

AN ABSTRACT OF THE THESIS OF

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The most common method of estimating the economic demand for and value of recreational resources is the Hotelling-Clawson approach. This methodology developed as an empirical technique and was never adequately founded upon a conceptual analysis of the decision to recreate. In response to this lack of a theoretical foundation alternative methodologies have been proposed by Gibbs and Edwards and by Pearse that are based upon explicit and remarkably similar conceptual models of the individual recreationist's decision to recreate. This thesis explores further the conceptual and empirical issues raised by these alternative methodologies. Following Gibbs and Edwards, and Pearse, it is argued that the length of stay at the site will be determined by the marginal cost of a recreation-day, i.e. on-site costs per day and that travel cost will determine whether

or not the trip to the site is taken. But whereas Gibbs and Edwards, and Pearse, do not attempt to explore what determines the marginal cost of a recreation day, it is argued in this thesis that the marginal cost of a recreation-day is a matter of choice. Specifically, the marginal cost of a recreation-day is shown to be dependent upon the allocation of recreation time between consumption time and leisure time. As incomes rise a substitution of consumption time for leisure time takes place and causes the marginal cost of a recreation-day to rise. Since the marginal cost of a recreation-day is endogenous to income the Gibbs-Edwards approach is misspecified. The Pearse approach is not affected in this respect since it is constructed to allow the marginal cost of a recreation-day to vary according to income class.

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of Economic Demand Models for  
Outdoor Recreation

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ON THE SPECIFICATION AND INTERPRETION  
OF ECONOMIC DEMAND MODELS FOR  
OUTDOOR RECREATION

CHAPTER I

INTRODUCTION

Statement of the Problem

The application of economic demand analysis to the estimation of the demand for and value of outdoor recreation resources has increased steadily for the past decade or so and this trend will no doubt continue. Outdoor recreation is recognized as one of several legitimate uses of scarce land and water resources and the problem we are faced with today is that of encouraging an efficient allocation of these land and water resources among these several resources. While an adequately developed market is capable of effecting a reasonably efficient allocation of resources, the allocation of outdoor recreation resources has traditionally been left largely to the public sector. This extra-market allocation of outdoor recreation resources poses the special problem for the economist of estimating costs and benefits without the usual market indices.

Several approaches have been suggested as methods for quantifying the extra-market value of outdoor recreation resources. These several approaches devolve themselves into two basic types. In the direct approach the recreationist is asked to state how much he is willing to pay for the recreation opportunity rather than be excluded. The

problem with this approach is that there is no way of knowing whether or not the recreationist's answer accurately reflects his willingness to pay. If the recreationist thinks that his answer will be taken into consideration if a fee schedule is to be developed, he may be tempted to understate his actual willingness to pay. On the other hand, if the recreationist thinks his answer will be taken into consideration if a public appropriation is to be made to develop or preserve the site, then he may be tempted to overstate his actual willingness to pay. Because of a lack of confidence in the direct approach, many economists tend to favor the indirect approach which focuses upon an analysis of actual expenditures as an indication of willingness to pay.

The earliest indirect studies of recreation demand were primarily empirical in nature and were not based upon a conceptual analysis of the decision to recreate. These empirical methodologies are still employed in most cases. Recently, two alternative methodologies, based upon similar theoretical approaches to the problem of recreation demand, have been developed. These are the methods of Pearse (1968) and Gibbs (1969).<sup>1</sup> This thesis explores the conceptual and methodological issues raised by these approaches. These conceptual and methodological issues have to do with the relationship between travel cost, the net value of the recreation experience, and the marginal cost of the recreation-day as these are determined by or affect the individual's decision to recreate. It is argued that the decision to recreate is basically two-

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<sup>1</sup>See also Gibbs (1974) and Edwards, et al (1972).

fold. First, the marginal cost of a recreation-day is shown to be endogenous to and determined by income as a consequence of the allocation of recreation time between leisure and consumption. The second aspect of the decision to recreate involves a distinction between travel cost and on-site cost (the marginal cost of a recreation-day). Travel cost determines whether or not the trip is taken. If travel cost is greater (less) than the consumer's surplus of recreating at the site, the trip will not (will) be taken. On-site cost determines the length of stay at the site. The methodological implications of this conceptual model are explored.

#### Outline of the Thesis

Chapter II contains the central portion of the thesis, a theoretical framework for the analysis of recreation demand. This chapter precedes the review of some of the methodologies for estimating recreational demand and benefits (Chapter III) in order to establish a conceptual basis for reviewing them. Chapter IV attempts to apply methodologically the conceptual model of recreation demand in the Bend Ranger District. Chapter V summarizes and concludes the thesis.

## CHAPTER II

A THEORETICAL BASIS FOR THE ANALYSIS  
OF RECREATION DEMANDThe Distinction Between Travel and On-Site  
Cost in the Demand for Outdoor Recreation

Following Pearse (1968) and Gibbs (1969) a fundamental distinction can be made between the effects of travel and on-site costs on the demand for outdoor recreation. With respect to the length of time spent at a recreation site, travel cost is a fixed cost and does not effect the marginal cost of a recreation-day. On-site costs however, are typically incurred on a daily basis and therefore do affect the marginal cost of a recreation-day. The particular roles of these two types of costs must be adequately understood before a sound analysis of recreation demand can be undertaken.

In order to demonstrate further the particular roles of travel and on-site costs in the demand for recreation consider the indifference map for a hypothetical recreationist illustrated in Figure 1. Along the vertical axis is measured income, and along the horizontal axis is measured the quantity of recreation-days taken at a particular recreation site. Income is  $Y_0$  and the marginal cost of a recreation-day is  $S_0$ . If there is no travel cost associated with recreating at the site (imagine that the recreationist lives at the site) then  $Y_0$  income is available to allocate between recreation and the consumption of all other goods and services. The marginal cost of a recreation-day will equal the

