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THE VALUE OF RECREATIONAL BOATING AND FISHING IN THE CENTRAL BASIN OF OHIO'S PORTION OF LAKE ERIE

Nilima Dutta, L.L.M.
Ohio State University

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ABSTRACT

The demand for recreational boating and fishing in the Central Basin of Ohio's portion of Lake Erie is estimated using the individual travel cost model. The data for this study was provided by a sample of 443 recreational boaters and anglers who visited the Central Basin during 1982. Two approaches are used in estimating the travel cost model. One considers that the Central Basin is comprised of a group of four distinct substitute sites and estimates demand functions for each site. The other estimates a single demand function for the entire Central Basin.

The travel cost model is estimated using three alternative costs of travel time. These are travel money costs with zero cost of travel time to which are added travel time costs valued at 25% and 50% of the wage rate. On-site money and time costs are added to the consumer surplus estimates from the demand functions.

The economic value of the recreational activities is derived by combining the consumer surplus estimates and creel census data on fishing efforts in the Central Basin during 1982. This value varies according to the composition of the cost variable in the demand equation. When travel money and time costs are used, the economic values range from \$2.11 million to \$5.42 million. With the addition of on-site time and money costs to the consumer surplus estimates derived from the demand functions, these values range from \$7.39 million to \$30.39 million. Inclusion of on-site time and money costs directly in the demand functions yields values which range from \$47.07 million to \$116.26 million. Empirical results suggest that the best estimate is obtained when the cost of travel time is valued at 25% of the wage rate. Based on this estimate, the economic value of recreational boating and fishing in the Central Basin is approximated as \$18.84 million.

THE VALUE OF RECREATIONAL BOATING

AND FISHING IN THE CENTRAL BASIN OF

OHIO'S PORTION OF LAKE ERIE

A Thesis

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for the Degree of Master of Science

by

Nilima Dutta, L.L.M.

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Approved by

Leroy J. Hushak
Adviser
Department of Agricultural Economics
and Rural Sociology

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CHAPTER I

INTRODUCTION

Lake Erie is one of the five Great Lakes which together provide the world's finest freshwater fishery. The state of Ohio has 2 1/4 million acres of this lake and 262 miles of its shoreline (ODNR, 1980, p. 13). The portion of the lake which borders Ohio to the north has two distinct basins, the Western Basin and the Central Basin. Both areas of the lake support several species of fish like the highly prized walleye, yellow perch, channel catfish, smelt and freshwater drum. The Central Basin also has the coho salmon, trout and steelhead in its waters. These fish are only a few of the 138 species provided by the lake and its tributaries (ODNR, 1979, p. 68).

The warm shallow waters and the variety of fish in Lake Erie attract not only 32 percent of Ohio's one million licensed anglers but also fishermen from neighboring states (ODNR, 1979, p. 69). During the seven year period from 1975-1982, the number of angler hours annually expended by sport fishermen increased from 7.4 million to 13.6 million (ODNR, 1983). From Figure 1 it can be seen that the rise in angler hours is mainly due to the increased efforts made by walleye anglers. Since 1972, the walleye has been banned to commercial fishermen and only sport fishermen have the right to fish for it in the Ohio waters of Lake Erie. Table 1 shows the species and numbers of fish harvested by sport fishermen from 1975-1982.

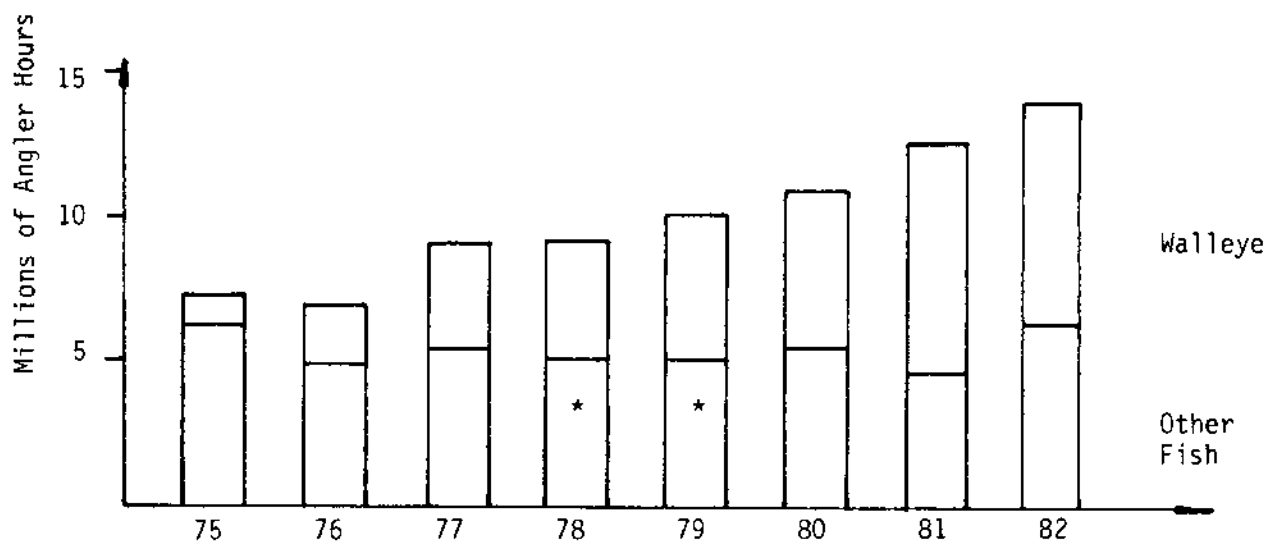


Figure 1. Sport Fishing Effort in Ohio's Lake Erie

Source: ODNR, 1983, P 15, Fig. 17.

* Estimated as surveys were not conducted for other fish during these years.

As mentioned earlier, Ohio has jurisdiction over two of the three basins of Lake Erie. The Western Basin extends from Toledo to Huron and the Central Basin from Huron to the Pennsylvania border. In Figure 2, the area marked A represents the Western Basin and areas marked B, C denote the Central Basin. The Western Basin has the greater fishing activity as reflected by the sport fish harvest (Winslow, Table 1, p. 4). Winslow made a study of private boat walleye angling in the Western Basin for 1981, as walleye is a dominant species and the chief source of attraction to fishermen in that basin. Historically, yellow perch and white bass have been the major species in the Central Basin. The sport angler harvest for 1982 shows that the numbers of yellow perch and white bass caught have increased substantially over the previous two years (Table 2). In addition to the fishing, a large number of recreationists use the lake for boating, swimming, water skiing and other purposes. The value of this lake is not known. This study was, therefore, undertaken for the purpose of estimating the economic value attached to the Ohio waters of the Central Basin of Lake Erie by private boat sport fishermen and recreational boaters during 1982.

Significance of the Study

The provision of ample recreational opportunities to Ohioans has become a state goal. Americans spend an estimated $180 billion on recreation each year and the number of jobs in the recreation service is increasing rapidly (ODNR, 1980). To ensure planned growth, economic information is required. Sport fishing and recreational boating constitute important aspects of recreation. Creel census data show that total

Table 1. Ohio Lake Erie Sport Angler Harvest (Thousands of Fish) 1975-1982

Year	Yellow Perch	Walleye	White Bass	Smallmouth Bass	Drum	Channel Catfish
1975	8,175	113	2,008	39	990	226
1976	6,451	671	1,121	34	576	241
1977	11,358	2,200	1,509	30	458	171
1978	10,403	1,612	*	*	*	*
1979	15,679	3,280	*	*	*	*
1980	11,806	2,227	729	43	393	245
1981	11,300	2,963	1,499	44	419	130
1982	12,228	3,056	2,851	83	330	190

Source: ODNR, 1983, Table 2, Page 16.

Table 2. Sport Fish Caught and Boat Angler Hours in Central Basin (1980-1982)

Species	1980	1981	1982
Yellow Perch	1,329,953	834,657	2,736,639
Walleye	73,270	85,675	56,173
White Bass	499,714	974,582	2,084,461
Smallmouth Bass	23,981	25,313	18,986
Freshwater Drum	209,782	172,846	154,139
Channel Catfish	14,829	9,217	7,234
Boat Angler Hours	1.9 million	1.6 million	2.1 million

Source: ODNR, 1983, and personal communication from Carl Baker (Appendix A).

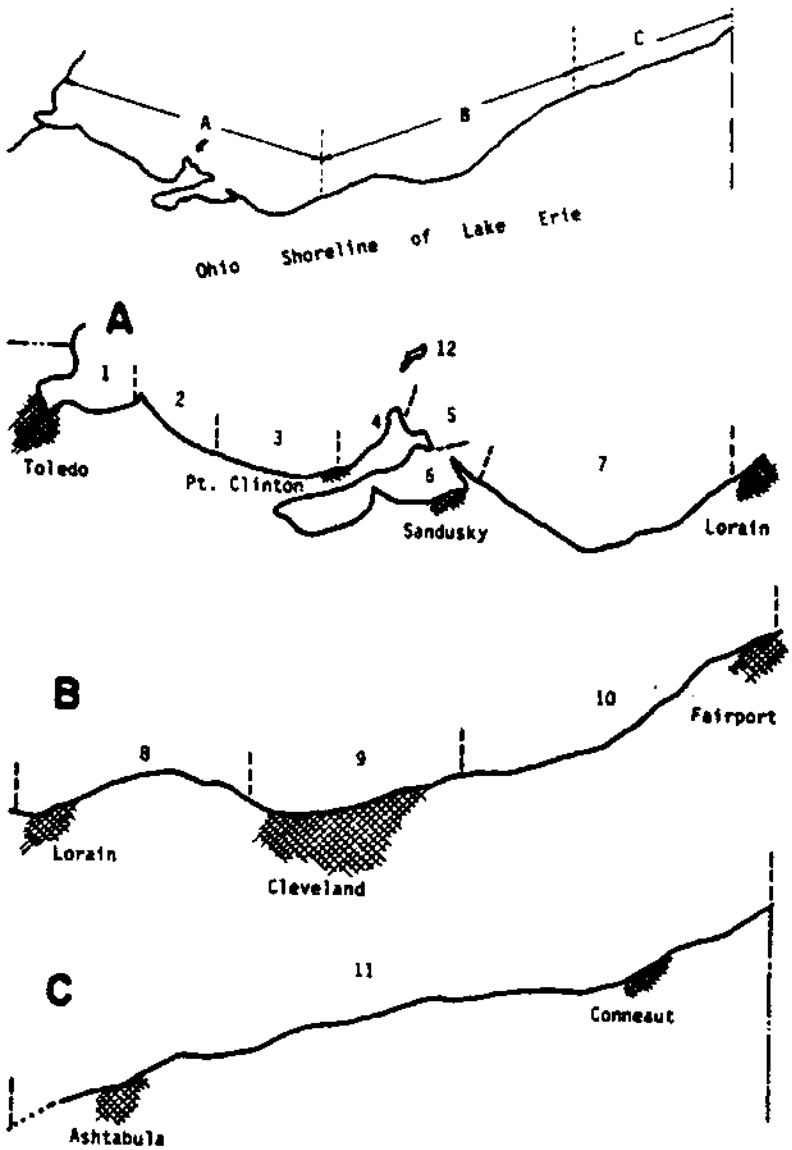


Figure 2. Ohio Shoreline of Lake Erie

Source: Baker, 1974, p. 8, Fig. 2.

boat angler hours in Ohio's portion of Lake Erie were 5.5 million in 1975, 5.3 million in 1976 and 7.5 million in 1977. Boat angler hours in the Western Basin during this period increased from 3.2 million in 1975 to 4.0 million in 1976 and 6.1 million in 1977. Boat angler hours in the Central Basin decreased from 2.3 million in 1975 to 1.3 million in 1976 and 1.4 million in 1977 (Baker et al., 1979, p. 41). In the eighties, these figures show an upward trend for the Central Basin as boat angler hours were 1.9 million in 1980, 1.6 million in 1981 and 2.1 million in 1982 (Table 2). From the projections shown in Table 3, the probability of continued growth in the demand for sport fishing in Lake Erie exists.[1/] The rise in demand for sport fishing in the Central Basin may be attributed to three factors--the growth of salmonids, the direct attempts made by concerned agencies to expand fish populations through artificial reefs and the overflow of the fishery from the Western Basin.

Table 3. Actual and Projected Sport Fishery Demand, U.S. Waters of Lake Erie

Year	Number of Anglers	Angler Days Expended
1960	476,079	8,569,426
1980	580,816	12,655,000
2000	708,596	17,915,000
2020	892,831	18,290,000

Source: Great Lakes Basin Commission, 1975, Table 8-45, p. 183.

1/ The figures in this table represent the sport fishery demand in the U.S. (as opposed to Ohio) waters of Lake Erie. 70% to 80% of this demand will be from Ohio.

To meet this demand, the facilities in the Central Basin need to be improved and increased. This would require public investment. An economic evaluation of the Central Basin's recreational fishery and boating will contribute to improved policy framing for the Central Basin.

Market Valuation Techniques--Its Problems

In a market economy, the market place allows direct exchange of information between producers and consumers of goods and services, whereby producers can adjust output according to demand of the buyers or consumers. In a perfectly competitive economy, each market participant can buy as many units of a good as he desires (subject to budget constraints) or can sell as many units as he desires (depending on the stock held) at the going market price which is equal to the marginal cost of the last unit produced. Recreational output cannot be sold on the market in the same way because it does not have the characteristics of a market good. The economic estimation of recreational boating and fishing becomes difficult as these are nonmarket goods which cannot be valued directly in the market place. The Lake Erie creel census reports provide data on sport angler efforts and annual sport harvests which can be given dollar values based on market prices received by commercial fishermen for their catch. But such a valuation ignores the benefits accruing to the fisherman such as enjoyment of the lake and the fishing activity, the opportunity to be with friends and family or even by himself. The value of the recreational good or output would be grossly underestimated if the recreational dimension of the fishing experience is ignored (Bishop and Samples, 1980). Therefore, nonmarket valuation techniques must be employed to value recreational output. Some of these methods are detailed in the literature review section.

