activities at several sites. The final approach, that of relying on interviews, is not affected by the dispersion of users or their activities except insofar as the existence of alternatives provides the possibility of including
questions in the interviews to test the consistency of the responses.

(b) availability and relative quality of alternatives -

As emphasized at the end of this Chapter, one of the high priority research areas revolves around the questions of what constitutes an alternative in the minds of recreationists and how can relative quality be measured. Until these questions are answered, all indirect travel cost techniques are limited in application. For the Hotelling-Clawson and Pearse techniques, ignoring alternatives implies all recreationists face similar spectra of substitutes for the site regardless of where they reside. This would seem most appropriate where the site being evaluated is either unique (hence no alternatives) or of an extremely common nature (hence readily available substitutes exist in all areas). In the Ullman-Volk and Laub techniques, alternative sites are a basic part of the analytical framework, but if differences in quality are not incorporated, the evaluations obtained will imply all sites are of comparable quality. The more important quality differentials become, the less valid will be the results of any evaluational techniques that ignore them. Only the interview technique is immune to this criticism in that the interview responses will theoretically reflect the current availability and relative quality of alternatives facing the recreationist. Therefore, as long as availability and quality of substitutes remain constant, the responses will reflect the value of the site.

(c) multiple-purpose recreationists -

Recreationists whose trips have several objectives such as visiting several sites, combining business with recreation, visiting relatives
while vacationing, and so on, pose special problems for the indirect travel cost techniques. Once a visit to a particular site becomes part of a "joint" output or product, it is no longer possible to consider all travel costs as being incurred in order to reach the site being evaluated. For sites where a large proportion of the visitors are making multiple-purpose trips (which often appears to be the case for major park areas), a simple application of any of the indirect travel cost approach is of questionable validity. The interview approach avoids this problem as long as the questions are formulated so that the responses reflect pre-trip willingness-to-pay and not the recreationist's response to being faced with unexpected fees at the site when he arrives (and hence already having incurred many of the trip expenses).

A somewhat similar problem arises where more than one member of the household participates in recreational activities at the site (i.e. multiple-user households). Here the unit of analysis should be the household and different demand functions should be estimated for different sizes of households to test the possibility that household willingness-to-pay is related to the number of participating members. This greatly increases the number of calculations and volume of data needed for variants of the indirect travel cost approach, but is easily incorporated in the interview approach by phrasing questions in terms of households rather than individuals.

(d) resident use -

While all of the techniques are designed to simulate markets, it has been argued in this thesis that conventional market simulations yield demand curves that are not appropriate when evaluating resident
use of an existing site unless the implicit distributional assumptions involved are recognized and socially accepted. Otherwise interview techniques should be used that are designed to measure the compensation payments required to reimburse the resident users for the loss of access to the site. In this case, the distributional value judgement is that the provision (or removal) of recreational sites will not be used as a redistributional tool and any project that displaces recreational activities at a site must generate sufficient net benefits to allow compensation to be paid. Hence the displacing project must pass the Kaldor-Hicks compensation criterion which implies that the project can potentially pass the Paretian efficiency test (i.e. make at least one person better off and no one worse off).

(e) imperfect knowledge -

Since all of the techniques simulate market demand curves, the results are meaningful only if willingness-to-pay (or compensation-required) is an accurate value indicator. Market prices will be poor social value indicators when consumers possess imperfect knowledge. Therefore, if there are widespread imperfections in the state of knowledge regarding the existence or characteristics of a site and/or its alternatives on the part of actual or potential users, all market valuations (whether actual or simulated) are of dubious validity. The same point can be made with respect to many forms of market imperfection and brings in the whole complex of arguments associated with the "Theory of Second Best".

2) Evaluation of a change in the characteristics of an existing site:

Since the Hotelling-Clawson and Pearse techniques concern themselves with different groups of recreationists visiting the same site, they
cannot be applied to the problem of measuring the effect a change in the characteristics of a site has on its value. However, assuming the changes in site quality are measurable in some sense and can be related to quality levels available elsewhere, both the Ullman-Volk and Laub variants could yield answers to this evaluational question. The interview approach could also be used as long as the changes are measurable, but the greater the divergence between the prevailing situation and the hypothetical situation proposed in the interviews, the more difficult it will be for respondents to give accurate appraisals of their reactions.