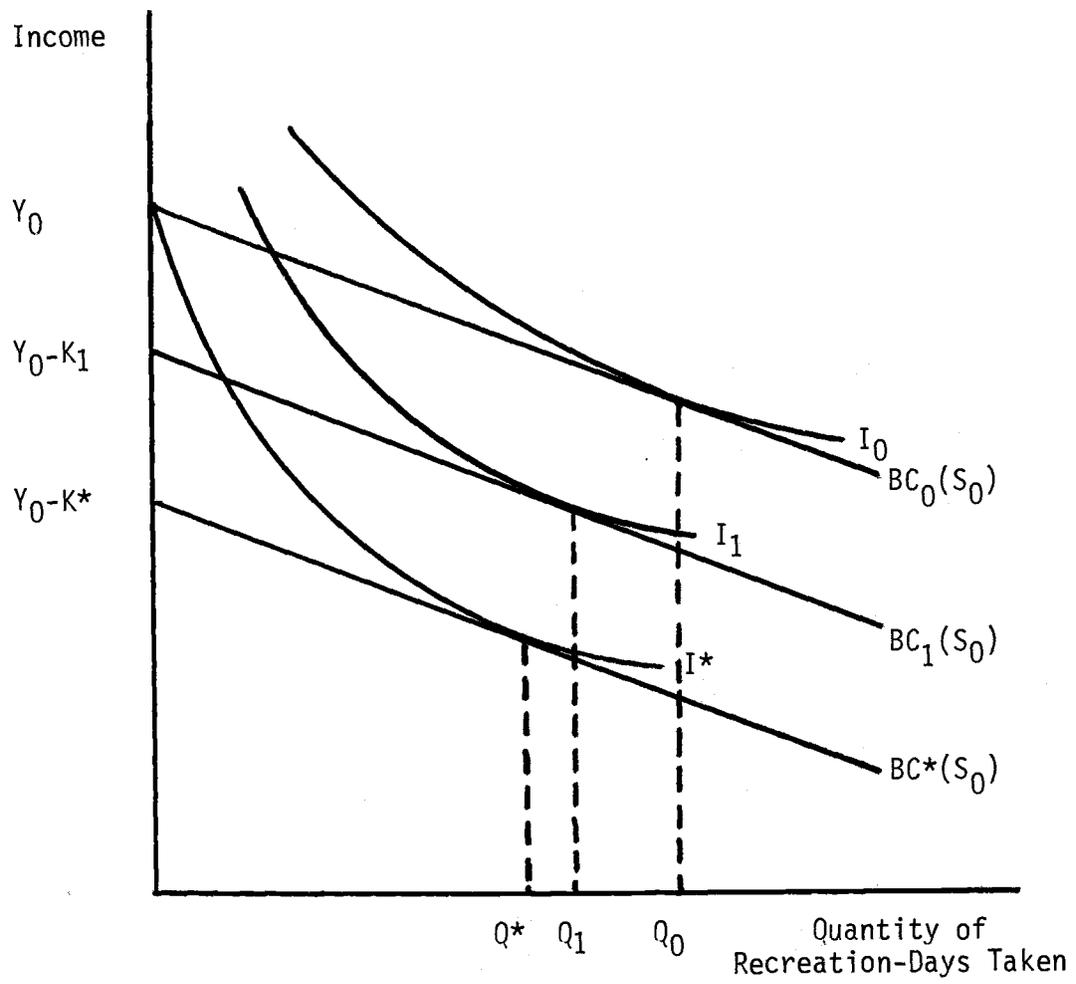


Figure 1. The Equilibrium Level Of Recreation Participation At Alternative Travel Costs.

marginal rate of substitution of income for recreation where the budget constraint  $BC_0$  is tangent to the indifference curve  $I_0$ . Assuming utility-maximization, the consumer will take  $Q_0$  recreation-days at the site.

Now suppose that the recreationist must incur some fixed travel cost  $K_1$  in order to recreate at the site. If he chooses to recreate, only  $Y_0 - K_1$  income will remain to be allocated between recreation and the consumption of all other goods and services. The budget constraint will shift downward to  $BC_1$  demonstrating the particular role of travel cost in the demand for recreation: travel cost acts as a demand shifter by altering the income available for allocation between recreation and the consumption of all other goods and services. Given that the recreationist must incur the fixed travel cost  $K_1$  in order to recreate at the site, the equilibrium level of recreation participation will be  $Q_1$ .

Now suppose further that the cost of travel increases to  $K^*$ .  $Y_0 - K^*$  will remain to be allocated between recreation and the consumption of all other goods and services and utility will be maximized by taking  $Q^*$  recreation-days at the site.  $K^*$  represents a critical level of travel cost in that if travel cost increases further the recreationist will choose not to recreate at all. A travel cost  $K > K^*$  will force the recreationist to some indifference curve  $I < I^*$ . Since the consumer can always attain a position on  $I^*$  by not recreating, the recreationist will be better off not recreating when  $K > K^*$ .

There is an explanation for this phenomenon in terms of the concept of consumer's surplus. The reader will observe that the quantity  $K^*$  is equal to the Hicksian price-compensating measure of consumer's surplus.

It represents the maximum amount an individual is willing to pay for the opportunity to consume a commodity for a particular price. In the case of recreation, the consumer's surplus from recreation is partly or wholly exhausted by the fixed travel cost. As long as the travel cost is less than the consumer's surplus from recreation the consumer will recreate. But if the travel cost is greater than the consumer's surplus of recreating the consumer will be better off not recreating. Since the maximum travel cost a consumer is willing to pay equals the consumer's surplus of outdoor recreation, an analysis of travel costs may offer an opportunity to quantify the net value of extra-marketed recreational resources.

#### Time and the Marginal Cost of a Recreation-Day

Cross-sectional variation in travel cost primarily reflects the geographical dispersion of recreationists. But how are we to explain observed cross-sectional variation in the marginal cost of a recreation day? The approach suggested here is to view the recreation-day as a composite commodity that allows a range of choice in the mix of activities that compose this composite commodity. The problem then becomes that of explaining the factors that influence the choice of mix. One direction worth exploring is that of the effect of income and time on the activity-mix of recreation.

The traditional micro-theoretic approach to the allocation of time focuses upon the work-leisure choice, But the allocation of time is not so simple. In addition to the allocation of time between work and non-

work activities, non-work time can be allocated between leisure and consumption.<sup>2</sup> Recreation time can be viewed as a combination of leisure time and consumption time. Since the marginal cost of a recreation-day is due to consumption, the marginal cost of a recreation-day will depend upon the relative mix of leisure time and consumption time. The marginal cost of a recreation-day will be higher for those recreationists who consume a high proportion of goods and services in relationship to the time they spend recreating than for those who allocate more time to leisure.

In order to establish the marginal conditions for an efficient allocation of time between leisure and consumption let us formulate a general statement of the work-leisure-consumption problem. A rational consumer maximizes the utility function.

$$U = U(C_t, L_t, W_t) \quad 2.1$$

where  $C_t$  is consumption time,  $L_t$  is leisure time, and  $W_t$  is work time. Assume that consumption time is allocated to the consumption of a composite commodity  $X$ , that  $P_x$  is the unit price of  $X$ , and that  $t_x$  is the time it takes to consume a unit of  $X$ . If  $w$  is the wage rate and  $I$  is non-wage income, then the money budget constraint can be stated in the form

$$(P_x/t_x)C_t = wW_t + I \quad 2.2.$$

In addition to the money budget constraint is the time constraint

$$C_t + L_t + W_t = T_t \quad 2.3$$

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<sup>2</sup>Becker (1965) and Linder (1970) deserve credit for pointing out the fact that consumption takes time. Otherwise, the argument that follows is original.

where  $T_t$  is the time endowment that is available to allocate between consumption, work, and leisure. By solving 2.3 for  $W_t$  and substituting the result into 2.2 we obtain the combined constraint

$$(P_x/t_x + w)C_t + wL_t = wT_t + I \quad 2.4.$$

Now assume the utility function to be twice differentiable. To establish the marginal conditions for utility maximization form the Lagrangean function

$$G = U(C_t, L_t, W_t) - \lambda \{ (P_x/t_x + w)C_t + wL_t - wT_t - I \} \quad 2.5$$

and set its partial derivatives equal to zero:

$$\partial G / \partial C_t = \partial U / \partial C_t - \lambda P_x / t_x - \lambda w = 0 \quad 2.6a$$

$$\partial G / \partial L_t = \partial U / \partial L_t - \lambda w = 0 \quad 2.6b$$

$$\partial G / \partial W_t = \partial U / \partial W_t = 0 \quad 2.6c$$

$$\begin{aligned} \partial G / \partial \lambda &= (P_x/t_x + w)C_t + wL_t - wT_t \\ &\quad - I = 0 \end{aligned} \quad 2.6d$$