Operational Definitions

Prior to the discussion of the nonmarket valuation techniques, definition of the important concept of "willingness to pay" is required. For consumer goods and services, willingness to pay can be measured as the area under the income compensated demand curve. It has two components: the actual market expenditure plus any excess amount the consumers might be willing to pay. This excess amount which is always positive when the demand curve is downward sloping is referred to as net consumers' surplus or net willingness to pay. It is a measure of the benefits to consumers in excess of what they actually paid. Alternatively, for recreational goods total willingness to pay can be defined as the maximum payment consumers would make to ensure that they are not excluded from a project (Dwyer, Kelly and Bowes, 1977). There are several methods for valuation of recreation based on the concept of willingness to pay. Consumers' surplus is one way of estimating willingness to pay. This consumers' surplus will be estimated in the present study.

Literature Review

In the report entitled "Improved Procedures for Valuation of the Contribution of Recreation to National Economic Development" (Dwyer, Kelly and Bowes, 1977) three methods of evaluating recreational output are stated. These are the travel cost method (TCM), the survey or contingent valuation method (CV) and the unit day value method. The former two methods preferred by Dwyer et al. are examined below.

Contingent Valuation Method

This method requires that the users of the resource respond to a hypothetical situation wherein they are asked to reveal their total willingness to pay for the recreational good being evaluated. In essence, the dollar amount which the recreationist is willing to pay over and above his expenditures rather than forego the experience is approximated as the value of the resource to the user. One shortcoming of this method is that the user may give distorted responses under the presumption that his response will influence site management and policy decisions. An example of this is when the user undervalues the resource because he thinks that this may be the amount charged in the future. Other shortcomings are improper understanding of the survey method, inadequate information of a hypothetical valuation market, etc. To be effective, this method requires the survey instrument to be carefully worded and capable of eliciting unbiased responses from the participants. This method was recently used to estimate the value of recreational boating at lakes in east Texas (Sellar, 1982).

Travel Cost Method

The travel cost method (TCM) estimates a recreational demand function for a site or resource by using travel cost as a surrogate for price. The area under this demand curve provides an estimate of user benefits. Hotelling (1949) was the first person to suggest use of travel costs for the estimation of demand curves. The earliest application of this method was made by Trice and Wood (1958). A park was chosen and points of origin of recreationists who visited the park were noted. These park users were then grouped geographically into distance zones around the park. Each person within the group would be assigned the same cost of travel to the park. The group visiting the park from the farthest zone would set a maximum value of benefits of park use. The costs incurred by people who travelled from the farthest zone would be compared to the costs of those who travelled from the other zones to give a measure of "consumer's surplus". A total figure for the recreational value attributable to the park would be a weighted summation of travel cost differences between the maximum cost and that for each other zone. The weights are the number of recreationists estimated to use the park from each zone.

In the basic travel cost method, the demand curve for the recreational site itself is estimated from the demand schedule for the total recreational experience. The method makes an assumption that recreationists will react in the same manner to an increase in entry fees as they would to an increase in travel cost. The total number of visitors from all the zones is counted when there is no entry fee. The travel cost for each origin is then incremented by fixed amounts (say $1.00) and the model is used to estimate use at the new hypothetical fee level. The procedure is repeated several times and a set of data obtained relating site use by number of visitors to the different entry fees. This set of data is then used to plot a site demand curve (Dwyer, Kelly and Bowes, 1977). In this study, the individual travel cost model with individual observations was used instead of the zonal model which uses grouped data.

The TCM is the appropriate benefit estimation technique whenever (1) users come from sufficiently varied distances, thus incurring sufficiently varied travel costs, which in turn allow estimation of a demand function, and (2) the travel costs have been made for the purpose of recreation at the resource which is to be evaluated. Both these requirements are met in the case of the Central Basin recreational boating and fishery. The users of this Lake Erie resource come from different parts of Ohio as well as from neighboring states. The travel costs which are a function of distance, therefore vary. The TCM can predict both use and benefits and this would be an additional advantage of applying it to the Central Basin.

Although the TCM seems to be the most applicable to this study, it does suffer from some drawbacks in the form of measurement of variables to be included in the model. There are controversies in the literature regarding which monetary expenditures to include, how to value travel and on-site time and consideration of substitute recreational sites and activities. The remainder of this section will focus only on the discussion of substitute sites which is an integral part of this study and the money and time costs will be discussed in the next chapter.

Substitute Sites

The literature on the TCM emphasizes the importance of substitute sites. The availability of substitutes is an important determinant of willingness to pay for a site and neglecting substitutes can generally lead to an overestimation of recreation benefits. Let X be a recreational site with substitutes. People who live closer to X make a greater number of visits than those who live further away. People who live further away from X visit a substitute site which is closer to them than X. If the smaller number of visits to X by people living in the more distant areas are attributed solely to the higher recreational costs (travel, etc.) they face, without taking into consideration the existence of the substitute site, then the benefits of site X will be overestimated.

Regional travel cost models have been developed to incorporate the presence of substitute sites. These need not be perfect substitutes. Two kinds of approaches have been used. In the one developed by Burt and Brewer (1971) and also used by Cichetti, Fisher and Smith (1976), demand equations for each of the recreational sites were estimated jointly. In this system of equations, each equation is interrelated with the other, is linear in travel costs and income, and is based on the number of trips made to the site(s) by the individual, from the place of origin.

The single equation model developed by Cesario and Knetsch (1976) reflected the existence of substitutes and also included a correction for travel time costs (excluded from the model discussed previously). It differs from the Burt and Brewer model in that it is nonlinear in the coefficients and uses grouped data, i.e., total visits made by groups, rather than individual participation rates.

The Central Basin of Lake Erie can be regarded in two ways. It can be viewed as a single recreational site with the Western Basin being the only substitute or it can be perceived to comprise of several sites. Each of these sites has distinctive characteristics in terms of fishing and recreational facilities offered, yet they are substitutes for each other. In this study, demand functions for each of the Central Basin sites will be estimated separately, the estimators being travel costs to the site itself, the travel costs to substitute sites (which includes the Western Basin) and income earned by the individuals. The estimated consumer surpluses will be aggregated to obtain the economic value placed on the recreational boating and fishing in the Central Basin. These results will be compared to those obtained by estimating a demand function for the Central Basin as a single site. These methods are chosen because they are appropriate for the nature of the problem presented by the Central Basin sites and for the kind of data which had been collected from individual recreationists.

Data Sources

Boaters were contacted on a random basis at nine public launching sites in the Central Basin and asked whether they would cooperate in completing a questionnaire aimed at measuring the economic value of recreational boating and fishing in the Central Basin of Ohio's Lake Erie. Names and addresses of 730 recreationists were collected for the sample. A questionnaire asking them to report fishing and recreational boating activities for 1982 was developed and mailed to each sample member (see Appendix A for a copy of the questionnaire).

Objectives

The objectives of this study are:

1. to test the hypothesis that the Central Basin sites are substitutes for each other;
2. to estimate the travel cost model using individual observations; and,
3. to measure total willingness to pay of boaters for recreational fishing and boating in the Central Basin so that an economic value can be attached to this water resource.

Format of the Thesis

In the first part of Chapter II, the concept of consumers' surplus is discussed as it is an important measure of economic value. This is followed by a description of the variables incorporated in the travel cost model used in the study. The results of preliminary analysis of the data and descriptive statistics are given in Chapter III. The empirical model and empirical results are presented in Chapters IV and V. In the final chapter, Chapter VI, a summary and conclusions arising from the study are presented.

CHAPTER II

THEORETICAL FRAMEWORK

The benefits accruing to consumers of nonmarket goods are measured in several ways, estimation of consumer's surplus being one of them. This chapter deals with discussion of this concept of consumer's surplus followed by details of the travel cost method used in its estimation.

Consumer's Surplus

The concept of the consumer's surplus was invented by a French engineer called Dupuit in 1844. It was left to Alfred Marshall to popularize the concept of consumer's surplus. He defined it as "...the price which a person pays for a thing can never exceed, and seldom comes up to that which he would be willing to pay rather than go without it, so that the satisfaction which he gets from its purchase generally exceeds that which he gives up in paying away its price; and he thus derives from the purchase a surplus of satisfaction. The excess of the price which he would be willing to pay rather than go without the thing, over that which he actually does pay is the economic measure of this surplus satisfaction. It may be called consumer's surplus" (Mansfield, 1971).

Consumer's surplus can be graphically described as the entire area lying below the demand curve and above the price line, up to the quantity demanded, as shown in Figure 3.

The demand function which is an integral part of the travel cost model needs to be discussed. A formal definition of demand is given by Talhelm (1973, p. 7) where demand is "...a schedule relating the maximum quantity of a good which would be purchased at each given price, during a given period of time, other things being equal."

The demand schedule for private boat sport fishing and recreational boating is depicted in Figure 3. AB is the demand curve. Price is measured on the vertical axis and quantity of recreational activity units on the horizontal axis. An inverse relationship exists between price of a good and the quantity or amount demanded. AB shows the number of recreational activity units demanded at any given price level. If P is chosen as the price, then quantity demanded is Q units.

Nonmarket goods do not lend themselves to market valuation techniques, as already stated in Chapter I. The economic value attached to a natural resource has to be approximated by nonmarket valuation techniques. This can be done by measuring the benefits of the recreational service accruing to the consumers. The measure of the benefit lies in observing what the consumer would be willing to pay to use the resource rather than go without it altogether. The willingness to pay measure of the benefits of recreation services provided can therefore be approximated by the total area under the demand curve up to the quantity demanded (Figure 3).

This total area is known as gross consumer's surplus or total willingness to pay, which comprises of two elements:

1. the net consumer's surplus shown by triangular area APR and

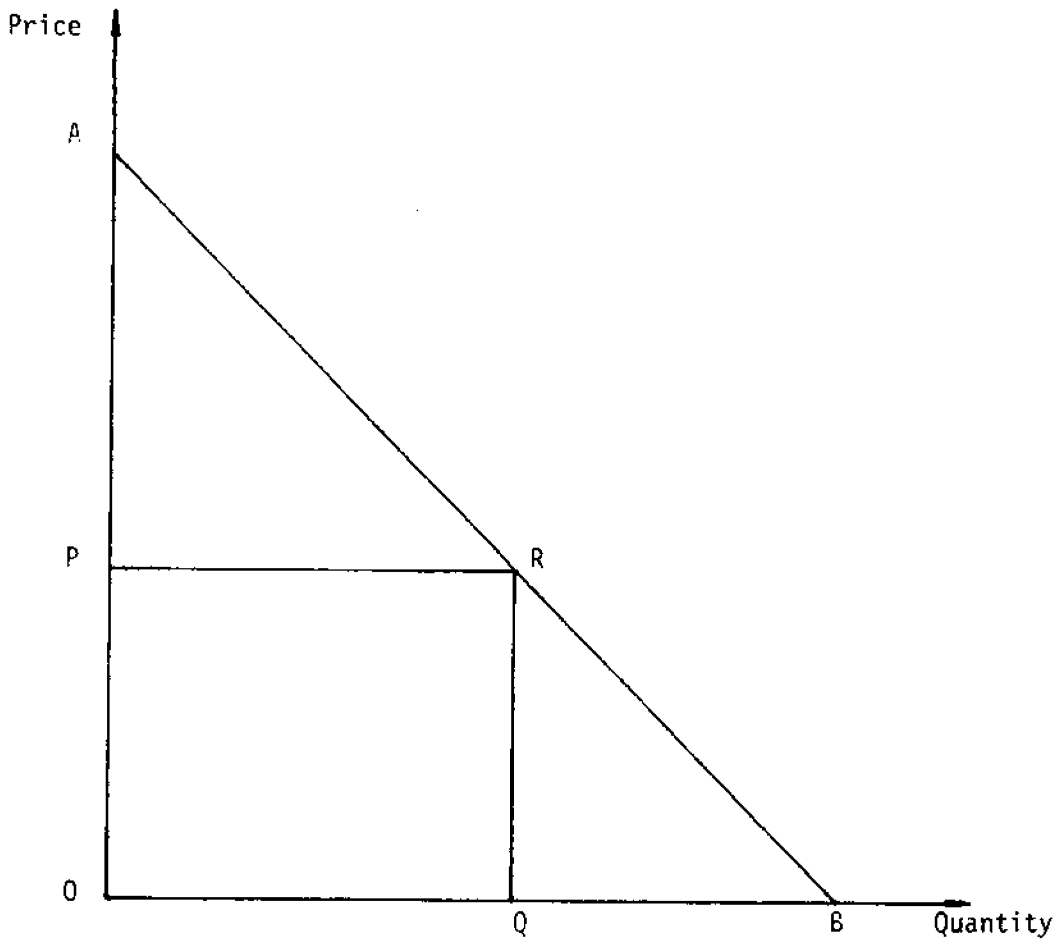


Figure 3. Demand schedule for Central Basin of Ohio's Lake Erie

2. the costs of the resources sacrified by the recreationists in undergoing the recreational trip, shown by area OPRQ.

These costs can be calculated by using costs of the trip to the recreational site as the surrogate price (per trip expenditures) times the quantity (number of trips made). The expenditure per trip includes both the costs of travelling to and from the site as well as on-site costs.

The triangular area APR represents the amount the recreationist would be willing to pay in excess of price P, rather than forego all trips. This area is known as net willingness to pay or net consumer's surplus. Consumer's surplus thus equals the area below the demand curve and above the price line. It can also be interpreted to be a measure of the benefit to the individual of a reduction in the price of the commodity from A to P. The total benefit to a recreationist would then be the entire area under the demand curve, and exclusion of triangular area APR or net consumer's surplus would result in an underestimation of the value of the resource.

Thus far, the demand curves referred to have been those derived under the assumption that money or nominal income is held constant. These demand curves are also known as ordinary or Marshallian demand curves. It will be shown here that the compensated (or Hicksian) demand curve is more useful in estimating consumer's surplus for the purposes of this study.