3) **Evaluation of a single proposed site:**

Neither the Hotelling-Clawson nor the Pearse techniques were designed to evaluate proposed sites. However, this problem can be handled by the Ullman-Volk and Laub variants of the travel cost approach. The interview approach could also be used in this context, but would suffer from three handicaps. First, the interviews would have to be fairly complex in that the potential recreationists would have to be informed with respect to the characteristics of the proposed new site. Secondly, interviews with recreationists at an existing site have demonstrated some of the difficulties involved in having people react to a hypothetical situation (eg. pricing of an existing site). Where a proposed site is involved, there is an additional level of abstraction in the hypothetical situation and an additional reason for doubting the validity of the responses. Finally, the researcher must be prepared to defend the sample chosen - and it may be difficult to determine from which areas
the potential recreationists would be drawn for a major new site.

4) Evaluations involving several sites:

Since the demands for recreation at different sites in the same region are obviously not independent, any agency responsible for the management of all recreational sites within one jurisdiction will want evaluational techniques designed to measure the value of possible additions, deletions, and modifications of sites within the region. The Laub variant of the indirect travel cost approach is a first step towards developing techniques that explicitly incorporate the interdependencies among competing recreational sites. The scope of such techniques was indicated in Chapter Three along with the major obstacles inhibiting their use:

(i) lack of adequate data on the recreational activities of provincial residents to allow classification of users at each site by residence and socio-economic characteristics;

(ii) lack of research on what constitutes an alternative to any given site, and

(iii) lack of data on site characteristics and the relative quality of the recreational experience offered.

The latter two points represent serious obstacles to the use of all indirect travel cost techniques. Interview techniques are considered inapplicable to multiple-site problems on the grounds that the "hypothetical" situations to be described in the interviews would be too numerous and too complex to expect accurate response.
C. Research Priorities:

As affluence and population grow, as leisure time increases, and as areas suitable for outdoor recreation diminish, it becomes progressively more important to develop techniques that aid in resolving the allocational conflicts between competing recreational and non-recreational uses of resources. The single site evaluation approach for which the currently utilized techniques were designed should be replaced by a systems approach wherein the demand interactions among the various recreational activities (and between recreational and related non-recreational activities) are explicitly incorporated. The Laub Variant is a first step in this direction and serves to identify a number of problem areas needing study.

The most obvious obstacle to the implementation of the systems approach in Canada is a lack of data on patterns of recreational activities. So high priority should be placed on a data collection system that generates comparable data for each of the provinces in scope and form that are consistent with the evaluational procedures and management techniques to be used. Improved data availability may allow new techniques to be implemented, but this is not sufficient. Because of the lack of any direct test of the results of market simulation techniques, it is essential that a high priority be placed on testing the assumptions underlying these techniques. In terms of the Laub Variant, there are two areas in which the evaluation results appear to be most sensitive. First is the estimation of the travel cost coefficients where the most complex problems are encountered when trying
to convert time costs into monetary equivalents as perceived by the recreationists. The second area revolves around the question of the formation of attitudes and preferences regarding recreation. There is a tremendous amount of basic research that needs to be done on leisure-time decision-making before we can confidently define which factors are relevant in measuring the quality of the recreational experience, in measuring the impact of congestion, and in determining what constitutes a substitute for any particular type of recreational experience. This research would also provide welcome insight into the validity of the assumption of similar preferences that appears in a variety of forms in the indirect travel cost techniques.

To date, there has been a serious imbalance in the allocation of research effort with a relative over-emphasis on the problems of implementing the various market-simulation techniques and a relative under-emphasis on the extraction and testing of the underlying assumptions. The first priority of future research thrusts should be a move to correct this imbalance.
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Pearse, Peter H. and Michael Laub, The Value of the Kootenay Lake Sport Fishery, Study Report No. 3 on the Economics of Wildlife and Recreation, Fish and Wildlife Branch of the Department of Recreation.


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APPENDIX A: THE 1967 KOOTENAY LAKE CREEL CENSUS AND SUPPLEMENTARY SURVEYS
Much of the data contained in the foregoing study is based on the provisional results of the 1967 Kootenay Lake creel census taken by the Fish and Wildlife Branch of the British Columbian government. However, considerable revision of the creel census results was necessary before they could be used to estimate total fishing activity in angler-days, and the division of fishing activity between residents and non-residents.

A. The Creel Census:

For the purposes of the creel census, Kootenay Lake was divided into four areas corresponding roughly to the west arm, the north arm, the south arm, and the central area where these three arms meet (see Figure 10). The creel census was based on a minimum sample of four days in each area with the four days being selected so as to include one Saturday, one Sunday, one Monday, and one other week-day. The results of each sample-day were considered to represent 100% coverage of the area for that day. The data collected by the creel census sampling were expanded to cover the whole month by multiplying each sample-day's results by the number of days of that type in the month, i.e. the Saturday observations were multiplied by the number of Saturdays in the month, the Sunday observations were multiplied by the number of Sundays, and so on.