The marginal condition for an efficient allocation of time between consumption and leisure is obtained by solving equations 2.6a and 2.6b simultaneously:

$$\partial L_t / \partial C_t = (P_x/t_x + w) / w \quad 2.7$$

This marginal condition for an efficient allocation of time between consumption and leisure requires that the marginal rate of substitution

of consumption time for leisure time be equal to ratio of the "time prices" of consumption time and leisure time. These time prices,  $(P_x/t_x + w)$  and  $w$ , reflect the money opportunity cost of the time allocated towards these purposes. In the case of leisure we obtain the same result as obtained in the traditional analysis of the work-leisure choice: the opportunity cost of leisure time is the wage rate. But in the case of non-working time devoted to the consumption of commodities the opportunity cost of time is the wage rate plus the money cost per unit of time it takes to consume the commodity (i.e  $w + P_x/t_x$ ).

This conclusion, that the opportunity cost of consumption time will be greater than the wage rate due to the money cost per unit of time associated with the purchase and consumption of commodities, has important implications for the behavior of consumers under conditions of rising incomes. The effect of an increase in the wage rate on the time price of consumption time and the time price of leisure time is asymmetrical. As wages rise the opportunity cost of leisure time increases more rapidly than the opportunity cost of consumption time. A formal statement of this phenomenon can be obtained by taking the partial derivative of 2.7 with respect to the wage rate:

$$\partial(\partial L_t / \partial C_t) / \partial w = (-P_x / t_x) / w^2 \quad 2.8$$

This result implies that the marginal rate of substitution of consumption time for leisure time must fall as wages rise if utility is to remain maximized. In turn this implies a substitution of consumption time for

leisure time: as wages rise the opportunity cost of leisure time increases more rapidly than the opportunity cost of consumption time thereby inducing a substitution of consumption time for leisure time. Leisure time is an inferior good.

Since the marginal cost of a recreation-day depends upon the relative mix of leisure time and consumption time in the recreation day, we can say something about the effect of rising incomes upon the marginal cost of a recreation-day. As income rise and consumption time is substituted for leisure time the marginal cost of a recreation-day rises. The marginal cost of a recreation-day is therefore endogenous to income.

#### The Effect of Changes in Income on the Demand for Recreation

The marginal cost of a recreation-day is endogenous to income. As incomes rise the marginal cost of a recreation-day should tend to rise. A test of this hypothesis is reported in a later chapter. A theoretical implication of this argument is the possibility of a negative correlation between income and recreation demand even though recreation is a normal good. Refer to Figure 2. A consumer initially has income  $Y_0$ , a marginal cost per recreation-day  $S_0$ , and a fixed travel cost  $K_0$ . The equilibrium level of participation,  $Q_0$ , is determined where the indifference curve  $I_0$  is tangent to the budget constraint  $BC_0$ . Now suppose income increases to  $Y_1$ . The increase in income will cause the budget constraint to shift upward. Simultaneously a substitution of consumption time for leisure time in the recreation day will cause the marginal cost of a recreation-day to increase. The new budget constraint

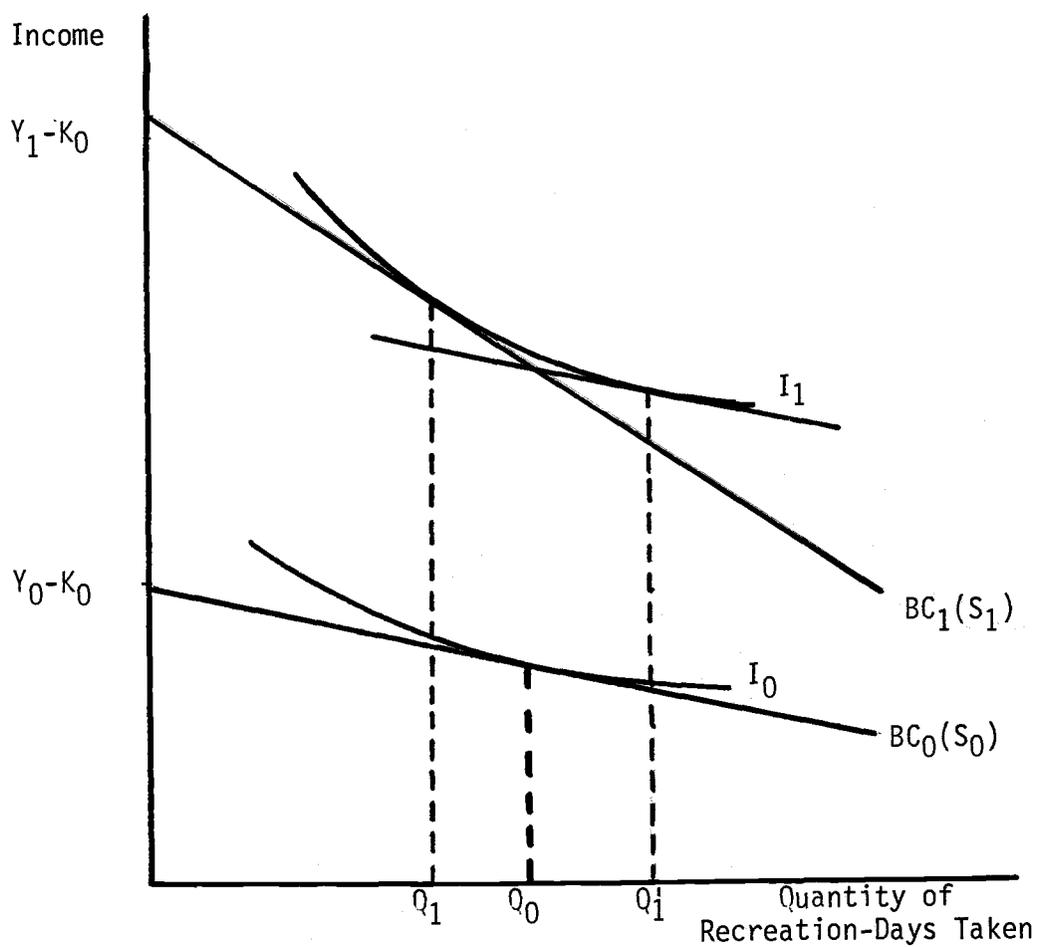


Figure 2. Income And Substitution Effects Of A Change In Income On The Demand For Recreation.

$BC_1$  will be steeper than the old budget constraint  $BC_0$  reflecting the fact that  $S_1 > S_0$ . The new equilibrium level of participation,  $Q_1$ , is determined where the indifference curve  $I_1$  is tangent to the new budget constraint. Figure 2 demonstrates a case where recreation participation declines as income rises. But this does not reflect the fact that recreation is an inferior good. By drawing a line tangent to  $I_1$  having the same slope as the original budget constraint  $BC_0$  we see that the income effect is positive and that by itself it would induce an increase in consumption from  $Q_0$  to  $Q_1'$ . But since the marginal cost of a recreation-day is now higher a substitution occurs along  $I_1$  from  $Q_1'$  to  $Q_1$ . The negative correlation between income and recreation demand is therefore a consequence of the negative substitution effect outweighing the positive income effect.