The derivation of the income compensated curve is illustrated in Figures 4a and 4b. In Figure 4a the consumer's budget line through P on the vertical axis has a slope of $-P_1$. At this price the consumer on

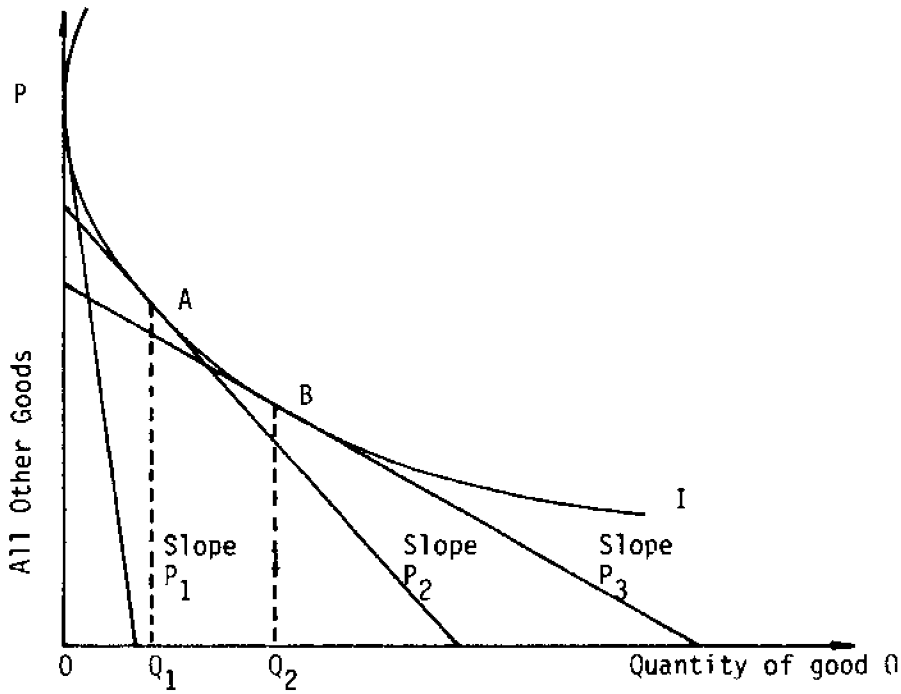


Figure 4a. Changes in the slope of the budget line real income kept constant

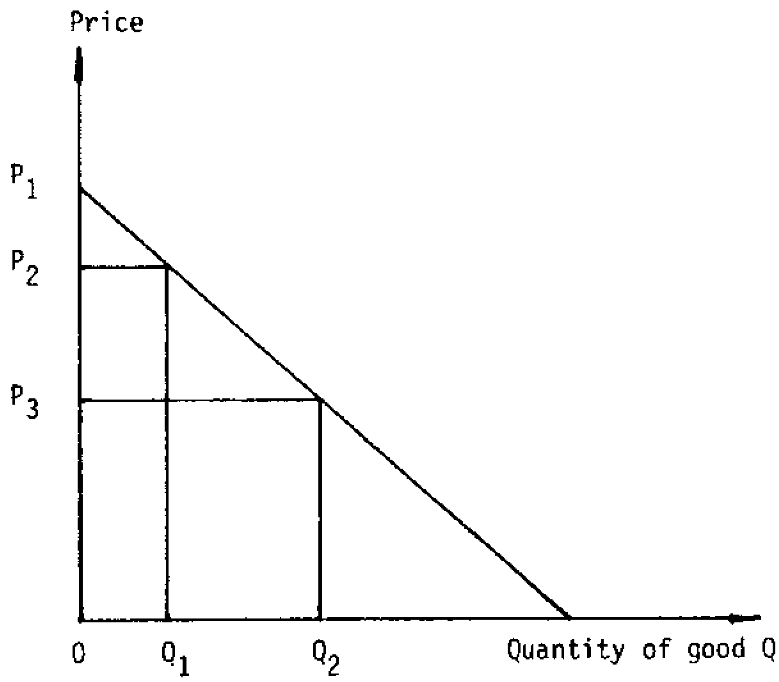


Figure 4b. The derived compensated demand curve

indifference curve I would choose to consume P dollars worth of all other goods and none of Q. Let the price fall to P_2 and let the individual be compensated for income so that he can remain on indifference curve I. Pt A (bundle of commodities) can now be consumed. If the price is reduced to P_3 and the individual's income compensated again, the choice of bundle B will be made. Several choices of consumption bundles can thus be made along indifference curve I. In Figure 4b the quantities demanded of the commodity on the horizontal axis at various prices are plotted to give the compensated demand curve for the given commodity. Along this curve real income is held constant at that level corresponding to indifference curve I.

The ordinary demand curve is contrasted with the compensated demand curve in Figure 5. When the price is reduced from P_1 to P_2, the individual's real income increases and he purchases more of commodity Q although his nominal money income remains constant. The total effect of the price reduction of the commodity can be separated into two effects, the pure substitution effect (when real income is held constant) and the pure income effect. From the compensated demand curve, OQ_1 is the pure substitution effect. The pure income effect of the price reduction, Q_1,Q_2, is the horizontal distance between the two demand curves. Since the ordinary demand curve lies to the right of the compensated demand curve, the income effect must be positive and the good consumed a normal one. With a negative income effect, when the good is an inferior one, the ordinary demand curve would lie to the left of the compensated demand curve. The Hicksian demand curve is drawn in Figure 6. It shows the quantity a consumer will demand at each price, assuming his income

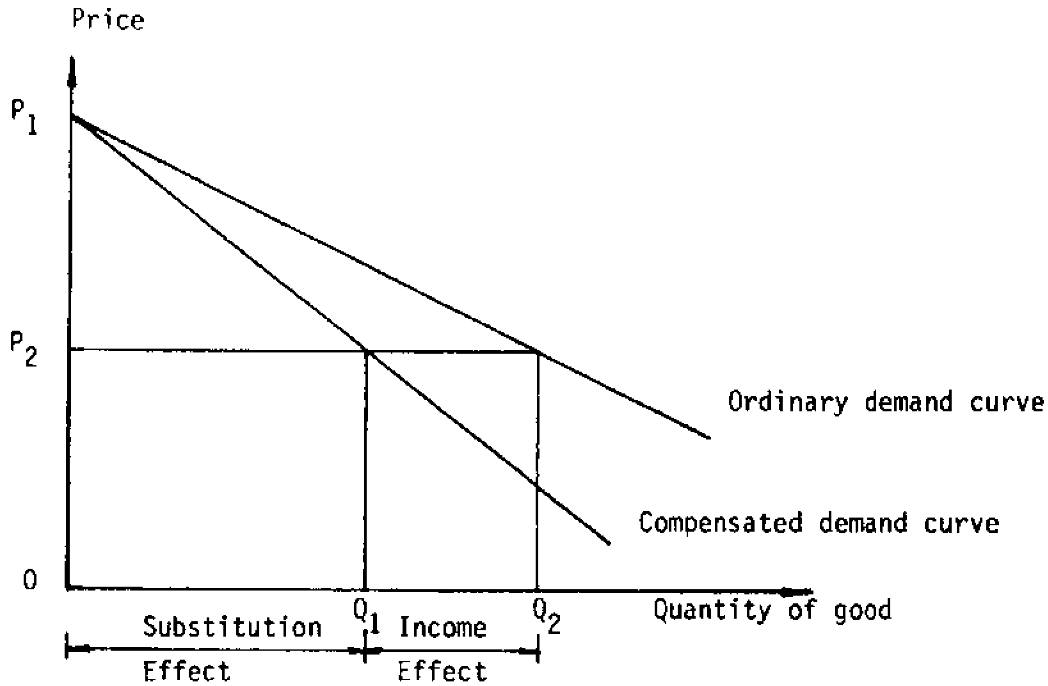


Figure 5. Ordinary and compensated demand curves

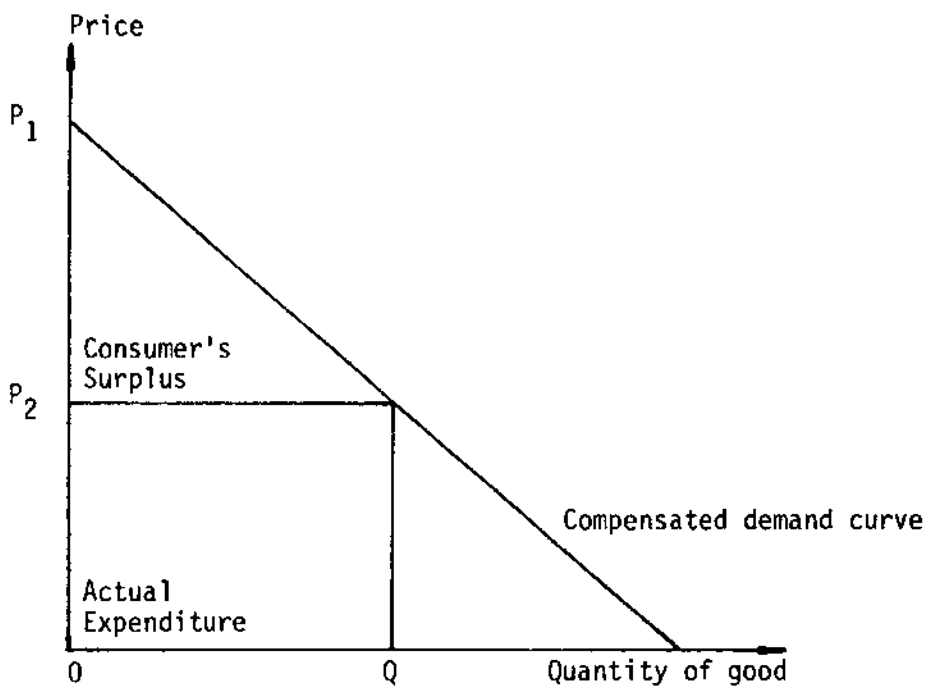


Figure 6. Consumer's surplus when income effect is zero

is adjusted so that he remains on the same indifference curve. The income effect of price reductions from P_1 is zero. The consumer's surplus is therefore the measure of benefits to the individual of a reduction in the price of the good from P_1 to P_2.

When the income effect is positive, the unknown compensated demand curve lies to the left of the ordinary demand curve as shown in Figure 5. If the area under the ordinary demand curve to the left of Q_2 is calculated, there is an overestimation of the net willingness to pay. The amount by which the estimated net willingness to pay exceeds the true value will depend on the exact position of the compensated demand curve which itself depends on the magnitude of the income elasticity (Willig, 1976).

There are difficulties in identifying the exact position of the compensated demand curve so ordinary demand curves are usually used in cost-benefit analyses. If this demand curve is used, biased results of consumer's surplus will be obtained as shown in Figure 7. If the ordinary and compensated demand curves both go through (P_1, Q_1), then if the good is a normal one, the ordinary demand curve lies to the left of the compensated demand curve above P_1 and to the right of it below P_1. This occurs because along the compensated demand curve, the income effects are zero, while income effects for the good reduce the quantity demanded above P_1, and increase the quantity demanded below P_1. Thus the consumer's surplus can also be underestimated when ordinary demand curves are used.

An assumption has been made in this study that the real income of the recreationist (or consumer) does not change and all recreationists

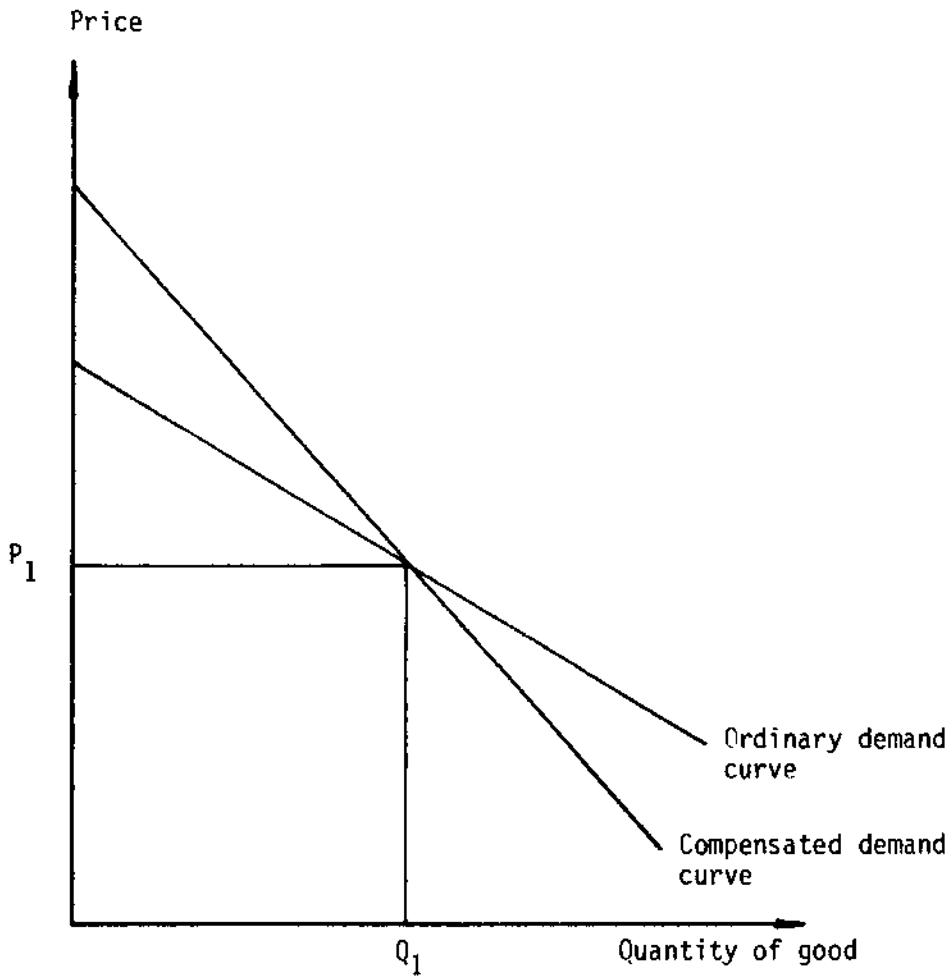


Figure 7. Underestimation of consumer's surplus

are on the same demand curve. This assumption is based on the fact that the recreationist travels a 'fixed' distance from the place of permanent residence to the Central Basin. The costs of travelling this distance are the surrogate prices, all other things remaining constant. Since these prices are not expected to change during 1982, the recreationist's real income is also unchanged. For further development of this argument refer to Winslow (1982, pp. 24-26). The estimated demand curve used in the travel cost model for the calculation of willingness to pay is therefore a real income compensated demand curve.