While a boat was frequently used by the creel census clerk, the majority of the sampling was done by a census clerk stationed at the major launching point for the area being sampled. He interviewed the anglers recording information on the number of anglers, number of rods, 

1Mondays are treated separately because most local businesses close on Mondays and it is felt that this may affect the pattern of fishing activity.
number of hours fished, species sought, species caught, and the place of residence of the angler.

There are two overwhelming sources of error in such a creel census. As carried out by a stationary creel census taker, the creel census estimates total use for the major launching point in the area - not for the area as a whole. Anglers who do not put in to major launch points are usually missed and since there are numerous launching points in each area, a significant proportion of the anglers are consistently ignored. This source of creel census error is not serious during the months of light fishing pressure as most of the minor resorts close during the winter. However, during seasons of heavy fishing pressure the proliferation of minor launching points increases the importance of this error. Further, when the level of fishing pressure in the west arm of the fishery becomes heavy, the creel census clerk is unable to interview all of the anglers launching from the major marinas where he operates. Thus the creel census for the west arm misses not only the anglers launching from the private piers and less important marinas, but also some of the anglers launching from the major marinas where the creel census is taken.

B. Revision of the Creel Census through Supplementary Surveys:

To get a more accurate picture of the real level of fishing activity, resort owners on the north and south arms of the lake were asked to cooperate by maintaining records of the number and places of residence of the anglers using their resorts for each day during the months May through August. These records allowed the estimation of the number-of angler-days consumed during these months in the north and south arms of the lake that were "ignored" by the creel census because they
involved anglers not using the major marinas in the areas. The creel census for the central area could not be corrected due to the lack of cooperation from the resort owners in the area.

The keeping of supplementary records was not feasible for the west arm due to the large number of private launching points in this area. Total use in the west arm was estimated by using a combination of boats and aircraft to count the number of boats using the area. Interviews conducted by boat provided data on the number of anglers per boat and their places of residence. The total number of angler-days estimated by the boat counts was then compared to the creel census estimates for the same days to see what proportion of total west arm use was registered by the creel census. Based on eight observations, it was found that the creel census only covered about 39% of the total west arm fishing activity. Total fishing activity for the months from April through September in the west arm was calculated by expanding the creel census results accordingly. For the remaining months of low fishing pressure (see Table XIIIB) it was assumed that the creel census represented 100% coverage.

Table XIIA presents the level of fishing activity as estimated by the creel census and as subsequently revised by the supplementary records and the west arm boat counts.

For each creel census area, the division of the total number of angler-days consumed between resident and non-resident anglers was determined from the place of residence information gathered by the

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2Some fishing activity was still missed since one resort on the south arm and one on the north arm refused to keep the supplementary records, and some of those that did cooperate kept incomplete records.
Table XIA: 1967 Kootenay Lake Fishing Activity as Estimated by the Creel Census and Subsequently Revised (in angler-days)\textsuperscript{a}

<table>
<thead>
<tr>
<th>Creel Census Area</th>
<th>Creel Census Estimate (A-D)</th>
<th>Revised Estimate (A-D)</th>
</tr>
</thead>
<tbody>
<tr>
<td>West arm</td>
<td>13,809</td>
<td>42,416\textsuperscript{b}</td>
</tr>
<tr>
<td>South arm</td>
<td>2,809</td>
<td>6,236\textsuperscript{c}</td>
</tr>
<tr>
<td>North arm</td>
<td>5,199</td>
<td>5,952\textsuperscript{c}</td>
</tr>
<tr>
<td>Central area</td>
<td>1,505</td>
<td>1,505</td>
</tr>
<tr>
<td><strong>TOTAL</strong></td>
<td><strong>23,322</strong></td>
<td><strong>56,109</strong></td>
</tr>
</tbody>
</table>

\textsuperscript{a}Pearse and Laub, The Value of the Kootenay Lake Sport Fishery, Table A-1.

\textsuperscript{b}Adjusted according to the results of the boat counts for April through September.