#### Estimating the Value of and Demand for Outdoor Recreation Resources

The theoretical model developed in this chapter provides the basis for an analysis of recreation demand. Recreation demand studies are ordinarily directed towards one or both of the following objectives: 1) a quantification of the economic value of the resource, and 2) specification of the demand for the resource either in terms of the number of visits or the number of visitor-days taken at the resource. The implications of the theory for the attainment of these objectives will now be discussed.

Theoretically, the quantification of consumer's surplus as an estimate of the net economic value of an extra-marketed recreation resource is

quite simple. The marginal user of an extra-marketed recreation resource is the one whose fixed travel cost is just equal to the consumer's surplus of on-site recreation. As discussed earlier, if consumer's surplus is less than the fixed cost associated with travel to the site, then the recreationist will be better off not recreating. If the marginal user can be identified then any other user having the same marginal cost per day and similar preferences, and having a lower fixed travel cost, has a measurable surplus in excess of travel and on-site costs consisting of the difference in travel costs. If  $K^*$  is the critical travel cost, and if  $K_i$  is the travel cost for the  $i^{\text{th}}$  recreationist having similar preferences and marginal costs per recreation-day as the marginal user, then the net economic value of the resource consists of the summation of the differences between  $K^*$  and the  $K_i$ :

$$V = \sum_{i=1}^n (K^* - K_i) \quad i = 1, 2, 3, \dots, n$$

2.9.

This approach is valid only as long as preferences are similar and the marginal cost of a recreation-day is constant in cross-section. Since the marginal cost of a recreation-day is a function of income the individual observations should be stratified according to income. The net economic value of the resource then consists of the summation of the differences in travel costs within each income class and then among the income classes:

$$V = \sum_{j=1}^m \sum_{i=1}^n (K_j^* - K_{ij}) \quad \begin{array}{l} i = 1, 2, 3, \dots, n \\ j = 1, 2, 3, \dots, m \end{array}$$

2.10

for the  $i^{\text{th}}$  individual and the  $j^{\text{th}}$  income class. The conceptual validity of this approach has been established by the argument of this chapter. The empirical problems associated with estimating  $K_j^*$  are taken up later.

Recreation demand research has been stimulated by a desire to develop a method of estimating the effect of a change in the marginal cost of a recreation-day on recreation participation rates. Prior research has attempted to specify cross-sectional participation rates as a function of cross-sectional variation in marginal costs per recreation-day. But as argued here, the marginal cost of a recreation-day is endogenous to income. All recreationists with similar incomes are implicitly or explicitly presumed to have similar marginal costs per recreation-day. Cross-sectional variation in participation rates reflects differences in travel costs and incomes; there is no theoretical reason why marginal costs per recreation-day should vary exogenously in cross-section. This being the case, the effect of a change in the marginal cost of a recreation-day cannot be determined from cross-sectional data. Only over time will the marginal cost of a recreation-day vary exogenously. Recreation demand models focusing upon this aspect of recreation demand must be specified on the basis

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<sup>3</sup> Note that although most cross-sectional demand models are based on an assumption about the similarity of preferences for all individuals, this approach requires this assumption only within income classes. No assumption about the similarity of preferences among income classes is required.

of time-series data.

While cross-sectional data is insufficient to specify recreation-days as a function of marginal costs per recreation-day, such information can be used to specify the demand for trips or visits. Let  $\Delta K$  be an increase in travel cost. If  $\Delta K < (K_j^* - K_{ij})$  for the  $i^{\text{th}}$  recreationist in the  $j^{\text{th}}$  income class the recreationist will continue to recreate even though trip costs increase by  $\Delta K$ . A demand schedule can be derived by calculating the number of visitors that will continue to recreate at alternative  $\Delta K$ 's. For  $\Delta K=0$  the number of visitors that recreate is the present equilibrium. For  $\Delta K=1$  the number of visitors that will continue to recreate will diminish if  $(K_j^* - K_{ij}) > 1$  for some of the recreationists. As  $\Delta K$  increases the number of visitors who continue to come to the site diminishes. Eventually, some  $\Delta K$  is reached such that the number of visits taken becomes zero. A plot of the number of visitors who come at alternative  $\Delta K$ 's represents a demand curve for the recreation site. The area under this demand curve equals the net economic value of the site as derived by summation according to equation 2.10.

### Conclusion

As conceived here, the decision to recreate is basically two-fold. First, the marginal cost of a recreation-day will reflect an efficient allocation of recreation time between consumption time and leisure time.

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<sup>4</sup>This method of deriving an outdoor recreation demand curve follows Pearse (1968).

As incomes rise a substitution of consumption time for leisure time will occur thus causing the marginal cost of a recreation-day to increase. Thus, the marginal cost of a recreation-day is endogenous to income. Secondly, the decision to recreate will be influenced by travel cost and onsite cost. On-site cost per day will determine the length of stay at the site. Travel cost will determine whether or not the trip is taken. If travel cost is greater than the consumer's surplus of recreating at the site, the trip will not be taken. The trip will be taken if travel cost is less than, or perhaps equal to, the consumer's surplus of recreating. The marginal user within an income class is the one whose travel cost is just equal to the consumer's surplus of recreation. The net value of the site to any user is the difference between the consumer's surplus of recreation and the fixed travel cost the user pays. A summation of these differences represents the aggregate net value of the resource.

## CHAPTER III

A REVIEW OF SOME OF THE METHODOLOGIES  
FOR ESTIMATING RECREATIONAL BENEFITSThe Hotelling-Clawson Approach

The most common method of estimating recreational benefits is based upon an approach originally suggested by Hotelling (1949) in a letter to the Director of the National Park Service. His suggestion was to estimate recreational benefits by quantifying the consumer's surplus that presumably accrues to recreationists who live nearest to the recreation site. His suggestion was to

Let concentric zones be defined around each park so that the cost of travel to the park from all points in one of these zones is approximately constant . . . If we assume that the benefits are the same no matter what the distance, we have, for those living near the park, a consumers' surplus consisting of the differences in transportation costs. The comparison of the cost of coming from a zone with the number of people who do come from it, together with a count of the population of the zone, enables us to plot one point for each zone on a demand curve for the service of the park. By a judicious process of fitting, it should be possible to get a good enough approximation to this demand curve to provide, through integration, a measure of the consumers' surplus resulting from the availability of the park. It is this consumers' surplus (calculated by the above process with deduction for the cost of operating the park) which measures the benefits to the public in the particular year.<sup>5</sup>

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<sup>5</sup>Quoted by Brown, et al (1964, pp. 6,7).