The Travel Cost Method

One of the objectives of this study is to measure the economic value of the Central Basin sport fishery and recreational boating. The sample population is comprised of recreationists contacted at nine public launching sites at the Central Basin. They come from 13 different counties of Ohio and also from the state of Pennsylvania, thus providing a variation in distances travelled to reach the recreational site. The travel cost model would be appropriate to use to estimate willingness to pay of the recreationists in the sample.

Several aspects of the travel cost method need to be examined, such as the correct specification of the dependent variable, the existence of substitute sites, the computation of the travel cost variable, on-site money and time costs and the use of individual data versus grouped data.

The Quantity or Dependent Variable

This variable is commonly understood to be the number of visits or trips made by each individual to the recreational site under study.

Burt and Brewer (1971) used number of visitor days as the dependent variable while Sinden (1974) used number of hours at the site to represent it. In the model used in this study, the dependent variable is the number of trips made by the individual recreationist from his residence to one of the Central Basin sites.

Individual Observations Versus Grouped Data

The grouped data approach for estimating the recreational demand function was first discussed by Clawson (1959), based on Hotelling's approach. In his paper Clawson stated that the area surrounding a recreational site should be divided into a number of zones with roughly equal total populations. These zones should preferably circumscribe the site. The relationships between the number of visits per hundred thousand population of each zone and the average round trip travel costs from each zone to the site are then calculated using the basic TCM. The recreational site in Clawson's paper was a reservoir.

Caulkins (1982, pp. 22-23) has summarized the assumptions made by Clawson about the use of the TC model. These are:

1. The sole purpose of the trip must be to visit the lake. If the trip was made to serve other purposes (like visiting friends, sightseeing) it would not be possible to allocate proportions of travel costs to the lake.
2. The behavior of recreationists from one zone provides a measure of behavior of recreationists from another zone, under identical travel costs incurred. People coming from distant zones are expected to face higher travel costs which would reduce their frequency of visits to the lake while people closer to

the lake would have a higher frequency of visits, other things being equal. If the costs of travel were raised for those living in a closer zone to equal the travel costs of the distant zones, it was expected that number of visits from both zones would equal each other.

3. The second assumption leads to the inference of nonexistence of substitute sites. If substitutes did exist, the difference in visitation rates cannot be fully explained by differences in travel costs. If the recreationists living in the distant zone make fewer trips to the site in the center because the substitute sites are nearby, the coefficient of the travel costs will be affected. This would bias the estimates of consumer's surplus.

4. Recreationists respond to a change in entrance fees to the site in the same way they would react to a change in travel costs.

Many authors disagree with the grouped data approach although grouped data is usually used because individual data is not available. Brown and Nawas (1973) used individual observations in the TC model. Their contention was that aggregating data tended to cause multicollinearity problems and led to difficulties in estimating the parameters of the demand equation. With the help of an empirical example, they showed that efficiency of estimation could be greatly increased by disaggregating the zonal data. The model used was the traditional travel cost demand function which estimates the inverse relationship between participation rates and transfer (travel) costs. The net economic value of a big game resource in Oregon to big game hunters was to be estimated.

The state was divided into five regions. 248 hunter families who hunted in one region were divided into 31 zones of eight families each. Using money costs and travel time as separate independent variables, a participation transfer cost relationship was first estimated from the 31 distance zone averages and reestimated using 248 individual observations (after disaggregation of the data). The coefficient for the transfer cost variable for the grouped data was not significant. Using individual observations made the transfer cost coefficient statistically significant thus giving more efficient estimates. It was decided to use individual observations in this study to avoid the problems of the grouped data approach and also because it was possible to collect primary data and thus observe the behavior of individual recreationists.

Weighted Participation vs Unadjusted Individual Observations

Brown et al (1983) while endorsing the view that use of individual observations instead of traditional zone averages led to efficiency gains in estimation of outdoor recreational demand functions, also expressed reservations about it. They contend that use of unadjusted (or unweighted) individual observations in the TCM do not account for cases in which a lower percentage of the more distant population zones participate in the recreational activity. The travel cost coefficients estimated by this method would be biased resulting in biased consumer surplus estimates. The researchers recommend that the dependent variable, participation rate, be expressed on a per capita basis. A hypothetical example was given by the authors to illustrate their argument.

The method proposed by the authors merits recognition. However, it is subject to some problems. One of them is that a small sample size was used which by itself could be a source of bias. Secondly, the weighting of individual observations was done on a hypothetical basis. In real life, there are difficulties involved in allocating zonal populations among the individual observations and thus accurate weighting of the individual observations may become a problem. Third, the researchers assumed that there were no entry fees charged nor were there any on-site costs. Ignoring on-site costs could bias consumer surplus estimates considerably.

Substitute Sites

The demand function for any good is stated as

(1) $X = f(P_x, P_y, Y)$

where X is the quantity of the good, Px its own price, Py the price of its substitute and Y the income. The original TC model did not take into account the possibility of substitutes. Use of substitute sites in the TC model was considered by Burt and Brewer (1971), and Cichcetti, Fisher and Smith (1976). An assumption of homogeneity is made between services offered by substitute sites which may not necessarily be valid. For example, in the Burt and Brewer study, substitutes other than reservoirs were not considered. In a deer hunter study by Heberlein and Laybourne (1978), it was found that the majority of the sample considered non-hunting outdoor activities or activities around their homes as substitutes to deer hunting (Bishop and Heberlein, 1980).

The structure of the Central Basin itself necessitated the incorporation of substitutes in the TC model. The nine launching sites in the Central Basin were aggregated into four sites and demand functions were estimated for each site, with other sites being considered as substitutes.

The Cost Variable

The TCM uses costs as surrogate prices for estimation of the recreational demand function. Two main types of costs are recognized in the literature; they are money costs and time costs.

Money Costs

There are two kinds of money costs recognized in the literature--travel money and on-site money costs. Travel money costs for the sample recreationists include both costs of transportation to the site and wear and tear of the vehicle. On-site money costs are all on-site expenditures such as lodging, food, boat fuel, boat supplies, boat repair costs, fishing equipment and bait, charters for boats and launching/docking fees where payable. The discussion regarding inclusion of on-site costs stated below also applies to on-site money costs.

Time Costs

The weakness in the basic TCM is that time costs of individuals travelling to the recreation site are ignored leading to an underestimation of benefits attributed to the sites. Bishop and Heberlein (1980) found that the inclusion of travel time costs in their model increased consumer surplus by 300 percent, time of travel costs being valued at 50 percent of the wage rate. Two types of time costs have been recognized in the literature. On-site time costs and travel time costs. McConnell (1975), Bockstael and McConnell (1981), Bishop and Heberlein (1980) and

Wilman (1980) view the inclusion of on-site time costs as essential since the time spent in the recreational experience has an opportunity cost. This opportunity cost is equal to the full wage rate if the recreationist could have spent this time working. Henderson and Quandt (1980) have suggested that the rate of substitution of income for leisure equals the wage rate. For the individual who cannot choose his/her work hours, the opportunity cost of leisure time is less than the full wage rate.

The cost used for travel time is often 25 to 50% of the average wage rate, as recommended by Cesario (1976). These percentages were arrived at by reviewing studies of values placed on travel time by urban commuters. The problem in this approach is that it is difficult to choose between the two percentages, since these were drawn from urban commuter studies and not from recreational studies.

The valuation of on-site time costs is still a matter of considerable debate in the literature. In their study of reservoir recreation of Missouri residents, Burt and Brewer did not include time costs in their model. Cesario, Cichetti, Fisher and Smith; Brown and Nawas did not use on-site time costs as a variable in their models. However, despite lack of empirical work in the area of evaluation of on-site time costs, theoretical recognition of it has been made by several authors (McConnell, 1975; Bishop and Heberlein, 1980; Cichetti, Fisher and Smith, 1976).

It was decided that both money and time costs should be incorporated in the demand estimations in this study. The measure of time cost was the one used by Sellar (1982). Sellar defines the cost of time as:

(2) $$T_{ik} = \frac{Y_{ix}}{2000} \ x \ (time_{ik})$$

where $\frac{Y_{ix}}{2000}$ is an approximate hourly wage rate and $time_{ik}$ is time spent by the ith person travelling to site k, and x is a time cost parameter. Cesario (1976) suggests that three values can be chosen for x. When cost of time = 0, x = 0, x = 1/4 when cost of time = 25% of the wage rate and x = 1/2 when cost of time is 50% of the wage rate. The hourly wage rate is computed by assuming an annual work period of 50 weeks (with 2 weeks as paid vacation in a year) with 40 hours of work done per week. The total annual income Y divided by 2000 would give the average hourly wage rate (50 X 40 = 2000).

The TC Model

The travel cost demand model used in the study was:

(3) $$V_{ij} = \alpha_j + \Sigma_{k=1}^{5} B_{jk} C_{ki} + \sigma_j Y_i + \varepsilon_{ij}$$

where i = 1...n observations

j...k = 1,...,5 sites

V_{ij} = number of visits made by individual i to site j.

α_j = intercept to function j

B_{jk} = price coefficient for function j and cost variable k

σ_j = coefficient of income for site j

Y_i = income of individual i ($/year). Income data was obtained on a class basis. The midpoint of the income class to which the respondent belongs was taken to be equivalent to the annual income earned.

C_{ki} = cost of travel to site k by individual i.

C_{ki} has four components. It was measured in several ways to include three income variants (0, .25 and .5 of the wage rate). The four components of C_{ki} are travel money costs, on-site money costs, travel time costs and on-site time costs. Each one is defined in detail, relevant to its usage, in the empirical models specified in Chapters IV and V.

Two approaches were used in estimating the demand functions for the Central Basin based on two hypotheses. The first was that the Central Basin recreationists perceive the sites as substitutes for each other. The nine launching sites in the Central Basin were aggregated into four sites and demand functions estimated for each of these four sites, applying the TC model specified in Equation 3. To test substitutability between Central Basin sites and the Western Basin, the costs of travelling to them were incorporated into each of the four separate demand functions. The results are presented in Chapter IV. An alternative way of applying the TC model was based on the hypothesis that the entire Central Basin constitutes a single recreational site with the Western Basin as the only substitute. A single generic demand equation was then estimated, results of which are presented in Chapter V.

CHAPTER 3

DESCRIPTION OF THE SAMPLE

The first part of this chapter describes how the sample was obtained and the sampling procedures used, followed by a brief discussion of the representativeness of the sample respondents as a whole. The last part of the chapter is comprised of descriptive statistics and characteristics of the recreational boaters and anglers included in the sample.

The Sample

The population to be studied is comprised of all recreational boaters and private boat sport anglers using the Central Basin of Ohio's portion of Lake Erie. The Central Basin was chosen as the study region because no estimates of the economic value of its private boat sport fishing and recreational boating activities have been made so far, although similar work has been done in the Western Basin (Winslow, 1982). Sample members were selected from among those private boat anglers and boaters who launched their boats at nine public launching sites in the Central Basin. During Fall 1982, Sea Grant Advisory Services' extension agents contacted persons at the Central Basin sites, and obtained names and addresses of persons willing to participate in the survey. The data enabled the estimation of the economic value placed on the Central Basin's private boat sport fishery and pleasure boating for the period of January to December 1982. The 730 people contacted at nine sites formed the sample. Each member of the sample was mailed an eight page questionnaire together with a cover letter explaining the objectives of the survey. The mailing was done in the third and fourth weeks of December 1982. Prepaid reply envelopes were enclosed to encourage responses. A follow-up mailing of the questionnaires was done after three weeks to those members of the sample who had not responded by then. Copies of the survey instrument and letters mailed to the sample members are presented in Appendix A.

It had been decided that the travel cost method would be relied on for attaining the objectives of the research project. The questionnaire, therefore, was designed to obtain the information vital to the travel cost method such as:

1. The number of visits or trips made in 1982 to the Central Basin expressed in terms of visits made to each of the nine launching sites.
2. The expenditures incurred on each trip to the Central Basin inclusive of land and boat fuel costs, food, lodging, vehicle repair and maintenance.
3. County of residence.
4. Estimated miles per gallon given by the vehicle on each trip.
5. Individual annual income.

The mileage driven on each trip was calculated as the straight line distance from the county seat of residence to the recreational site.

The importance of the number of trips and expenditures lies in the fact that the number of trips or visits made forms the dependent variable in the travel cost equation and the cost of travel and other expenditures are used as surrogate prices in the same model.

The other information called for in the survey instrument included the duration of time spent at the site, time spent in travelling to and from the site(s), amount of time spent in different activities on the Lake, number of persons in the group, numbers of fish caught of different species, age and sex of respondent and number of hours worked per week. The sample members were also asked to identify the three most imperative fishing and boating needs in the Central Basin and also to give quality ratings to the Central Basin site they used.

Responses were received from 479 or 65.62% of the sample members. However, only 443 or 60.68% of the completed questionnaires were considered usable. The high response rate could be attributed to:

1. The personal contacts made with the recreationists at the nine launching sites and collection of names and addresses from only those persons who had expressed their willingness to participate in the survey.
2. The follow-up mailing of questionnaires after three weeks to those who had not responded initially.
3. The high level of interest evinced by the Central Basin recreationists in establishing the need for new launching facilities and for artificial reefs.

Representativeness of the Sample

It is difficult to establish how representative the sample is of the population universe, as guidelines for such determinants are not available. To insure representativeness of the sample, the recreationists were contacted on a random basis, on different days of the week, at the nine launching sites.

To examine how representative the 443 sample respondents are of the 730 sample members, the total sample is classified into two sub-samples of respondents and non-respondents. To facilitate data analysis, some of the launching sites situated very close to each other are aggregated so that there are now five launching sites instead of nine. The names of these launching sites and the number of sample members contacted in each area are presented in Table 4. From this table, it can be observed that the proportion of sample respondents is similar to the proportion of sample members at each site, implying that the sample respondents are, at least, representative of the sample members.