\textsuperscript{c}Adjusted according to the results of the supplementary records for May through August.
Table XIIIB: 1967 Kootenay Lake Fishing Activity - Distribution by Month and Creel-Census Area

<table>
<thead>
<tr>
<th>Month</th>
<th>West arm</th>
<th>South arm</th>
<th>North arm</th>
<th>Central</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Jan.</td>
<td>179</td>
<td>256</td>
<td>231</td>
<td>69</td>
<td>735</td>
</tr>
<tr>
<td>Feb.</td>
<td>72</td>
<td>144</td>
<td>164</td>
<td>128</td>
<td>508</td>
</tr>
<tr>
<td>March</td>
<td>484</td>
<td>215</td>
<td>168</td>
<td>77</td>
<td>944</td>
</tr>
<tr>
<td>April</td>
<td>3,000</td>
<td>313</td>
<td>373</td>
<td>4</td>
<td>3,690</td>
</tr>
<tr>
<td>May</td>
<td>2,780</td>
<td>382</td>
<td>476</td>
<td>132</td>
<td>3,770</td>
</tr>
<tr>
<td>June</td>
<td>3,350</td>
<td>135</td>
<td>1,484</td>
<td>142</td>
<td>5,111</td>
</tr>
<tr>
<td>July</td>
<td>16,960</td>
<td>981</td>
<td>1,104</td>
<td>122</td>
<td>19,167</td>
</tr>
<tr>
<td>August</td>
<td>8,870</td>
<td>975</td>
<td>657</td>
<td>506</td>
<td>11,008</td>
</tr>
<tr>
<td>Sept.</td>
<td>6,004</td>
<td>1,026</td>
<td>533</td>
<td>88</td>
<td>7,651</td>
</tr>
<tr>
<td>Oct.</td>
<td>536</td>
<td>858</td>
<td>278</td>
<td>95</td>
<td>1,767</td>
</tr>
<tr>
<td>Nov.</td>
<td>126</td>
<td>782</td>
<td>304</td>
<td>112</td>
<td>1,324</td>
</tr>
<tr>
<td>Dec.</td>
<td>55</td>
<td>169</td>
<td>180</td>
<td>30</td>
<td>434</td>
</tr>
<tr>
<td>Total</td>
<td>42,416</td>
<td>6,236</td>
<td>5,952</td>
<td>1,505</td>
<td>56,109</td>
</tr>
</tbody>
</table>

% of total fishing activity

75.6  11.1  10.6  2.7  100.0

aSee Figure 10.
creel census, the supplementary records, and the west arm boat inter­views.

To transform the quantities of angler-days into numbers of anglers and households, the distribution of angler-days by distance zone was generated from the residence data. The interviews provided the information necessary to calculate the average number of trips per year for anglers from each zone, the average number of anglers per household for each zone. Multiplying the number of trips per year by the number of angler-days per visit yields the average number of angler-days per year for each angler. Expanding this figure by the average number of anglers per household for the zone gives the average number of angler-days per year per household. Dividing the total number of angler-days consumed by the residents of a zone by the average number of angler-days per angler (household) produces the number of anglers (households) from each zone that visited Kootenay Lake. Summing over all zones and rounding off the total to whole numbers yields the total number of anglers (households) estimated to have fished Kootenay Lake in 1967. The composition of total fishing activity is broken down by category of angler in Table XIII.

3 Due to the limited number of interviews with anglers residing in some of the distance zones, the data here is based on both the extended interviews (see Form B-1 of Appendix B) and the 211 supplementary interviews. For B.C. Census Districts 6, 7, 8, and 10 there were still two or fewer observations per District. Therefore, the average angler-days per year and average number of anglers per household statistics for these Districts are based on the relevant statistics for whichever of the other six Districts comes closest to being equi­distant from the Kootenay Lake fishery.
Table XIII: Composition of Fishing Activity by Category of Fishermen for 1967a

<table>
<thead>
<tr>
<th>Category of fishermen</th>
<th>No. of anglers</th>
<th>No. of angler-days</th>
</tr>
</thead>
<tbody>
<tr>
<td>Residents of B.C.</td>
<td>1,910</td>
<td>37,836</td>
</tr>
<tr>
<td>local fishermenb</td>
<td>1,278</td>
<td>34,283</td>
</tr>
<tr>
<td>non-local fishermansc</td>
<td>632</td>
<td>3,553</td>
</tr>
<tr>
<td>Non-residents of B.C.</td>
<td>2,531</td>
<td>18,273</td>
</tr>
<tr>
<td>Canadians</td>
<td>380</td>
<td>2,741</td>
</tr>
<tr>
<td>Americans</td>
<td>2,151</td>
<td>15,532</td>
</tr>
<tr>
<td>Total</td>
<td>4,441</td>
<td>56,109</td>
</tr>
</tbody>
</table>

\(^a\)From Peter H. Pearse and Michael E. Laub, op. cit., Table 1.

\(^b\)A local resident of B.C. is defined as one who resides in B.C. Federal Census District Number 2, the boundaries of which are indicated in Figure 16.