Hotelling's suggestion provided the basis for the pioneering work of Marion Clawson (1959). Following Hotelling's suggestion, Clawson defined concentric zones around the site such that the cost of travel from a given zone to the site and back again was approximately constant for all visitors from the particular zone. The inverse relationship between visits per capita (the quantity variable) and travel cost (the price variable) was interpreted as a demand curve. But unlike Hotelling, who interpreted this to be a demand curve for the services of the site, Clawson argued that a demand curve derived in this manner is a demand curve for the "total recreation experience." As elaborated by Clawson and Knetsch (1966) this total recreation experience encompasses 1) anticipation, 2) travel to the site, 3) on-site experiences, 4) travel from the site, and 5) recollection. Clawson reasoned that a demand curve derived in this manner does not reflect demand for the "recreational opportunity per se" because "the costs incurred for the total recreation experience are for items other than rent on the recreation site, except as the latter finds small expression in the entrance fees."<sup>6</sup>

Clawson suggested a method of deriving a demand curve for the site per se from the demand curve for the total recreation experience by assuming "that the experience of users from one location zone provides a measure of what people in other location zones would do if costs in money and time were the same."<sup>7</sup> The method involves calculating the effect of a postulated schedule of additional costs or entrance fees.

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<sup>6</sup>Clawson (1959, p. 23).

<sup>7</sup> Op. cit. p. 24.

A number of limitations to the Hotelling-Clawson approach are now recognized. Clawson's assumption about the homogeneity of location zones implies that recreationists are homogeneously distributed throughout the total population. While some assumption about the homogeneity of preference structures is implicit in all cross-sectional demand models, Clawson's method requires an assumption that is more stringent than most.<sup>8</sup> This assumption is related to the use of zone aggregates. Brown and Nawas (1973) have demonstrated that the use of zone aggregates can be misleading and is inferior to the use of individual observations. Zone aggregation eliminates much of the individual variation in demand creating artificially high  $R^2$  values.

Another limitation to the Hotelling-Clawson approach relates to Clawson's conceptual interpretation of his two demand curves. All that Clawson's method does is transform a representative demand curve for the individual zone into an aggregate demand curve summed across all zones. Both demand curves express demand for the same commodity (some particular recreation resource) as a function of travel cost. Since the inherent nature of the commodity demanded is not changed in the process of

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<sup>8</sup> According to Edwards, et al (1972, p. 42):

An underlying assumption in using cross-sectional data in demand analysis is that the parameters of the demand functions of the individuals in the relevant population are identical; differences in observed consumption behavior are the result of differences in the values of the variables influencing demand, not differences in the demand functions themselves. This assumption, in turn, implies a certain identity in the preference functions of the consumers in the relevant population from which the parameters of the demand functions are derived.

Clawson's assumption is more stringent than necessary because it requires assuming identical preference structures with a non-relevant population (non-recreationists).

deriving an aggregate demand curve, there is no basis for concluding that a demand curve for the site per se has been derived from the demand curve for the total recreation experience. Clawson's so-called demand curve for the site per se can be interpreted as such only under the assumption that travel to and from the site is not a source of utility or disutility. If the trip is a source of utility, Clawson's second demand curve adequately reflects response to potential increases in travel costs but understates response to entrance fees. Since a recreationist can always make the trip without staying at the site, but can never stay at the site without making the trip, response to entrance fees will be more elastic than response to travel costs. Therefore the actual demand curve for the site per se will lie below and to the left of Clawson's demand curve for the site per se. On the other hand, if the trip is a source of disutility, the true demand curve for the site per se will lie above and to the right of Clawson's demand curve for the site per se. This possibility has been suggested by Cesario and Knetsch (1970) as a consequence of the disutility associated with the time it takes to travel to the site.

#### The Gibbs-Edwards Approach

In recognition of some of the limitations to the Hotelling-Clawson approach an alternative methodology has been proposed by Gibbs (1969, 1974) and Edwards, et al, (1972). Their method recognizes the conceptual distinction between the fixed nature of travel cost and the variable nature of on-site costs and uses individual observations rather than

zone aggregates as data points. The critical weakness to their approach is an assumption about the exogeneity of the parameters of the demand function. They suggest that

a possible line of attack on our conclusion is to view the several elements of the recreational experience--transportation cost, on-site costs, and length of stay--as mutually dependent variables in the decision process. In our analysis we have assumed that both transportation cost and on-site costs for each recreationist is exogenously determined, i.e., our theory does not encompass the determination of these variables.<sup>9</sup>

The primary contribution of this thesis is to suggest that on-site costs are endogenously determined. If this argument is correct then the Gibbs-Edwards approach is invalid.

#### The Pearse Approach

Another methodology which recognizes the conceptual distinction between the fixed nature of travel cost and the variable nature of on-site costs, and which uses individual observations rather than zone aggregates as data points, has been proposed by Pearse (1968). In Pearse's method the individual observations are stratified according to income and then ranked within each stratum according to travel cost. The highest travel cost within each stratum corresponds to the  $K^*$  discussed in the previous chapter. At the margin the consumer's surplus of recreation is just offset by the fixed travel cost that must be incurred in order to recreate; the net value of the site to the marginal user is thus zero. By assuming that "the recreationists who pursue the activity in question and have similar incomes also have similar preferences for

<sup>9</sup>Edwards, et al (1972, p.57).

the recreation, and incur similar marginal costs per recreation-day"<sup>10</sup> the difference between the travel cost a particular individual pays and the highest travel cost paid by a member of the same income class can be interpreted as the net value of the site (the unappropriated surplus) to that individual. The validity and usefulness of Pearse's method depends upon 1) whether or not the method is conceptually sound, and 2) whether or not the underlying assumptions are limiting.

The Pearse method is similar to the other "travel cost" approaches in that it is based upon the explicit assumption "that recreationists will respond to a toll in the same way as they respond to an equal increment in travel costs"<sup>11</sup> Whereas Hotelling-Clawson applications that specify recreation-days as a function of travel cost can be criticized on the basis of the conceptual implications of the distinction between travel costs and on-site costs per day, the Pearse method avoids this trap by specifying the number of visits as a function of what Pearse calls "fixed access charge." Since Pearse is referring to changes in fixed costs his assumption is not unreasonable. But Pearse does recognize that the validity of this assumption is attendant on yet another assumption to the effect that "the sole purpose of the journey is assumed to be the enjoyment of on-site recreation"<sup>12</sup> . Since the Pearse method is a travel cost method it estimates demand for the entire recreational experience of which the services of the site are a part. Consequently, the remarks made earlier about the possibility of specification bias

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<sup>10</sup>Pearse (1968, p. 92).

<sup>11</sup>Gibbs (1974, p. 309).

<sup>12</sup>Pearse (1968, p. 94).

in demand functions based on travel costs are relevant here also.

Pearse's method has been challenged by Brown, et al (1973) who argue that the "Pearse surplus" has no particular relationship whatever to consumer's surplus as traditionally defined by the area below the demand curve but above the price line. They purport to demonstrate this argument by the use of a hypothetical case which in fact misconstrues Pearse's method. Using the hypothetical demand function  $q = 1 - 0.01C$  they first calculate from it a "Pearse surplus" and then compare it with consumer's surplus as traditionally defined. The comparison is inappropriate because the Pearse method involves summing differences in fixed costs whereas the cost variable in a demand function (such as C in their hypothetical demand function) represents variable costs. It is not correct to conclude that the Pearse surplus has no particular relationship whatever to consumer's surplus as traditionally defined. The Pearse surplus corresponds to the traditional concept of consumer surplus net of travel cost.