Boat Angler Hours

The average time spent fishing by the anglers in the sample during 1982 was 5.3 hours, and the mean number of trips to the Central Basin sites was 28.4 which gives a total of 66,680 boat angler hours for the

Table 4. Frequencies by Launching Areas Where Contacted. Total Sample, Sample Respondents and Sample Nonrespondents

Launching Site	Total Sample		Respondent		Nonrespondent	
	Number	Percent	Number	Percent	Number	Percent
1. Lorain Harbour, Rocky River, Edgewater Park, East 72nd Street and Wildwood Park	236	32.3	148	30.9	88	35.1
2. Chagrin River	72	9.9	46	9.6	26	10.4
3. Grand River	225	30.8	156	32.6	69	27.5
4. Ashtabula	121	16.6	74	15.4	47	18.7
5. Conneaut	76	10.4	55	11.5	21	8.4

443 sample respondents. The average group size of the recreationists who visited the Central Basin is three persons, so the total number of angler hours expended by this group is 200,040 hours (66,680 x 3 = 200,040). The number of boat angler hours expended by sport fishermen in the Central Basin during 1982 amounts to 2.1 million (information furnished by Ohio Department of Natural Resources) of which nearly 10% is accounted for by the anglers in the sample.

Characteristics of the Sample

The average respondent is male, about 44.5 years old and has an annual income which lies between $20,000-25,000. He goes fishing or boating for recreation to the Central Basin with an average of two other persons.

This group of persons mainly made day trips to the Central Basin although some spent one to seven nights at the recreational site. The average respondent made 28.4 day trips to the Central Basin during 1982. The total number of trips of different lengths, made by the sample respondents during 1982 are presented in Table 5. The average length of

Table 5. Percentage of Sample Respondents Who Made Different Kinds of Trips to the Central Basin in 1982

Length of Trip (Visits)	Percent of Trips (Visits)
Day only	96.07
1 night	1.44
2-3 nights	2.93
4-5 nights	.45
6-8 nights	.18

each trip is 1.13 days which is obtained by weighting the length of trips by the number of trips to all sites.

There are 88 counties in the state of Ohio. However, 97.8% of the respondents came from thirteen Ohio counties with the counties of Lake and Lorain accounting for 54.7% of the respondents. 1.1% of the recreationists came from Pennsylvania. There were no responses for county of residence from 1.1% of the sample. Table 6 lists the origins of the sample respondents.

The mean one way distance the average respondent has to travel from the county seat to the Central Basin site is 16.8 miles. This figure is

Table 6. Origins of Sample Respondents

Counties	Percent
1. Ashtabula	15.3
2. Cuyahoga	11.1
3. Erie	.5
4. Geauga	4.5
5. Lake	30.5
6. Lorain	24.2
7. Mahoning	3.6
8. Medina	0.2
9. Montgomery	0.2
10. Portage	1.1
11. Stark	0.7
12. Summit	2.0
13. Trumbull	3.8
Out of State, i.e., Pennsylvania	1.1

the weighted average of the direct distance from the county seat of the respondent to each of the four launching sites on the Central Basin, based on the number of recreational fishing/boating trips made during 1982. (The four launching sites resulted from aggregating the sites of Ashtabula and Conneaut as these are located near each other and there is a great deal of overlap in visitations between these two sites.)

Of all the different on-site expenses of the sample respondents, the largest allocation is towards meeting boating needs such as boat fuel, repairs, supplies and launching/docking fees, which comprise 54.4% of the recreationist's on-site budget. The anglers in the sample incurred additional expenses for fishing equipment and bait. The average yearly and per trip on-site expenses incurred by the sample respondent are listed in Table 7.

The price of the boat which is a heavy cost of the recreational activity is not included in the on-site money expenditures as it is a capital expense. Boat prices ranged from $0 (for those persons who did not own boats) to $25,000 with a mean sample value of $3,520. 93.2% of the sample reported being boat owners and 6.3% stated they did not own boats. There were no responses regarding boat ownership from 0.5% of the sample.

The question regarding proportion of boat use for fishing and pleasure boating activities at the lake revealed that 40.8% of the sample used their boats exclusively for fishing in the Central Basin, 5.2% used their boats only for recreational boating and 54% of the sample did both. The average time spent fishing was 5.3 hours while pleasure boating took up 1.7 hours. The average time spent by the

Table 7. Mean On-Site Expenditures Incurred Per Person Per Trip and Per Year

Item	Amount in $ per trip	Amount in $ per year	Percentage
Food	2.18	34	14.5
Lodging	.25	4	1.7
Subtotal	2.43	38	16.2
Boat			
Gas and Oil	2.94	51	21.7
Supplies	3.04	37	15.7
Landing and Docking Fees	.75	11	4.7
Repairs	1.23	29	12.3
Subtotal	7.96	128	54.4
Fishing			
Equipment	1.85	30	12.8
Bait	1.37	24	10.2
Subtotal	3.22	54	23.0
Charters	.67	2	.9
Other	.78	13	5.5
Subtotal	1.45	15	6.4
Total	15.06	235	100.0

respondents on a typical day, on different activities at a Central Basin site are presented in Table 8.

The average respondent first began going to the Central Basin in 1965. 70.9% of the respondents reported going every year since their first visit, 15.3% went almost every year, 9.7% went less often and 1.8% said they went infrequently. Table 9 lists the frequency of annual visits made to the Central Basin by sample respondents.

The dollar amounts and time spent per day on fishing indicates that sport fishing is the predominant activity of the sample respondents. The mean fishing harvest of the anglers in the sample is presented in Table 10. The species and numbers of fish kept show that yellow perch

Table 8. Time Distribution of a Typical Recreational Day

Activity		Number of Hours
1. Travelling to and from the site		1.3
2. Fishing		5.3
3. Recreational boating		1.7
4. Sightseeing		.4
5. Camping		.7
6. Other		.2
	Total	9.6

Table 9. Responses to Frequency of Annual Visits to the Central Basin

	Percent
Every Year Since First Trip	70.9
Most Years Since First Trip	15.3
Half the Years Since First Trip	5.0
Occasionally Since First Trip	4.7
Very Seldom	1.8

forms a dominant part of the fish population in the Central Basin. Although the figures for walleye caught in the Central Basin are small in comparison to yellow perch (3 kept per person per trip) and white bass (1 kept per person per trip), the walleye harvest seems to be encouraging, even though it is small compared to the walleye population in the Western Basin, where number of walleye caught, per person, per season, is 28.5, the season being a three month period beginning May 15 and ending August 15 (Winslow, 1982, p. 52; Table 17, p. 72).

Sample respondents were asked to indicate the two (out of seven) most important qualitative aspects of the Central Basin sites which attracted them. Their responses are shown in Table 11. Some of the respondents checked more than three responses so a maximum of five was considered acceptable. The responses clearly show that the Central Basin is mainly used by those who do not want to travel longer distances to more prolific fishing areas like the Western Basin. A frequency distribution of the Central Basin sites visited by sample respondents in 1982 is given in Table 12. The number of people who visited the Western

Table 10. Fish Species Harvested Per Group During 1982

Species	Number Kept	Range
Walleye	16.4	0-225
Yellow Perch	243.2	0-5000
Steelhead/Salmon/Trout	2.8	0-120
White Bass	63.8	0-2400
Smallmouth Bass	5.0	0-250
Sheepshead	5.3	0-500
Other	13.0	0-1500

Table 11. Quality Ratings Given to the Central Basin as a Recreational Site

Responses	Frequency	Percentage
Close to home	381	86.0
Quality fishing	163	36.8
Easy boat access	153	34.5
Improved water qaulity	112	25.3
Not crowded	56	12.6
Only place for salmon/trout/steelhead	26	5.9
Other	31	7.0

Table 12. Frequency Distribution of Central Basin Sites Visited by Sample Respondents in 1982

Name of Launching Site	Number of Sample Respondents	Range of Visits
1. Lorain Harbour	127	1-150
2. Rocky River	35	1-34
3. Edgewater Park	40	1-100
4. East 72nd Street	32	1-30
5. Wildwood Park	57	1-20
6. Chagrin River	123	1-65
7. Grand River	189	1-200
8. Ashtabula	127	1-112
9. Conneaut	108	1-100
Western Basin of Lake Erie	230	1-40

Basin of Ohio's Lake Erie, listed at the bottom of the table, shows that 52% of the sample respondents made at least one trip there.

To test the hypothesis of distance being an inhibiting factor for travel to the Western Basin, a frequency distribution of sites visited was carried out once again. The nine sites mentioned in Table 12 were aggregated into four sites and four data sets were created on the basis of whether or not a sample respondent visited a site. The number of visitors from each of these four groups who went to the Western Basin were obtained. The results presented in Table 13 show that the recreationists who frequent Ashtabula and Conneaut Harbors, which are furthest away from the Western Basin, have the lowest frequency of those who visit the Western Basin.

Since 86% of the sample chose to go to the Central Basin because of its relative proximity (see Table 11), it was not surprising to find that 51% of the sample intended visiting the Central Basin more often in the future, 47% said their visits would remain at the same level and

Table 13. Frequency Distribution of Visits to the Western Basin, by Group

	Name of Group	Number Visited Central Basin Site	Range of Visits	Number Visited Western Basin Site	%	Range of Visits
1.	Lorain Harbour and Rocky River	146	1-150	98	67	1-40
2.	Chagrin River Wildwood Park, East 72nd Street and Edgewater Park	161	1-100	99	61	1-25
3.	Grand River	189	1-200	117	62	1-25
4.	Ashtabula and Conneaut Harbours	169	1-114	66	39	1-25

only 2% said they would decrease their future use of the Central Basin facilities.

A question as to what the respondents regarded as the three most important needs for boating/fishing in the Central Basin area elicited the following responses: 86% wanted more and/or better launch sites, 67% thought that artificial reefs should be built to attract and concentrate sport fish and 25% wanted additional fishing information such as location and best times for fishing.

The socioeconomic information about the sample respondents is reported in terms of their employment status and annual income earned. Table 14 lists the employment profiles. A large percentage of the respondents were employed full time (40 hours per week) as expected but surprisingly 14% had been unemployed during the period the survey was undertaken.

The income earned by the individual respondent is used in estimating the demand function. For obvious reasons, respondents were not asked to specify their actual income, but only to indicate their income levels by categories. Respondent income levels are listed in Table 15. The final category was open ended and includes all with incomes over $50,000. The income of the respondent is assumed to be at the midpoint of the reported income group, but for the open ended group the midpoint was assumed to be $75,000. The respondent's income defined in this manner is used for estimating the demand function. The mean income for the sample respondents is $24,295.

As mentioned earlier the sample is predominantly male with only seven female respondents. Since, recreational groups are often

Table 14. Employment Profiles of Sample Respondents During 1982

Occupational Status	Number of Respondents	Percentage of Respondents
Working Full Time	288	65
Fully Retired	73	16
Retired, Working Part Time	10	2
Presently not Employed	60	14
None of the Above	12	3

Table 15. Frequencies of Sample Respondents by Income Groups

Income Group	Number	Percentage
0-4,999	5	1.1
5,000-9,999	30	6.8
10,000-14,999	53	12.0
15,000-19,999	70	15.8
20,000-24,999	85	19.2
25,000-29,999	82	18.5
30,000-34,999	51	11.5
35,000-39,999	13	2.9
40,000-44,999	6	1.3
45,000-49,999	4	0.9
50,000 and over	16	3.6

comprised of women and children, more female recreationists may be found among those who visit the Central Basin.

CHAPTER IV

DISAGGREGATED DATA ANALYSIS

The results of estimating four demand functions using disaggregated data based on the travel cost model specified in Chapter II are given in this chapter. The first section states the model and the composition of variables. The following two sections give the model estimates and the values of consumers' surplus calculated by using the demand equations. The results of analyzing the aggregate data are presented in the next chapter.

The Basic Model

The travel cost demand model estimated in the study was:

$$(4) \quad V_{ij} = \alpha_j + \sum_{k=1}^{5} \beta_{jk} C_{ki} + e_{ij}$$

where $i = 1 \ldots n$ observations

$j \ldots k = 1, \ldots, 4$ sites

The original sample is comprised of 443 observations. The sample members had been contacted at nine sites as mentioned in Chapter III. These nine sites were aggregated into four sites and four subsamples were generated from it on the basis of whether or not a sample respondent visited a site. The four datasets were named Lorain Harbour, Cleveland, Grand River and Ashtabula. The subscripts used to denote the different sites in the Central Basin here and elsewhere in the chapter are

1. Lorain Harbor and Rocky River collectively named Lorain Harbour

2. Chagrin, Wildwood, East 72nd Street and Edgewood Park collectively named Cleveland

3. Grand River

4. Ashtabula and Conneaut collectively named Ashtabula

Subscript 5 denotes the Western Basin of Ohio's Lake Erie which is hypothesized to be a substitute for the Central Basin.

The income variable was dropped from the model because results of the regression analysis showed that the coefficient of the income variable was not significantly different from zero.

It was hypothesized that members of each subsample perceived the various sites in the Central Basin as substitutes for each other, the site closest to home being visited most often due to lower costs of travel. Visits to other sites were probably made because the quality of fishing and facilities offered at those sites were different. The Western Basin was hypothesized to be a substitute for the Central Basin sites and its 'price' was accordingly incorporated in each of the four demand equations estimated separately for the four sites. Results of testing the hypotheses are given later in the chapter.

The Variables in the Model

The dependent variable in each equation was the number of visits made to the site under study. That is, for Lorain Harbour, the dependent variable NTS1 was the number of visits made to site 1 and the demand function was estimated for that site using Equation 4. Similarly, separate demand functions for the other three sites were estimated. In each subset of data, observations for which the dependent variable had zero values were excluded.