\(^c\)Any B.C. resident who does not reside in Census District Number 2.
APPENDIX B: INTERVIEW and EXPENDITURE SURVEYS OF KOOTENAY LAKE ANGLERS
A. The Interviews:

The interviews, which were introduced as an attitude survey, were conducted at the major launching points around Kootenay Lake from May to September of 1967. Respondents were interviewed individually so one respondent would not be influenced by hearing the replies of another angler. In general, the Kootenay Lake fishermen were quite cooperative as is evident in Table XIV.

The heavy proportion of non-resident interviews is a consequence of the fact that most non-residents launch their boats from the major commercial marinas on the lake while relatively more residents use private piers or beach areas in the provincial parks. With the vast shoreline created by the size and shape of Kootenay Lake, it was not possible to cover more than the major launch points. Further, it was found that boat to boat interviews were not feasible except in cases where very few questions need be asked (eg. a creel census).

The interview questionnaire is presented in Form B-1. For multiple-angler households, questions #10 and #11 were asked in the individual form to each member of the household having a licence if that person paid for his licence himself. Where the head of the household paid for all licences, as was usually the case, then only the head of the household was interviewed and he was asked questions #10 and #11 both in the individual form for each angler in his household, and in the household form (as indicated by the parentheses in #10).

In addition to these interviews, shorter supplementary interviews were conducted including only the first nine questions in Form B-1 plus questions regarding the composition of trip expenditures and the reason
Table XIV: The Interview Sample (Form B-1)$^a$

<table>
<thead>
<tr>
<th></th>
<th>resident</th>
<th>non-resident</th>
<th>total</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Total no. of households fishing Kootenay Lake in 1967</strong></td>
<td>1736</td>
<td>1777</td>
<td>3513</td>
</tr>
<tr>
<td><strong>No. of interviews attempted</strong></td>
<td>143</td>
<td>247</td>
<td>390</td>
</tr>
<tr>
<td><strong>No. of interviews successfully completed</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>-households</td>
<td>120$^b$</td>
<td>226</td>
<td>346</td>
</tr>
<tr>
<td>-no. of anglers covered</td>
<td>132$^b$</td>
<td>316</td>
<td>448</td>
</tr>
<tr>
<td><strong>Sample as a percentage of total no. of fishing households</strong></td>
<td>6.9%</td>
<td>12.7%</td>
<td>9.9%</td>
</tr>
</tbody>
</table>

$^a$Pearse and Laub, op. cit., Table A3.

$^b$Of these, only 64 households (containing 64 anglers) gave satisfactory responses to question 13 regarding compensation-required.
why anglers making their first trip chose Kootenay Lake. A total of 211 of the shorter interviews were completed between February and October of 1967. The information gathered by the abbreviated interviews was used to supplement the extended interview results where there were insufficient observations obtained by the latter.

B. Mailed Expenditure Survey:

To obtain expenditure data from non-resident anglers, 966 questionnaires were mailed to non-residents who purchased their B.C. angler's licences in the Kootenay Lake area. The names and addresses were selected randomly from the counterfoil records of the B.C. Fish and Wildlife Branch. Of the 572 replies received, 439 were usable, the remainder being incomplete or from anglers who did not fish Kootenay Lake. The geographical distribution of the residences of the respondents to the mail questionnaire was similar to the pattern observed in the creel census results. Therefore, to estimate the total amount and composition of non-resident expenditures in B.C. the questionnaire data was expanded to cover the 1,777 non-resident households estimated to have used the Kootenay Lake sport fishery in 1967. The expenditure questionnaire is presented in Form B-2.
Form B-1: Kootenay Lake Interview Questionnaire

Date and creel census area of interview

1) Place of residence.

2) Number of adults accompanying respondent (i.e. paid for by respondent).
   Number and type of adult B.C. angler's licences held.
   Number of minors accompanying the respondent.
   Number of B.C. angler's licences held.

3) Number of previous fishing trips to Kootenay Lake: ___ over ___ years.
   Number of trips currently made per year.
   Number of trips respondent expects to make next year.

4) Your round trip will take ___ days with ___ days spent fishing on Kootenay Lake.
   What is the average number of days spent fishing on Kootenay Lake when you come here?

5) Was this trip made exclusively to fish on Kootenay Lake? If not, what proportion of the trip was motivated by the desire to fish Kootenay Lake?

6) Are you fishing for a particular species, if so, which?

7) Do you consider travelling to and from Kootenay Lake a pleasure in itself? A displeasure?