Conceptually, Pearse's method is sound. A more important consideration is whether or not the assumptions that underly application of the method are limiting. Pearse explicitly assumes that preference structures within income class are similar. Some such assumption is unavoidable. But in Pearse's method the assumption is unusually critical. In a cross-sectional demand function the parameter estimates are the mean values of many observations; if atypical or extreme values are observed, their effect tends to be dampened by the averaging process. But in Pearse's method the estimates of  $K^*$ , the critical travel cost, depend upon the

value of a solitary observation. If for some reason the highest travel cost paid within an income group is not typical of the preferences of the group as a whole their willingness to pay will be misspecified. In a similar approach to the estimating of recreational benefits Trice and Wood (1958) employed the 90th percentile as the marginal value. This approach has the advantage that it depends upon the general distribution of observations without being biased if extreme values are observed at either end of the range. But like all statistics the 90th percentile as an estimate of the upper limit of a distribution must be interpreted in probabilistic terms. That is, we are more certain that  $K^* \neq \hat{K}^*$  if we use a lower percentile to estimate  $K^*$  but this increases the probability that  $K^* > \hat{K}^*$ . The choice of the 90th percentile is a compromise.

#### Summary

Three methods for estimating recreational benefits have been reviewed. The Hotelling-Clawson method requires unnecessarily restrictive assumptions and is inferior to methods that utilize individual observations rather than zone aggregates. The other two methods reviewed, the Gibbs-Edwards approach and the Pearse approach, avoid many of the shortcomings associated with the Hotelling-Clawson methodology. Both approaches are based upon conceptual frameworks that recognize the distinction between the effect of travel cost and on-site cost on the demand for recreation, and both approaches focus upon the individual recreationist as the unit of observation. The fundamental difference between the two involves the type of question they are designed to answer. The Gibbs-Edwards formulation was directed toward explaining the demand

for recreation-days and therefore focused on on-site cost per day as the price variable. Pearse directed his method toward explaining the value of recreational services in terms of the individual visit and consequently focused upon the role of travel cost. A limitation associated with the Gibbs-Edwards methodology is that it assumes that on-site costs per day are exogenous. The argument of this thesis is that on-site costs per day are endogenous to income and will vary in cross-section as income varies in cross-section. The Gibbs-Edwards approach does not therefore appear to be a valid approach to the specification of cross-sectional demand models. The Pearse approach can be used in cross-section, but is limited by the nature of the question it is designed to answer. There does not yet appear to be a satisfactory way to specify the demand for recreation-days on the basis of cross-sectional investigation.

## CHAPTER IV

### AN EMPIRICAL STUDY OF RECREATION DEMAND

#### Objectives of the Study

Earlier it was argued on theoretical grounds that as incomes rise consumption time is substituted for leisure time in the recreation-day resulting in an increase in the marginal cost of a recreation-day. If this argument is correct then on-site expenditures per day by recreationists will be positively correlated with their incomes. One objective of this study was to test this hypothesis.

Another objective of this study was to incorporate into an analysis of the value of and demand for an outdoor recreation resource the concept of a critical travel cost as the basis for the estimation of recreation demand.

#### Construction of the Variables Used in this Study

The variables used in this study are based upon a sample survey of 480 recreation units who recreated in the Bend Ranger District during the summer of 1967.<sup>13</sup> From that survey data was available regarding reported family income, on-site expenditures per day, and distance traveled to the site. The data on family income and distance was modified for the purposes of this study. In the original survey incomes

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<sup>13</sup>For further information on the survey procedure see Guedry (1970) and/or Edwards, et al (1972).

were classed within \$2,000 intervals with two open intervals, under \$2,000 and over \$20,000. The midpoints of the closed intervals were taken as individual observations on income for each individual unit. For incomes under \$2,000 the recreation units were assigned an income of \$1,000. For incomes above \$20,000 the recreation units were assigned an income of \$35,550 on the basis of an analysis of unpublished personal tax data. These values were utilized without any changes for the first part of this study. But in the second part of this study the size of the open intervals was increased in order to increase the sample size of these two classes. In that part of the study individual values were not assigned since the point of concern was with the distribution of frequencies within each class. The open intervals chosen were under \$6,000 and over \$14,000. The distance data was modified by transforming it to an imputed travel cost; round-trip travel cost was estimated by multiplying the distance traveled to the site by a cost-per-mile factor of \$0.12.

The Effect of Income on  
On-Site Costs Per Day

In order to test the hypothesis that marginal costs per recreation-day are a positive function of income, on-site costs per day were regressed on income. A regression model was estimated by the method of least squares and the following result, where  $S_i$  is the  $i^{\text{th}}$  recreation group's marginal cost per recreation-day and where  $Y_i$  is that group's reported family income, was obtained:

$$\text{Ln } S_i = -0.000017Y_i \quad Y_i + 0.3193 \text{ Ln } Y_i \quad 4.1.$$

(-5.88)                      (76.85)

The figures in parentheses are t-statistics and they are both significant at the 1% level of significance; the second term is especially significant. The coefficient of determination for this regression,  $R^2$ , is 0.979. This result strongly confirms the hypothesis that the marginal cost of a recreation-day is a positive function of income.

One way of interpreting the above regression is to view it as an Engel curve for on-site consumption. Figure 3 depicts the general properties of this curve. These properties are consistent with what would be expected from theory. The curve originates at the origin, reflecting the presumption that consumption does not generally occur without income. The slope of the function is positive, but only up to a point. This pattern reflects two phenomena. A positive correlation between income and on-site expenditures per day will be observed if the rising opportunity cost of leisure time vis-a-vis consumption time is inducing a substitution of consumption time for leisure time in the recreation-day. But at the same time rising incomes create alternative recreational opportunities that could not previously be afforded. At some high level of income the demand for recreation in the Bend Ranger District should become an inferior good. The Engel curve of Figure 3 reflects both of these phenomena. Up to an income of \$18,906.30 the income elasticity of on-site consumption is positive; above that level of income it becomes negative.