The cost variable C_{ki} (costs of visiting the k^{th} site by the i^{th} recreationist) has several components. These are travel money costs, travel time costs, on site money costs and on-site time costs. Inclusion of one or more of these cost components in the travel cost model depends on the perception of the recreational experience. If the recreational visit or trip is viewed as a time consuming activity, the opportunity costs of travel time and time spent at the site should be added to the money costs of the trip. Bishop and Heberlein (1980) and Wilman (1980) urge the inclusion of on-site time costs in the cost variable to ensure a correct estimation of consumers' surplus, as exclusion of such costs would lead to a downward bias in the demand curve.

For the purpose of this study, only travel costs (money and time) were incorporated in the disaggregated model, because the data did not permit allocation of on-site money expenditures incurred by the recreationists on a site basis. On-site money costs of the recreational trip are available from the dataset on an aggregate basis for the Central Basin, but not for the four individual sites. Using an average estimate of these costs would only shift all four demand functions to the same extent (by a constant amount) not adding any efficiency to the model. On-site time costs were not included in the model because on-site time cannot be allocated among the four sites.

The two cost components then included were the cost of travel to and from the site and the opportunity cost of travel time for the round trip. The direct money cost is defined as

(5) C_{ki} = (2 X $MILES_k$ X VEHCOST)/NUPERS

where NUPERS is the average size of the group engaging in the recreational activity during 1982, 2 is the factor by which one way distance or miles is converted to round trip distance and MILES is the one way direct distance from the county seat of the recreationist to each of the five sites k, k = 1,--,5. VEHCOST is defined as

(6) VEHCOST = ($.15) + $1.20/HWYMPG

where $.15 represents costs per mile of maintaining the vehicle, $1.20 is an approximation of the average cost of gasoline per gallon during 1982 in Ohio, and HWYMPG is the number of miles travelled per gallon of gas as reported by the respondents.

Costs of Time

In the literature, the most commonly accepted costs of travel time are those valued at 25%-50% of the wage rate of the recreationist. In this study, the opportunity cost of travel time valued at 50% of the wage rate was used as the upper bound and omission of time cost of travel then provided the lower bound, for the estimation of the demand functions. The valuation of the opportunity cost of time at the full wage rate was not done because it assumes that the individual could have spent this time working at the full wage rate. This assumption would be incorrect for the sample as 288 of the 443 respondents stated that they worked a forty hour week whilst others were retired, unemployed or employed part time. The assumption that can then be made is that the recreational activity is undertaken during weekends, in the evening, or on vacations by those who are employed full time (40 hours a week), so that their opportunity cost of time is lower than the full wage rate.

McConnell (1975) says that if instead of increased work hours, another leisure activity is chosen by the recreationist as the next best alternative, then the opportunity cost of time should be valued at less than the full wage rate. Bishop and Heberlein (1980) state that women and children, who often form part of the group, have a lower opportunity cost of time. The values of 25%-50% of the wage rate were selected because a study on urban commuters showed that they valued their travel time as such (Cesario, 1976).

The three different cost definitions used in this study are:

5(i) $C_{ki1} = (2 \times MILES_k \times VEHCOST)/NUPERS$

5(ii) $C_{ki2} = (2 \times MILES_k \times VEHCOST)/NUPERS + .25\ TRAVTIME$

5(iii) $C_{ki3} = (2 \times MILES_k \times VEHCOST)/NUPERS + .5\ TRAVTIME$

where TRAVTIME is defined as

(7) $TRAVTIME = (INCMEAN/2000) \times (2 \times MILES_k/50\ MPH)$

where INCMEAN is the midpoint of the income class to which the respondent belongs, 2000 is the average hours worked per year assuming a yearly work period of 50 weeks (with two weeks as paid vacation in a year) and a work period of 40 hours a week; and 50 MPH is the average travel speed expected to be maintained on the road while undertaking the trip.

Demand Function Estimates

The demand functions for the four sites in the Central Basin were estimated using the three definitions of cost given above. The prices of the substitute sites were incorporated in the model. Since there were several alternative estimated equations, results are presented only for two equations per site. In one equation the prices of the statistically most significant substitute sites are incorporated, while the other has no substitute prices. The equation with substitute prices is considered to be the best estimate. The equation with no substitute prices provides an upper bound estimate of the consumer surplus from each site.

The coefficients of own costs in all the equations were negative leading to a downward sloping demand curve, as expected. They were all statistically significant. The cost coefficients of the substitutes were in general, statistically significant and had positive signs. In some models, multicollinearity problems between site prices caused changes in the signs of the substitutes' cost coefficients. The results of the regression analysis are presented in Tables 16-19. The first column in all the tables gives the names of the variables and the statistics. Columns two, three and four, and five, six and seven respectively give the corresponding values estimated when cost of travel time is set at zero, one-quarter and one-half of the wage rate.

Table 16 gives the results of analyzing Lorain Harbour. When the cost of travel to site 1 was the only independent variable, the explained variance ranged from .062 to .043 and the elasticity changed from -.202 to -.154 and then to -.132. The slope of the own cost coefficient decreased in absolute value as a higher proportion of the wage cost of travel time was included in the cost variable leading to a steeper slope of the demand curve. This occurs because the inclusion of opportunity costs of travel time causes the price axis to expand in scale, while the quantity axis remains the same. The inclusion of the

Table 16. Travel Cost Demand Function Estimates for Lorain Harbour

	5(i)	5(ii)	5(iii)	5(i)	5(ii)	5(iii)
C_1	-2.08 (3.03) [-.202]	- .92 (2.56) [-.154]	- .56 (2.40) [-.132]	-3.96 (4.51) [-.386]	-2.30 (4.31) [-.383]	-1.56 (4.22) [-.369]
C_2				2.61 (3.27)	1.74 (3.39)	1.22 (3.40)
Intercept	29.60	28.87	28.39	34.10	34.68	34.38
R^2	0.062	0.048	0.043	0.130	0.127	0.122
F	9.18*	6.53*	5.76*	10.26*	9.29*	8.90*
N	140	130	130	140	130	130

t ratios in ( ), point elasticities at the mean in [ ].
* F ratio significant at the 1 percent level.

price of site 2 in the above model changed the slopes of the demand curve in a manner similar to the one above. The incorporation of opportunity costs of time is equivalent to a "stretching" of the price axis over the same quantity of trips, hence the coefficients decline in magnitude. The elasticity changed from -.386 to -.383 and then to -.369. The sign on the cost coefficient for site 2 was positive and this coefficient was statistically significant implying that site 2 is an important substitute for site 1. The explained variance ranges from .130 to .122 showing that the model in Table 16 improves with the inclusion of the substitute site 2.

The effects of the other sites were investigated by estimating several models. Sites 1 and 5 together did not give significant results. The own cost coefficient for site 1 was negative but not statistically significant and the sign on the cost coefficient of site 5 was also negative. Since site 5 (Western Basin) was expected to show up as a substitute the results were unexpected, but are probably due to high collinearity between travel costs to site 1 and site 5. With sites 1, 2 and 5 in the model, site 2 showed up as a significant substitute for site 1. The cost coefficient for site 5 was statistically insignificant, although it carried a positive sign. A model with all five sites gave a statistically significant coefficient with a negative sign for site 1, showed site 2 as a weak substitute but gave statistically insignificant results for the other three sites. Two models were then estimated excluding site 2 from each. In the one with sites 1, 3 and 5, site 3 showed up as a strong substitute although site 5 did not (negative insignificant coefficient). Site 4 showed up as a strong substitute for site 1 in the absence of sites 2 and 3 in the model, the behavior of the cost coefficient for site 5 being almost identical to the one above. In another model sites 2, 3 and 5 displayed themselves to be substitutes for site 1 with site 2 appearing to be the strongest one. The erratic behavior of the variables seems to have been caused by multicollinearity [see Appendix Table B1 for correlation matrix].

Table 17 contains the results of analyzing Cleveland. When the cost of travel to site 2 was the only independent variable, the slope of the own cost coefficient declined in absolute value from -1.71 to -.82. The explanation given earlier for this kind of change also holds for this site. The explained variance ranges from .095 to .116. The elasticity changes from -.526 to -.636 to -.620. This implies that the

Table 17. Travel Cost Demand Function Estimates for Cleveland

	5(i)	5(ii)	5(iii)	5(i)	5(ii)	5(iii)
C_2	-1.71 (4.02) [-.526]	-1.20 (4.32) [-.636]	- .82 (4.29) [-.620]	-2.64 (4.15) [-.811]	-1.62 (4.09) [-.852]	-1.11 (4.10) [-.828]
C_5				.52 (1.94)	.27 (1.49)	.18 (1.53)
Intercept	19.24	20.89	20.64	24.77	23.83	23.62
R^2	.095	.117	.116	0.116	0.131	0.130
F	16.18*	18.65*	18.43*	10.13*	10.51*	10.47*
N	156	142	142	156	142	142

t ratios in ( ), point elasticities at the mean in [ ].
* F ratio significant at the 1 percent level.

demand curve becomes more elastic when travel time is valued at 25% of the wage rate and then becomes more inelastic when cost of time is increased further. The impact of adding site 5 to the model can be seen in Table 17. The coefficients for this site have positive signs and are significant at the 10% level showing that site 5 is a substitute for site 2. The own cost coefficients are negative and have decreasing slopes. The elasticity changes from -.811 to -.852 to -.828 peaking when travel time is valued at 25% of the wage rate. These results suggest that a further increase in opportunity cost of time makes the demand for a fishing/boating trip relatively more inelastic.

The effects of other sites were also studied. A model with the costs of travel to sites 2 and 1 gave a negatively signed, statistically significant own cost coefficient, which responded in a manner similar to the models in Lorain Harbour, after time costs of travel were included. The cost coefficient for site 1 was significant and had a positive sign, showing itself as a substitute site for site 2. A model including both sites 1 and 5 gave significant results for site 2, but insignificant coefficients for sites 1 and 5 although the signs for both were positive. This could also be due to collinearity problems. The same kind of results were obtained when sites 3 and 5 and sites 4 and 5 were tested in Cleveland. A model with sites 2, 1, 3, 4 and 5 gave a significant negatively signed cost coefficient for site 2, but insignificant positively signed coefficients for sites 1, 3 and 4. Site 5 had a negative coefficient. The result can probably be attributed to multicollinearity (see Appendix Table B2).

Two of the results of analyzing Grand River are listed in Table 18. With own cost as the independent variable, the

Table 18. Travel Cost Demand Function Estimates for Grand River

	5(i)	5(ii)	5(iii)	5(i)	5(ii)	5(iii)
C_3	-3.22 (3.47) [-.275]	-1.91 (3.88) [-.304]	-1.29 (3.82) [-.296]	-4.41 (3.85) [-.376]	-2.30 (3.69) [-.367]	-1.57 (3.60) [-.362]
C_4				1.24 (1.75)	.43 (1.01)	.28 (1.00)
Intercept	27.16	26.91	26.74	29.36	28.16	27.96
R^2	.062	.080	.078	.078	.086	.084
F	12.03*	15.04*	14.61*	7.62*	8.03*	7.80*
N	183	173	173	183	173	173

t ratios in ( ), point elasticities at the mean in [ ].
F ratio significant at the 1 percent level.

explained variance ranged from .062 to .080, the slopes declined in magnitude and elasticity changed from -.275 to -.296 peaking at -.304 with time cost valued at 25% of the wage rate. Inclusion of site 4 in the same model increased R^2 slightly. The elasticity changed from -.376 to -.367 to -.362 corresponding to inclusion of increased time costs in the manner observed in Lorain Harbour and Cleveland mentioned above. Site 4 did not turn out to be as strong a substitute as expected, although the evidence of it being a substitute is present.

Results of estimating other equations (not included in Table 18) are briefly discussed here. An equation with sites 3 and 5 only gave satisfactory results for the own cost coefficient. Although the cost coefficient for site 5 was positive, it was not statistically significant, implying that the Western Basin is not viewed as a substitute by the sample members in Grand River. The travel costs of visiting sites 3 and 5 are weakly correlated, so the only explanation seems to be that site 5 is not perceived to be a substitute site, obviously because the distance (and thus costs) to the Western Basin is quite large. In the presence of sites 3 and 5 in the model, both sites 2 and 1 gave insignificant results and had negative signs. On the basis of these results it is not possible to say whether sites 2 and 1 are complements to site 3, because their proximity to site 5 may have caused collinearity problems (see Appendix Table B3).

The results of estimating two demand equations for site 4 are presented in Table 19. When demand is estimated using only own costs, the explained variance ranges from .156 to .183. The cost coefficient is negatively sloped, statistically significant and decreases in absolute value as costs of travel time are increased in the model. The elasticity changes from -.711 at zero time cost to -.759 (when time is valued at 25% of the wage rate) to -.659 (when time is valued at 50% of the wage rate). In Table 19, the importance of site 3 as a substitute site can be seen. The signs for its coefficients are positive and the coefficients are statistically significant. The explained variance changes from .269 to .302 and then decreases to .289. The own cost elasticity increases from -.996 to -1.126 but falls to -1.069 when time is valued at 50% of the wage rate.

When sites 3 and 5 were entered in the model, the own cost coefficient responded in a manner similar to all the others in the above equations. The elasticity changed from -.985 to -1.139 to -1.063 reaching a peak when time cost was valued at 25% of the wage rate. The signs on the coefficients of both sites 3 and 5 remained positive and

Table 19. Travel Cost Demand Function Estimates for Ashtabula/Conneaut

	5(i)	5(ii)	5(iii)	5(i)	5(ii)	5(iii)
C_4	-2.58 (5.45) [-.711]	-1.48 (6.24) [-.759]	- .88 (5.86) [-.659]	-3.61 (7.40) [-.996]	-2.19 (8.14) [-1.126]	-1.43 (7.89 [-1.069]
C_3				2.73 (4.98)	1.49 (4.70)	1.05 (4.80)
Intercept	34.83	35.10	33.03	40.57	42.28	41.26
R^2	.156	.202	.183	.269	.302	.289
F	29.75*	38.99*	34.38*	29.49*	33.18*	31.20*
N	163	156	156	163	156	156

t ratios in ( ), point elasticities at the mean in [ ].
* F ratio significant at the 1 percent level.

the coefficients were statistically significant. However, the coefficient for site 5 which was statistically significant when cost of time was equal to zero, became less so as cost of time increased in the model. The explained variance ranged from .319 to .292, the highest observed for any equation.