8) Which age group do you fall in:
   0-19
   20-29
   30-39
   40-49
   50-65
   65+

9) Which annual income group does your household fall in:
   $ 0 -2499
   2500-4999
   5000-7499
   7500-9999
   $10000-14999
   15000-19999
   20000-30000
   30000+

At this point the respondent was asked if he was willing to answer some purely hypothetical questions. If he agreed, it was again stressed that the following questions were strictly hypothetical, but that his cooperation would be appreciated. The respondent was asked to consider each question carefully, and if at any time he felt he could not or did not wish to answer a question(s) to say so rather than give misinformation to the interviewer.
10) Consider the situation where a B.C. angler's licence entitled you to fish all B.C. sport fisheries except Kootenay Lake and for Kootenay Lake you were required to hold an annual Kootenay Lake angler's permit. What would be the maximum annual licence fee you would be willing to pay for such an annual Kootenay Lake permit? \[ \$x \]. Then if it were more than \$x you would go elsewhere? (Where there are more than one angler in the household, the head of the household is asked how much he would be willing to pay for a Kootenay Lake licence covering his entire family - in addition to the above question).

11) What fishing areas would you consider to be alternatives for Kootenay Lake? How would you rate these areas relative to Kootenay Lake as far as fishing quality is concerned? For the purpose of this trip, if you couldn't have come to Kootenay Lake to fish, where would you have gone and what would you have done?

12) Considering then that you could go to ________ which you rate as ________ to Kootenay Lake, would you still be willing to pay \$x and if so, is \$x the most you would pay for an annual Kootenay Lake angler's permit? Would you be willing to pay more, less, or the same if:
   i) the average catch was doubled, i.e. more fish per hour, same size;
   ii) the " " " halved, i.e. fewer " " " ";
   iii) the number of fishermen was halved; average catch constant;
   iv) the number of fishermen was doubled; " " " ".

13) What would be the minimum annual cash payment that you would accept to stop fishing Kootenay Lake (household)? \[ \$y \]. So as long as you were given \$y per year you would be willing to give up fishing here? Would you accept \$.9y dollars? (if yes) \$.8y dollars? etc.. (This question for residents only).

14) Before you left home, what did you anticipate this trip would cost you?

15) What would you like to see done to increase the value of the Kootenay Lake sport fishery?
Form B-2: Mailed Expenditure Questionnaires for Non-Residents

1) Where did you fish on your most recent fishing trip in B.C.?  
   Kootenay Lake _____ Other _____ (please specify).

2) If you were accompanied by members of your family (or any others  
   whom you paid for) please indicate how many: _____.

3) Please indicate the number of days you spent:  
   a) on the whole trip ____; b) fishing ____.

4) Please indicate how much you spent on the following items during  
   your trip WHILE IN B.C.:

   Food (groceries, meals, cigarettes, etc.) $_____
   Alcoholic beverages $_____
   Accomodation (cabin, trailer space, etc.) $_____
   Travel expenses (gas, oil, repairs, plane/train  
   tickets, etc.) $_____
   Other (equipment rental or purchase, etc.) $_____

5) How much did this trip cost you in total for all  
   expenditures both in B.C. and elsewhere: $_____