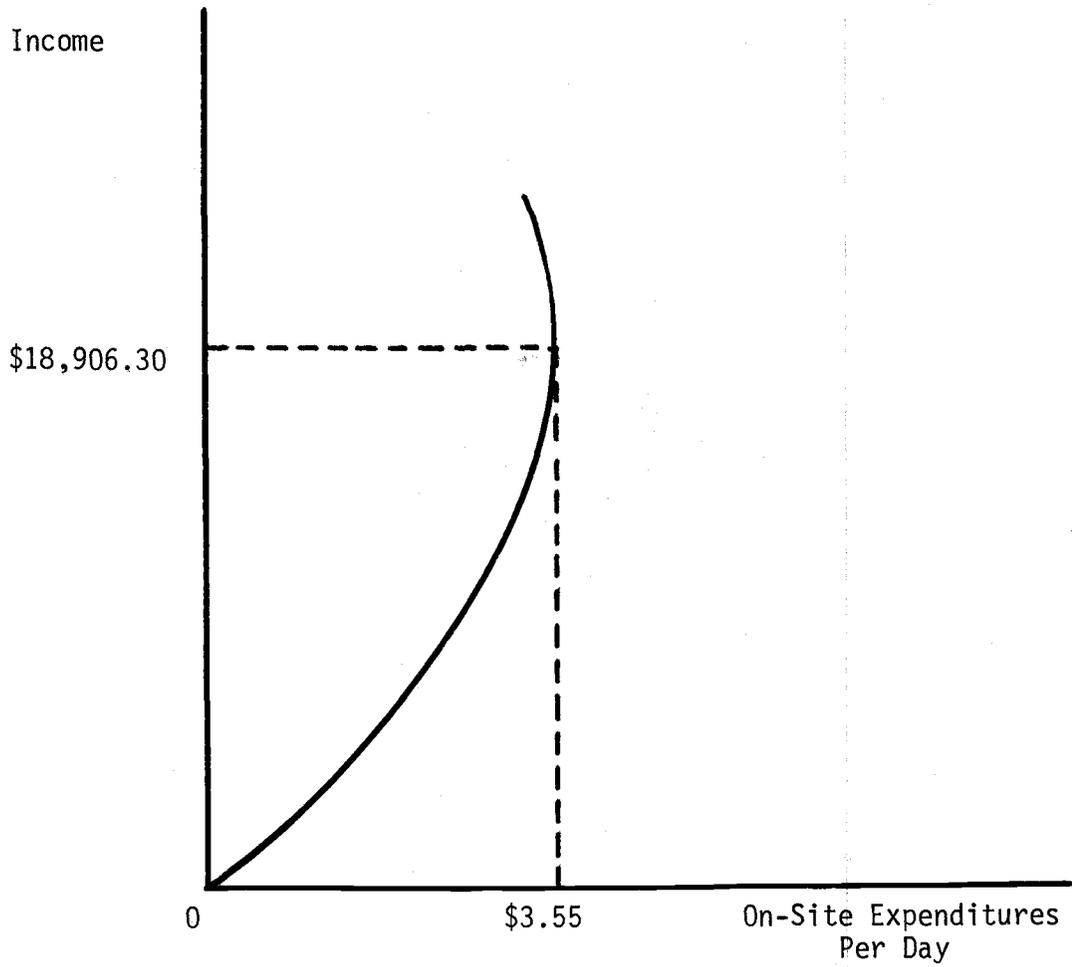


Figure 3. An Engel Curve for On-Site Consumption  
In The Bend Ranger District

Derivation of the Net Value of the Site  
to the Sampled Recreation Units

It was argued in Chapter II that the travel cost paid by the marginal visitor just equals the consumer's surplus of recreating at the site. This was referred to as the critical travel cost and was designated  $K^*$ . If this  $K^*$  can be estimated with any reasonable degree of accuracy then the net value of the site to the sampled recreation units can be objectively estimated. In a similar approach we earlier noted that Pearse (1968), in effect, estimated  $K^*$  for a particular income group as the highest travel cost paid by a recreationist within the group. This procedure, while conceptually defensible, introduces error if the observation chosen to represent  $K^*$  is atypical of the general distribution of observations within the group. An alternative estimate of the upper limit of a frequency distribution, which is not affected if the upper limit of the range is extreme, is the 90<sup>th</sup> percentile. In this study the individual observations were stratified into separate income groups and the 90<sup>th</sup> percentile within each group was taken to estimate the  $K^*$  for that group.

Stratification of the observations into different income groups is justified on the basis of the fact that the marginal cost of a recreation-day is endogenous to income. Since the reliability of the 90<sup>th</sup> percentile as an estimate of  $K^*$  depends upon the number of observations within an income group some of the smaller sized groups were consolidated. The final income classes employed to stratify the observations were: under \$6,000; greater than or equal to \$5,000 but less than \$8,000; greater than or equal to \$8,000 but less than \$10,000; greater than or equal to

\$10,000 but less than \$12,000; greater than or equal to \$12,000 but less than \$14,000; and over \$14,000.

In order to construct frequency distributions for each income class the observations were further stratified according to travel cost. Travel cost was classed according to \$14.00 intervals with two open intervals, under \$14.00 and over \$97.99. The resulting frequency distributions are tabulated in Table 1. For each income class the median value and the 90<sup>th</sup> percentile was computed. These values were very similar among several of the classes; the notable exceptions were for incomes greater than or equal to \$6,000 but less than \$8,000, and for incomes greater than or equal to \$14,000. These two income classes exhibited estimated  $K^*$ 's that were higher than the others. While we might anticipate that  $K^*$  is a positive function of income the statistical results seem inconclusive. Other factors, such as the effect of sociological influence (place of residence, education, occupation, camping experience, etc.), may also be important determinants of the willingness-to-pay.

The median and 90<sup>th</sup> percentile were used to estimate the "average" surplus for the income class by subtracting the median travel cost from the 90<sup>th</sup> percentile. The results are also tabulated in Table 1. The total surplus for each income class was then obtained by multiplying the average surplus times the number of observations in the class. The aggregate net value of the site for the 480 recreationist units was then obtained by summing the totals for each income class. The result was an aggregate net value of \$25,859.39.

TABLE 1

## FREQUENCY DISTRIBUTIONS OF TRAVEL COSTS BY INCOME CLASS

TRAVEL COST	INCOME CLASS					
	< \$6,000	> \$6,000 < \$8,000	> \$8,000 < \$10,000	> \$10,000 < \$12,000	> \$12,000 < \$14,000	> \$14,000
\$14.00	9	15	14	7	3	8
\$14.00- \$27.99	24	50	80	69	24	42
\$28.00- \$41.99	6	5	7	5	0	7
\$42.00- \$55.99	5	2	4	0	3	2
\$56.00- \$69.99	5	2	10	5	8	12
\$70.00- \$83.99	1	0	2	0	0	0
\$84.00- \$97.99	0	1	0	1	0	1
\$98.00+	4	8	6	6	1	16
n	54	83	123	93	39	88
Median	\$24.50	\$21.42	\$22.31	\$22.01	\$23.65	\$26.00
90th Percentile	\$68.31	\$93.79	\$63.97	\$63.55	\$64.91	\$104.30
Average Surplus	\$43.81	\$72.37	\$41.66	\$41.54	\$41.26	\$78.30

Derivation of a Demand Curve  
for the Bend Ranger District

By subtracting a recreationist's travel cost from his maximum willingness to pay ( $K^*$ ) we obtain an estimate of how much more the recreationist would be willing to pay rather than go without the opportunity to recreate at the site. By calculating this difference for each recreation unit, and by comparing the number of recreation units that would continue to recreate at alternative added costs, a demand schedule is obtained. This procedure was followed to obtain the demand schedule presented in Table 2 and illustrated in Figure 4. This demand relationship represents the potential response of these 480 recreation units to a schedule of increases in fixed costs. The area underneath this demand curve is equal to the aggregate net value calculated earlier, \$25,859.39.