Site 5 showed itself to be a strong substitute for site 4 when introduced by itself. Sites 1 and 5 introduced together in another equation showed up as weak substitutes. However, in an equation with sites 2 and 5 included as substitutes, only site 2 showed a positively signed, statistically significant coefficient. The sign on the coefficient for site 5 became negative and the coefficient was also insignificant. This probably occurred because the very high collinearity between travel costs to sites 2 and 5 distorted the results. The other sites did not seem to be substitutes in the models which included site 5. In a model in which all sites were included, sites 3 and 5 seemed to be substitutes for site 4, site 2 did not have a significant coefficient and site 1 had a coefficient with a negative sign. Again collinearity between costs of proximate sites could have affected the results in this manner (see Appendix Table B4).

Estimates of Gross Consumers' Surplus

The gross consumers' surplus or total willingness to pay is calculated from the area beneath the demand curve at a given price level. The two components of gross consumer's surplus are total expenditures and net consumer's surplus. The total (travel) expenditures are calculated as the product of the number of trips and price (cost) per trip. The net consumer surplus is calculated as the area of the triangle above

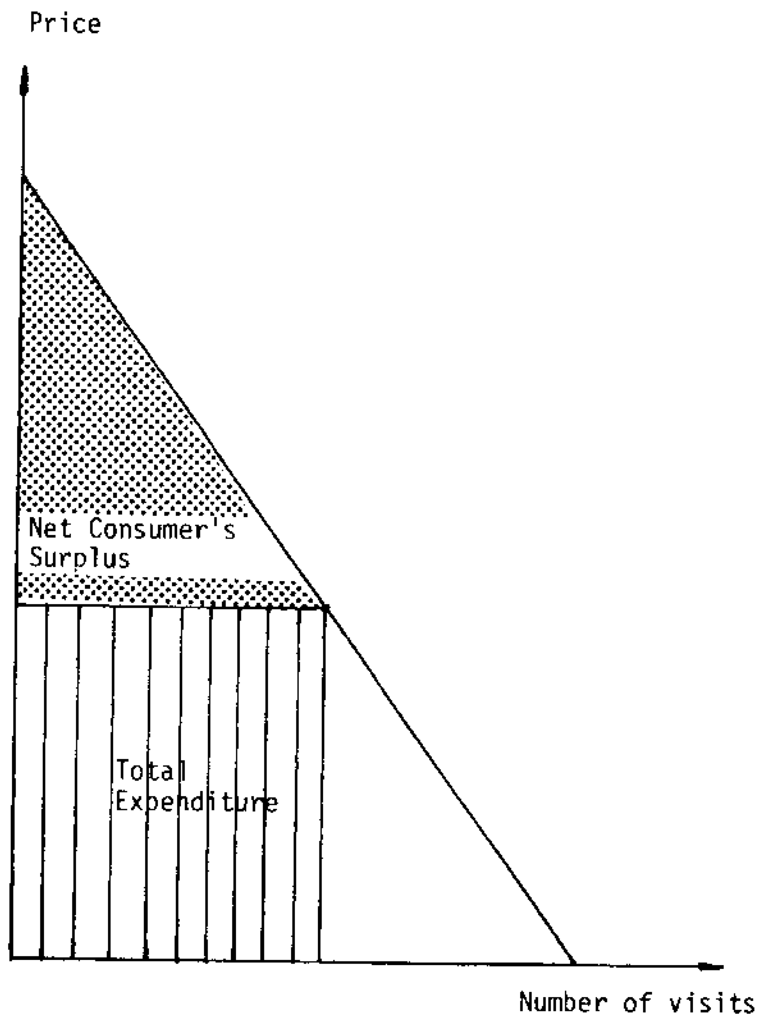


Figure 8. Pictorial representation of Total Expenditure and Net Consumer's Surplus

the price line and below the demand curve. A diagrammatic presentation of these two components of gross consumer's surplus is made in Figure 8. The vertically shaded area represents the expenditures and the shaded triangular area represents the net consumer's surplus.

The gross consumer's surplus was calculated for each of the models listed in Tables 16-19 using the mean prices of each site and the mean number of visits to each site. Calculation of estimated expenditures, net consumer's surplus and gross consumer's surplus per person per trip is shown for site 1 in Table 20 using the models presented in Table 16. The consumer's surplus per trip changes from $8.32 at zero cost of time to $17.78 when time is valued at 25% of the wage rate and increases by more than 300% when the value of time is estimated at 50% of the wage rate. These consumer's surplus values are obtained when the demand function for site 1 is estimated against its own cost (price only). When the price of site 2 is added to the demand function as a substitute price, the consumer's surplus values increase from $5.51 to $9.63 and

Table 20. Estimated Expenditures, Net Consumer's Surplus, and Gross Consumer's Surplus for Lorain Harbour

	Without Substitute Sites			With Substitute Sites		
	5(i)	5(ii)	5(iii)	5(i)	5(ii)	5(iii)
Trips	24.91	24.91	24.91	24.91	24.91	24.91
Expenditures ($)	59.06	104.60	149.10	59.03	104.78	149.33
Net consumer's surplus ($)	146.69	340.27	560.59	76.51	136.63	201.80
Gross consumer's surplus per year ($)	204.75	448.87	709.69	135.54	241.41	351.13
Gross consumer's surplus per trip ($)	8.32	17.78	28.32	5.51	9.63	13.99

then to $13.99 corresponding to the increase of costs of time in the model. The results are not surprising because inclusion of a substitute makes the demand curve flatter and relatively more elastic. This leads to the conclusion that estimated net benefits derived from site 1 are biased upward if price of substitute site 2 is excluded.

The gross consumer's surplus or total willingness to pay per trip, estimated for the other models (Tables 17 to 19) are presented in Tables 21-23. The highest value of gross consumer's surplus on a per trip basis is estimated for site 4 (Ashtabula), the lowest is for site 3 (Grand River). The values of consumer's surplus change in a manner almost identical to those for site 1 discussed above. The consistent increase in magnitude of the calculated consumer's surplus with inclusion of successive higher costs of time conform to the findings in other studies. Bishop and Heberlein (1980) found that their values of consumer's surplus increased by 300% using time values at 50% of the wage rate as compared to using a zero cost of time. As mentioned earlier in this chapter, several economists have recommended the inclusion of time costs for a correct estimation of consumer's surplus.

The relative values of the four Central Basin sites can be estimated by comparing the gross consumer surplus values derived from the demand functions estimated with prices of substitutes. From Table 24 it can be observed that Ashtabula generates the highest values of gross consumer's surplus per trip which is $8.43 for 1982 while Grand River has the lowest value of $4.24 per trip. The gross consumer's surplus of $171.29 per person per year is also highest for Ashtabula followed by

Table 21. Gross Consumer Surplus Estimates for Cleveland

	Without Substitute Sites			With Substitute Sites		
	5(i)	5(ii)	5(iii)	5(i)	5(ii)	5(iii)
Trips	12.76	12.76	12.76	12.76	12.76	12.76
Expenditures ($)	48.93	86.43	122.77	48.99	87.07	124.54
Net Consumer's Surplus ($)	46.47	67.94	98.93	30.19	51.05	75.19
Gross Consumer's Surplus per year ($)	95.40	154.37	221.70	79.18	138.12	199.73
Gross Consumer's Surplus per trip ($)	7.57	12.09	17.40	6.27	10.74	15.46

Table 22. Gross Consumer Surplus Estimates for Grand River

	Without Substitute Sites			With Substitute Sites		
	5(i)	5(ii)	5(iii)	5(i)	5(ii)	5(iii)
Trips	20.83	20.83	20.83	20.83	20.83	20.83
Expenditures ($)	38.77	67.86	97.76	38.83	67.75	97.26
Net Consumer's Surplus ($)	70.50	111.40	164.83	51.62	92.24	134.00
Gross Consumer's Surplus per year ($)	109.27	179.26	262.59	90.45	159.99	231.26
Gross Consumer's Surplus per trip ($)	5.13	8.69	12.73	4.24	7.77	11.27

Table 23. Gross Consumer Surplus Estimates for Ashtabula

	Without Substitute Sites			With Substitute Sites		
	5(i)	5(ii)	5(iii)	5(i)	5(ii)	5(iii)
Trips	20.06	20.06	20.06	20.06	20.06	20.06
Expenditures ($)	114.20	204.19	296.85	113.99	203.33	297.29
Net Consumer's Surplus ($)	80.42	134.53	225.07	57.30	90.26	138.98
Gross Consumer's Surplus per year ($)	194.62	338.72	521.92	171.29	293.59	436.27
Gross Consumer's Surplus per trip ($)	9.56	16.97	26.22	8.43	14.77	21.88

Table 24. Gross Consumer Surplus Estimates Compared

Name of Site	GCS per trip in $ Without substitute	GCS per trip in $ With substitute	Mean Number of Trips per year	GCS per person per year in $ Without substitute	GCS per person per year in $ With substitute	% change in GCS when substitute is included
Lorain Harbour	8.32	5.51	24.91	204.75	135.54	-34%
Cleveland	7.57	6.27	12.76	95.40	79.18	-17%
Grand River	5.13	4.24	20.83	109.27	90.45	-17%
Ashtabula	9.56	8.43	20.06	194.62	171.29	-12%

Lorain Harbour which has an annual gross consumer surplus of $135.54, although the sample recreationists, on an average, made the maximum number of trips (24.91) to Lorain Harbour. The lowest number of trips were made to Cleveland. The last column in Table 24 shows the percentage difference in gross consumer surplus estimates. Inclusion of the price of Cleveland in the demand function for Lorain Harbour results in a 34% decrease in the total willingness to pay for a trip to this site. When Grand River is treated as the substitute site for Ashtabula, the consumer's surplus decreases by 12%. Ashtabula has the strongest substitute site (Grand River) in terms of statistical significance, but by itself is a weak substitute for Grand River.

The figures in Table 24 show that the sample recreationists are willing to pay more for a trip to Ashtabula than for the other three sites. This is probably due to the location of site 4. It is the furthest site from the Western Basin and therefore the costs of visiting site 4 are much lower than that of visiting the Western Basin. Sites 1 and 2 are relatively closer to the Western Basin (a prolific fishing area). The sample recreationists would value these two sites less highly as they have the choice of visiting the Western Basin at lower costs compared to sample respondents who live closer to Ashtabula.

The estimates of gross consumer's surplus were obtained for each site on a per trip and per day basis. Aggregate estimates of the total willingness to pay for the Central Basin sport fishing and recreational boating were obtained using the following procedure:

$$GCS/day_j = GCS/trip_j \;/\; 1.13 \text{ (average days/trip)}$$

$$\text{Aggregate GCS/day} = \left(\Sigma \frac{V_j}{V} \times \text{GCS/day}_j\right) + \text{on-site money and time costs (see Appendix C)}$$

where V_j = total number of visits to the site j, j=1,...,4.

V = total number of visits to all sites.

Aggregate GCS for Central Basin during 1982 =

Aggregate GCS/day x 396226.42 (2.1 million boat angler hours / 5.3, i.e., average hours fished/day)

The upper portion of Table 25 shows the aggregate values of gross consumer's surplus on a per day basis and on an aggregate basis for the entire Central Basin, when prices of substitutes have been excluded from the TC demand functions. These estimates provide the upper bound of total willingness to pay for the Central Basin recreational boating and fishing. The lower half of Table 25 gives unbiased estimates when substitute prices are included in the demand functions. These are all lower than the upper bound estimates, as expected.

As stated earlier in this chapter, inclusion of travel time costs valued at 25% and 50% of the wage rate increases gross consumer's surplus values by more than 150%. The per day gross consumer's surplus values range from \$6.68 to \$18.83 when prices of substitutes are excluded and range from \$5.32 to \$13.68 when prices of substitutes are included. Addition of on-site money and time costs to the per day willingness to pay estimates does not change the pattern of increase of gross consumer's surplus values.

In three out of the four demand functions estimated with prices of substitutes, the explained variances were highest when travel time costs were valued at 25% of the wage rate. The "best" estimate of the econo-

Table 25. Per Day and Aggregate Central Basin Willingness to Pay, Using Four Disaggregated Sites

	Time cost = 0	Time cost = 25%	Time cost = 50%
	Without Substitute Site Prices		
Gross consumer's surplus per day ($)	6.68	12.29	18.83
On-site money costs and time costs ($)	13.33	38.18	63.02
Willingness to pay per day ($)	20.01	50.47	81.85
Aggregate Central Basin excluding on-site costs ($ million)	2.648	4.869	7.459
Aggregate Central Basin including on-site costs ($ million)	7.928	19.998	32.431
	With Substitute Site Prices		
Gross consumer's surplus per day ($)	5.32	9.36	13.68
On-site money costs and time costs ($)	13.33	38.18	63.02
Willingness to pay per day ($)	18.65	47.54	76.70
Aggregate Central Basin excluding on-site costs ($ million)	2.106	3.711	5.420
Aggregate Central Basin including on-site costs ($ million)	7.390	18.837	30.391

mic value of the Central Basin spent fishing and pleasure boating is then $18.837 million. This estimate is based on boat angler hours and hours fishing per day. Whether it over or underestimates the economic value of fishing and pleasure boating in the Central Basin depends upon how representative the data sample for this study is of those who boat for pleasure only.

The next chapter contains the results of estimating a single demand function for the Central Basin, using aggregate data. The consumer's surplus values obtained by using this equation will be compared to results listed in this chapter.

CHAPTER V

AGGREGATED DATA ANALYSIS

This chapter contains the results of analyzing the aggregate data using the travel cost demand function. The various cost components used are discussed in the first part of the chapter which is followed by a comparison of the consumers' surplus values obtained using the aggregated data and disaggregated data from the previous chapter.

The Model

The travel cost demand model used is the same as the one specified in Chapter IV, the only difference being that instead of estimating demand fuctions for four Central Basin sites, the demand function is estimated for the entire Central Basin with the Western Basin as the sole substitute. The demand equation can then be rewritten as:

$$(7) \quad V_i = \alpha + \sum_{k=1}^{2} \beta_k C_{ki} + e_i$$

where subscripts 1 and 2 respectively denote the Central Basin and Western Basin.