(Questionaires were numbered so place of residence and hence distance  
travelled could be determined).
APPENDIX C: DEFINITIONS of ZONES and their CHARACTERISTICS
<table>
<thead>
<tr>
<th>Zone</th>
<th>Distance to Kootenay Lake</th>
<th>Population (100,000's)</th>
<th>$V_{R_1}$</th>
<th>$V_{R_H}$</th>
</tr>
</thead>
<tbody>
<tr>
<td>1) Wash.: Stevens county</td>
<td>133</td>
<td>.174</td>
<td>190.4</td>
<td>142.5</td>
</tr>
<tr>
<td>2) Wash.: Pend Oreille county</td>
<td>69</td>
<td>.066</td>
<td>2131.0</td>
<td>1498.7</td>
</tr>
<tr>
<td>3) Wash.: Ferry county</td>
<td>148</td>
<td>.038</td>
<td>108.7</td>
<td>79.5</td>
</tr>
<tr>
<td>4) Wash.: Spokane county</td>
<td>168</td>
<td>3.300</td>
<td>221.1</td>
<td>156.1</td>
</tr>
<tr>
<td>5) Idaho: Bonner county</td>
<td>146</td>
<td>.161</td>
<td>725.4</td>
<td>509.6</td>
</tr>
<tr>
<td>6) Idaho: Boundary county</td>
<td>109</td>
<td>.057</td>
<td>709.0</td>
<td>499.4</td>
</tr>
<tr>
<td>7) Idaho: Kootenai county</td>
<td>193</td>
<td>.334</td>
<td>419.1</td>
<td>293.7</td>
</tr>
<tr>
<td>8) Montana: Lincoln county</td>
<td>163</td>
<td>.164</td>
<td>860.1</td>
<td>603.3</td>
</tr>
<tr>
<td>9) Wash.: Adams county</td>
<td>233</td>
<td>.133</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>10) Wash.: Asotin county</td>
<td>288</td>
<td>.146</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>11) Wash.: Columbia county</td>
<td>300</td>
<td>.044</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>12) Wash.: Douglas county</td>
<td>300</td>
<td>.188</td>
<td>12.2</td>
<td>9.0</td>
</tr>
<tr>
<td>13) Wash.: Franklin county</td>
<td>309</td>
<td>.350</td>
<td>28.1</td>
<td>20.3</td>
</tr>
<tr>
<td>14) Wash.: Garfield county</td>
<td>304</td>
<td>.028</td>
<td>198.2</td>
<td>138.1</td>
</tr>
<tr>
<td>15) Wash.: Grant county</td>
<td>268</td>
<td>.758</td>
<td>7.3</td>
<td>5.1</td>
</tr>
<tr>
<td>16) Wash.: Lincoln county</td>
<td>200</td>
<td>.110</td>
<td>25.8</td>
<td>18.4</td>
</tr>
<tr>
<td>Zone</td>
<td>Distance&lt;sup&gt;a&lt;/sup&gt; to Kootenay Lake</td>
<td>Population&lt;sup&gt;b&lt;/sup&gt; (100,000's)</td>
<td>VR&lt;sub&gt;I&lt;/sub&gt;</td>
<td>VR&lt;sub&gt;H&lt;/sub&gt;</td>
</tr>
<tr>
<td>------</td>
<td>-------------------------------</td>
<td>-----------------</td>
<td>-----</td>
<td>-----</td>
</tr>
<tr>
<td>17) Wash.: Okanogan county</td>
<td>250</td>
<td>.231</td>
<td>12.0</td>
<td>8.6</td>
</tr>
<tr>
<td>18) Wash.: Walla Walla county</td>
<td>327</td>
<td>.437</td>
<td>5.5</td>
<td>3.9</td>
</tr>
<tr>
<td>19) Wash.: Whitman county</td>
<td>243</td>
<td>.306</td>
<td>73.3</td>
<td>51.5</td>
</tr>
<tr>
<td>20) Idaho: Benewah county</td>
<td>243</td>
<td>.059</td>
<td>163.0</td>
<td>115.9</td>
</tr>
<tr>
<td>21) Idaho: Clearwater county</td>
<td>334</td>
<td>.088</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>22) Idaho: Latah county</td>
<td>279</td>
<td>.212</td>
<td>55.0</td>
<td>39.0</td>
</tr>
<tr>
<td>23) Idaho: Lewis county</td>
<td>316</td>
<td>.046</td>
<td>80.7</td>
<td>56.7</td>
</tr>
<tr>
<td>24) Idaho: Nez Perce county</td>
<td>274</td>
<td>.309</td>
<td>20.8</td>
<td>14.7</td>
</tr>
<tr>
<td>25) Idaho: Shoshone county</td>
<td>233</td>
<td>.196</td>
<td>305.0</td>
<td>179.5</td>
</tr>
<tr>
<td>26) Montana: Flathead county</td>
<td>274</td>
<td>.341</td>
<td>130.8</td>
<td>91.6</td>
</tr>
<tr>
<td>27) Montana: Mineral county</td>
<td>310</td>
<td>.040</td>
<td>0</td>
<td>0</td>
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<tr>
<td>28) Montana: Sanders county</td>
<td>240</td>
<td>.068</td>
<td>20.6</td>
<td>14.4</td>
</tr>
<tr>
<td>29) Southern Alberta</td>
<td>390</td>
<td>6.853</td>
<td>48.5</td>
<td>34.2</td>
</tr>
<tr>
<td>30) Wash.: Benton county</td>
<td>318</td>
<td>.708</td>
<td>37.8</td>
<td>26.6</td>
</tr>
<tr>
<td>31) Wash.: Yakima county</td>
<td>386</td>
<td>1.523</td>
<td>5.7</td>
<td>4.1</td>
</tr>
<tr>
<td>Zone</td>
<td>Distance* to Kootenay Lake</td>
<td>Population b (100,000's)</td>
<td>VR&lt;sub&gt;c&lt;/sub&gt;</td>
<td>VR&lt;sub&gt;d&lt;/sub&gt;</td>
</tr>
<tr>
<td>------</td>
<td>--------------------------</td>
<td>-------------------------</td>
<td>-------------</td>
<td>-------------</td>
</tr>
<tr>
<td>33) Wash.: C.D. No.'s 1, 2, 6, 7 Idaho: C.D. No. 2 Northern Alberta</td>
<td>580</td>
<td>24.800</td>
<td>7.1</td>
<td>5.0</td>
</tr>
<tr>
<td>34) Wash.: C.D. No. 3 Montana: C.D. No. 2 Oregon: C.D. No.'s 1, 2, 3</td>
<td>680</td>
<td>22.300</td>
<td>5.5</td>
<td>3.9</td>
</tr>
<tr>
<td>35) Oregon: C.D. No. 6 Calif.: C.D. No. 1-11, 14, 15 Nevada, Wyoming, Saskatchewan</td>
<td>900</td>
<td>81.600</td>
<td>0.9</td>
<td>0.6</td>
</tr>
<tr>
<td>36) Calif.: C.D. No. 12, 13, 16-38 Arizona, Colorado, Nebraska, Utah, New Mexico, North and South Dakota, Manitoba</td>
<td>1450</td>
<td>239.800</td>
<td>0.5</td>
<td>0.4</td>
</tr>
</tbody>
</table>
Distance is one-way road mileage from the major zonal urban center to Kootenay Lake. Where a zone has more than one major center, the weighted average is used with the weights based on relative populations.