Conclusion

These results are subject to some of the limitations already discussed. In particular, it is assumed that recreationists of similar incomes have similar preferences and pay similar marginal costs per recreation-day. The validity of this assumption is supported by the empirical evidence establishing a positive correlation between income and on-site expenditures per day. It is also assumed that on-site recreation is the only source of utility or disutility on the trip. The results are further limited by the assumption that the 90<sup>th</sup> percentile is a valid estimate of  $K^*$ .

TABLE 2

## THE DEMAND SCHEDULE

Added Costs	# of Visits	Added Costs	# of Visits	Added Costs	# of Visits
#0	480	35	375	70	105
1	434	36	371	71	100
2	430	37	369	72	92
3	425	38	361	73	91
4	418	39	340	74	86
5	417	40	314	75	79
6	414	41	285	76	77
7	411	42	269	77	76
8	408	43	251	78	63
9	406	44	229	79	60
10	405	45	214	80	54
11	405	46	202	81	49
12	403	47	185	82	42
13	402	48	180	83	39
14	402	49	174	84	36
15	400	50	170	85	30
16	399	51	165	86	25
17	398	52	164	87	21
18	398	53	163	88	20
19	397	54	158	89	16
20	396	55	156	90	12
21	395	56	156	91	9
22	395	57	154	92	9
23	395	58	151	93	9
24	393	59	148	94	8
25	393	60	139	95	8
26	393	61	135	96	8
27	393	62	134	97	7
28	392	63	132	98	7
29	392	64	125	99	5
30	389	65	121	100	4
31	387	66	121	101	2
32	384	67	119	102	2
33	381	68	115	103	2
34	378	69	113	104	1
				105	0

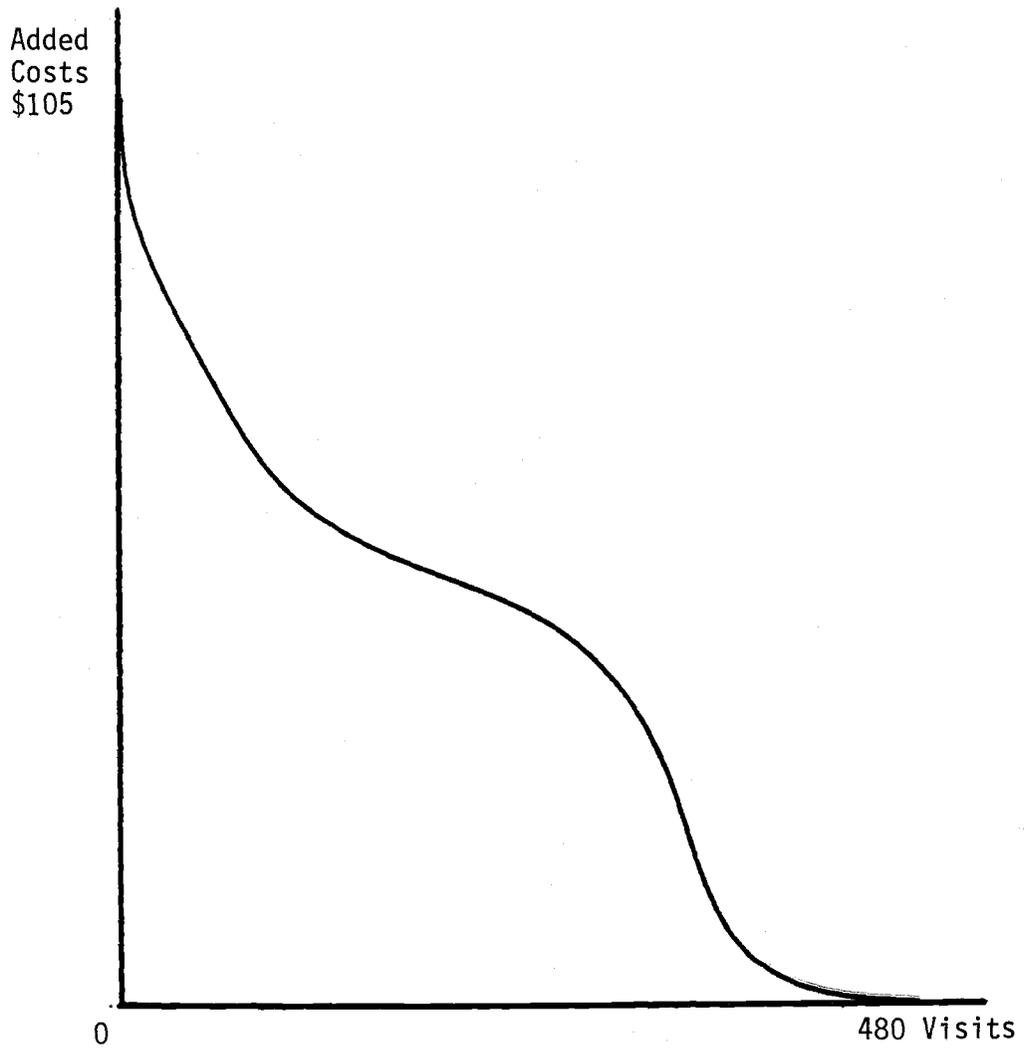


Figure 4. The Demand Curve For The 480 Sampled Recreation Units In The Bend Ranger District.

## CHAPTER V

## SUMMARY AND CONCLUSIONS

The primary objective of this thesis was to further explore the theoretical basis for the estimation of recreation demand. Beginning with Pearse (1968) and Gibbs (1969) a conceptual distinction was pointed out between effects of travel cost and on-site cost as they affect or determine the demand for recreation. In this thesis additional attention was focused upon the on-site cost of a recreation-day. It was empirically established for a sample survey of recreationists in the Bend Ranger District that the marginal cost of a recreation-day is endogenous to income. A theoretical explanation was suggested to account for this phenomenon. The marginal cost of a recreation-day depends upon the relative proportions of consumption-time and leisure-time in the recreation-day. As incomes rise the opportunity cost of leisure-time increases more rapidly than the opportunity cost of consumption-time thereby inducing a substitution of consumption-time for leisure-time in the recreation-day. This results in a positive relationship between income and the marginal cost of a recreation-day. As conceived here, then, the decision to recreate is two-fold. First, on-site expenditures per day will be determined by income. Second, the length of stay at a site will be determined by on-site expenditures per day. The role of travel cost is to determine whether or not the trip is taken. If the fixed cost of travel to and from the site is more (less) than the

consumer's surplus of on-site recreation then the trip will not (will) be taken.

This theoretical framework suggests a method of estimating the demand for and value of extra-marketed recreation resources. If travel to and from the site is assumed not to be a source of utility or disutility then at the margin the cost of travel to and from the site will just equal the consumer's surplus of on-site recreation. If recreationists can be stratified into groups having similar preferences and similar marginal costs per recreation-day, and if the marginal user within each group can be identified, then the net willingness-to-pay for any individual in the group is equal to the difference between the individual's travel cost and the travel cost paid by the marginal user. The most defensible basis for stratifying recreationists into groups of similar preferences and marginal costs per day appears to be according to income. The problem remains of estimating the critical travel cost of the group. In this thesis the 90<sup>th</sup> percentile was used but an appropriate subject for further research is whether or not superior techniques are available for estimating this critical travel cost.

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