Population is the estimated 1967 population based on the 1960 population expanded to 1967 using the zone's average annual rate of increase for the period 1950 to 1960.

VR_I represents the number of individual anglers per 100,000 population who visited the Kootenay Lake fishery in 1967.

VR_H represents the number of angling households per 100,000 population who visited the Kootenay Lake fishery in 1967.

Congressional Districts.
Table XVI: Alternative Set of Zones for the Hotelling-Clawson Technique

Alternative Zone Set:

<table>
<thead>
<tr>
<th>Zone</th>
<th>Distance to Kootenay Lake</th>
<th>Population (100,000's)</th>
<th>VR_I</th>
<th>VR_H</th>
<th>No. of Interviews</th>
</tr>
</thead>
<tbody>
<tr>
<td>1)</td>
<td>Stevens and Pend Oreille counties Idaho: Boundary and Bonner counties</td>
<td>100</td>
<td>.459</td>
<td>864.9</td>
<td>605.2</td>
</tr>
<tr>
<td>2)</td>
<td>Ferry and Spokane counties Idaho: Kootenai county Montana: Lincoln county</td>
<td>190</td>
<td>3.780</td>
<td>277.5</td>
<td>194.3</td>
</tr>
<tr>
<td>3)</td>
<td>Okanogan, Walla Walla, Whitman and Lincoln counties Idaho: Clearwater, Nez Perce, Latah, Lewis, Benewah and Shoshone counties Montana: Flathead, Sanders and Mineral counties</td>
<td>270</td>
<td>4.08</td>
<td>55.5</td>
<td>38.9</td>
</tr>
<tr>
<td>4)</td>
<td>Chelan, Kittitas, Yakima and Benton counties Idaho: Idaho and Adams counties Montana: Glacier, Missoula and Lake counties Oregon: Union, Umatilla and Wallows counties</td>
<td>360</td>
<td>4.51</td>
<td>13.6</td>
<td>12.0</td>
</tr>
<tr>
<td>Zone</td>
<td>Distance to Kootenay Lake</td>
<td>Population (100,000's)</td>
<td>VR_I</td>
<td>VR_H</td>
<td>No. of Interviews</td>
</tr>
<tr>
<td>------</td>
<td>--------------------------</td>
<td>------------------------</td>
<td>------</td>
<td>------</td>
<td>------------------</td>
</tr>
<tr>
<td>7) Montana: C.D. No. 2 east of Hill, Chouteau, Judith Basin, Meagher, and Park counties Idaho: Bonneville, Bingham, Power Bannock, Caribou, Cassia, Oneida, Franklin and Bear counties</td>
<td>850</td>
<td>19.5</td>
<td>2.1</td>
<td>1.5</td>
<td>3</td>
</tr>
</tbody>
</table>
As the distance between the zone and Kootenay Lake increases, the visitation rate normally falls. Thus the relationship between the rates for zones 9 and 10 above is inconsistent with normal behavior. The main explanation probably lies in the fact that the most important contributor of Kootenay Lake anglers in zones 8, 9, and 10 is the state of California. And within California, the major contributors are the cities of San Francisco and Los Angeles with their environs. San Francisco (zone 8) and Los Angeles (zone 10) contribute a disproportionately large number of total users for their zones. Thus, even though zone 9 is closer than zone 10, the former's lack of a major Californian urban center results in the zone 9 visitation rate being exceeded by the rate for zone 10. The predominance of users from California (and therefore from the two cities) would appear to be partially due to better lines of communication created by the numerous travel clubs (for trailer owners) in the state.