The dependent variable in the equation was the number of visits made by each of the 443 sample members to the Central Basin.

The income variable was dropped from the model because the coefficient of the income variable was insignificant.

The cost variable has four components: travel money costs, travel time costs, on-site money costs and on-site time costs. The TC model was first estimated in accordance with the method followed in Chapter IV to enable comparison of the results using aggregated and disaggregated data. The three cost definitions used are identical to equations 5(i), (ii) and (iii) and are renumbered as:

(7a) C_{ki1} = (2 X $MILES_{ki}$ X VEHCOST)/NUPERS

(7b) C_{ki2} = (2 X $MILES_{ki}$ X VEHCOST)/NUPERS + .25 TRAVTIME

(7c) C_{ki3} = (2 X $MILES_{ki}$ X VEHCOST)/NUPERS + .50 TRAVTIME

The variable $MILES_k$ is redefined as the weighted one-way average of the direct distance from the county seat of origin for individual i to each of the four designated Central Basin sites based on the total number of recreational boating/fishing trips made to the four Central Basin sites during 1982. The distance variable for the Western Basin remains as before.

The results of estimating the aggregate demand function, using the above mentioned cost components are given in Table 26. When the Western

Table 26. Travel Cost Demand Function Estimates Using Travel Money and Travel Time Costs, Aggregate Central Basin

	7a	7b	7c
C_1	-2.66 (5.48) [-.253]	-1.31 (5.22) [-.225]	-0.85 (5.02) [-.172]
C_2	.60 (3.29)	.20 (1.64)	.12 (1.50)
Intercept	37.45	36.51	35.98
R^2	.069	.068	.065
F	15.49*	14.26*	13.73*
N	421	395	395

t ratios in ( ), point elasticities at the mean in [ ].
F ratio significant at the 1 percent level.

Basin was included as the only substitute, the explained variance ranged from .069 to .065. The coefficients of own costs in all three equations were negative leading to a downward sloping demand curve, as expected. All the own cost coefficients were statistically significant. The slope of the own cost coefficient decreased in absolute value as higher proportions of the wage cost of travel time were included in the model. The explanation given in Chapter IV regarding the behavior of the demand curve can be applied here. Ths cost coefficient for the Western Basin had a positive sign. It was statistically significant when wage costs of travel time were excluded from the model but became less significant with increasing time costs. The own-price elasticity changed from -.253 (at zero cost of travel time) to -.225 to -.172 showing that the demand for a recreational boating/fishing trip becomes relatively more inelastic as opportunity costs of time are included in the model. It had been hypothesized that the Western Basin is a substitute for the Central Basin and the results presented in Table 17 support this hypothesis. In the present model, the Western Basin showed up as a significant substitute for the Central Basin, corroborating the earlier results.

To conform with the definition of the cost variable used in Chapter IV, only travel costs were used in the previous model As it was possible to allocate on-site time and money costs on the aggregated sample data, it was decided to incorporate these into the model. The five different cost components then used were:

(7.1) $C_{i1} = (2 \text{ X } MILES_k \text{ X } VEHCOST)/NUPERS + EXPEND$

(7.2) $C_{i2} = (2 \text{ X } MILES_k \text{ X } VEHCOST)/NUPERS + EXPEND + .25 \text{ } WCS$

(7.3) $C_{i3} = (2 \text{ X } MILES_k \text{ X } VEHCOST)/NUPERS + EXPEND + .50 \text{ } WCS$

$$(7.4)\ C_{14} = (2 \text{ X } MILES_k \text{ X } VEHCOST)/NUPERS + EXPEND + .25\ WCS + .25\ TRAVTIME$$

$$(7.5)\ C_{15} = (2 \text{ X } MILES_k \text{ X } VEHCOST)/NUPERS + EXPEND + .50\ WCS + .50\ TRAVTIME$$

where EXPEND is the sum of money spent during the recreational activity on gas and oil for the boat, boating supplies, launching and docking fees, boat charters, fishing equipment, bait, food and beverages, overnight lodging and miscellaneous expenses (see Appendix A, Q6 of questionnaire). The wage cost of on-site time is defined as

$$(8)\quad WCS = (8)\ (TRIPLEN)\ (INCMEAN)/2000$$

where 8 is the number of hours foregone in a working day when the recreationist spends the day boating/fishing. The other variables have been previously defined in Chapters III and IV.

The cost variable in equations 7.4 and 7.5 incorporates the costs of travel time valued at 25% and 50% of the wage rate, in addition to the travel money costs, on-site money costs and on-site time costs. The cost of travel time was excluded in equation 7.2 and 7.3 for the following reason: the variable TRIPLEN, which is a component of WCS (wage cost of on-site time) represents the total amount of time spent in the recreational activity, which includes time spent in traveling to and from the recreational site. Since the on-site time component (WCS) includes the cost of travel time, introduction of the opportunity cost of travel time as a separate variable (see equations 7.4 and 7.5) would result in a double count of travel time, leading to biased estimates of the demand function for the Central Basin. The results of estimating the TC model using the five definitions of cost are presented in Table 27.

Table 27. Travel Cost Demand Function Estimates Using Travel Money, On-Site Money, On-Site Time and Travel Time Costs

	7.1	7.2	7.3	7.4	7.5
C_1	-.13 (3.97) [-.075]	-.09 (3.76) [-.139]	-.06 (3.13) [-.152]	-.10 (3.80) [-.163]	-.06 (3.10) [-.160]
C_2	.20 (1.18)	.04 (.25)	.03 (.13)	.02 (.19)	.01 (.18)
Intercept	32.62	34.65	34.57	35.04	34.97
R^2	.039	.036	.025	.040	.030
F	8.33*	7.05*	4.89*	7.79*	5.74*
N	411	379	379	379	379

t ratios in ( ), point elasticities at the mean in [ ].
F ratio significant at the 1 percent level.

The own cost coefficients were significant in all five equations. The slope declined in magnitude with incorporation of wage costs of time. The elasticity changed from -.075 to -.152 when only .50 of wage costs of on-site time were included in the model, showing that the demand curve became relatively more elastic as higher wage costs of time were included in the model. A similar change occurred when both .25 of wage costs of travel time and on-site time were included in the model. The elasticity increased from -.075 (at zero cost of time) to -.163 when the above time costs were valued at 25% of the wage rate. There was no significant change in the slopes of the cost coefficients when wage costs of travel time were added in the model. The intercepts changed slightly. These results suggest that double counting of the wage cost of travel time did not bias the demand function estimates strongly. The cost coefficient for the Western Basin remained positive throughout, but did not show itself to be statistically significant.

A comparison of the results presented in Tables 26 and 27 shows that the slopes of the own cost coefficients which are quite large when on-site time and money costs are excluded, decline in magnitude when these costs are added to the travel money and travel time costs. This occurs because addition of on-site time and money costs to the model in Table 26, causes the price axis to be "stretched" over the same number of trips, resulting in the smaller figures shown in Table 27. The own price elasticities are higher when on-site costs are excluded from the model changing from -.253 to -.225 to -.172 with the inclusion of the costs of travel time valued at 25% and 50% of the wage rate. In the model presented in Table 27 the own price elasticities have much smaller values which increase when costs of on-site and travel time valued at 25% and 50% of the wage rate are added to the model.

In Winslow's study of the private boat sport fishery in the Western Basin of Ohio's Lake Erie, she found that inclusion of time costs and on-site money costs in the demand function estimates gave consumer surplus estimates which are biased upward. The results presented in Table 27 are similar and are biased upwards as well.

Estimates of Gross Consumer's Surplus

The gross consumers' surplus or total willingness to pay was calculated for each of the models listed in Tables 26 and 27. The consumers' surplus values estimated in Table 28 correspond to the models given in Table 26. The gross consumers' surplus per trip changes from $8.46 at

Table 28. Estimated Expenditures, Net Consumers' Surplus, and Gross Consumers' Surplus, On-Site Costs Excluded

	Per Trip		
	7a	7b	7c
Trips	29.62	29.62	29.62
Expenditures ($)	84.12	151.65	218.19
NCS ($)	166.46	337.07	517.46
GCS ($)	250.58	488.72	736.35
GCS per trip ($)	8.46	16.50	24.86
	Per Day		
GCS per day ($)	7.49	14.60	22.00
On-site money costs and time costs ($)	13.33	38.18	63.02
Willingness to pay per day ($)	20.82	52.78	85.02
	Aggregate Central Basin in $ million		
Without on-site costs	2.966	5.786	8.716
With on-site costs	8.249	20.914	33.680

zero cost of time to $16.50 when travel time is valued at 25% of the wage rate. It increases by almost 300% when wage cost of travel time at 50% is incorporated in the model. These figures, not surprisingly, conform to the consumers' surplus values obtained when disaggregated data was used (see Tables 20-23).

Table 28 also lists the Central Basin aggregate estimates of gross consumers' surplus. These aggregate figures are obtained using the following procedure:

GCS/day = GCS/trip / 1.13 (average days/trip)

Aggregate GCS for Central Basin during 1982 = GCS/day x 396226.42 (2.1 million boat angler hours in the Central Basin / 5.3, i.e. number of hours fished/day).

The numbers in the table which range from $8.2 million to $34.8 million represent the total willingness to pay for the Central Basin sport fishery and recreational boating. These estimates are based on boat angler hours and hours fishing per day. Recreational boating hours were not available.

Table 29 lists the values of estimated expenditures, net consumers' surplus, gross consumers' surplus and aggregate Central Basin figures using the models listed in Table 27. When travel money costs and on-site expenditures are the only components in the cost variable, the gross consumer's surplus per trip is $134.25. Inclusion of wage cost of on-site time causes this figure to increase substantially. A similar increase is observed when wage costs of travel time are added to the model.

The best functional fit of the model seems to have occurred when wage costs of on-site time and on-site expenditures are excluded. Inclusion of on-site costs seem to present a problem because of the variation in expenses and trip lengths across members of the sample which is difficult to standardize. The model which uses only travel costs (time and money) seems to present the least problems. The per trip willingess to pay for the Central Basin ranges from $134.25 to $331.56, when all costs are included in the TCM. The corresponding per day willingness to pay ranges from $118.81 to $293.42. Winslow's estimates of the Western Basin per trip willingness to pay range from $540 to $634 while per day estimates range from $290 to $341 when time is valued between zero and 50 percent of the wage rate.

The aggregate willingness to pay for the entire Central Basin ranges from $47 million to $116 million. The exclusion of travel time costs as a variable in equations 7.2 and 7.3 did not make a significant difference in the calculations of gross consumers' surplus. Winslow's estimates of the aggregate willingness to pay for the Western Basin sport fishery ranged from $313 million to $368 million, during the 1981 walleye season (Winslow, Table 33, p. 108). The Central Basin aggregate figures seem small in comparison but not unexpected as the number of boat angler hours were only 2.1 million in 1982, contrasted with Western Basin figures of approximately 8 million (1981) and 11.5 million (1982).

The best functional fit of the model seems to have occurred when wage costs of on-site time and on-site money costs are excluded. Including on-site costs seems to present a problem because of the variation in expenses and trip lengths across members of the sample, which is difficult to standardize. Winslow (1982) also concluded that the best fits of the demand function were obtained when only travel money costs were used in her empirical model.

Table 29. Estimated Expenditures, Net Consumers' Surplus and Gross Consumers' Surplus, On-Site Costs Included

	7.1	7.2	7.3	7.4	7.5
Trips	29.62	29.62	29.62	29.62	29.62
Expenditures ($)	520.72	1389.77	2248.75	1455.82	2380.56
NCS ($)	3455.76	5007.56	7407.67	4461.96	7440.54
GCS ($)	3976.48	6397.33	9656.42	5917.78	9821.10
GCS per trip ($)	134.25	215.26	326.02	199.78	331.56
GCS per day ($)	118.81	190.50	288.51	176.80	293.42
Aggregate GCS for 1982 ($ million)	47.073	75.479	114.320	70.051	116.260

CHAPTER VI

FINDINGS AND CONCLUSIONS

The focal point of this study has been the estimation of the demand for private boat sport fishing and recreational boating in the Ohio waters of the Central Basin in Lake Erie during 1982. Responses to a survey from 443 recreational boaters and anglers provided the information for the estimation of the Travel Cost Model (TCM), under several alternative definitions of cost. Based on these results, aggregate estimates of the total willingness to pay for Central Basin recreational boating and fishing are made. The principal findings of this study are summarized in the first part of this chapter, followed by brief notes on the implications, limitations and issues requiring further research.

Findings

It was hypothesized that the Central Basin is perceived in two ways by the recreationists in the sample. It is viewed as 1) a single site with the Western Basin as the only substitute or 2) as a group of four substitute sites. To test both hypotheses, the sample data was disaggregated by generating four subsamples on the basis of whether or not a sample recreationist visited one of the four Central Basin sites of Lorain Harbour, Cleveland area, Chagrin River and Ashtabula. Using the TCM, demand functions were estimated for each of the four sites, first excluding the prices of the substitute sites and subsequently incorporating them in the model. In the demand functions three definitions of costs were used which were pure travel money expenditures, travel money costs plus travel time cost valued at 25% of the wage rate and travel money costs plus travel time cost valued at 50% of the wage rate.

The explained variances were highest when cost of travel time valued at 25% of the wage rate was used in the demand functions for all four sites, with only one exception. The results confirmed the hypothesis that the four Central Basin sites are substitutes for each other. The Western Basin also showed itself to be a substitute for the Central Basin sites, but, very often, its cost coefficients were statistically insignificant. Obviously multicollinearity between the site "prices" prevented the observation of the effects of each site introduced in the demand equations.

Point elasticities calculated at the mean were without exception the highest when travel time valued at 25% of the wage rate was incorporated in all four demand functions. The elasticities were lower when travel time was valued at 50% of the wage rate, implying that the demand curve for a boating/fishing trip is more inelastic when time is valued at this proportion of the wage rate.

Aggregated data was used to estimate a single demand function for the entire Central Basin incorporating the cost of travel to the Western Basin as a substitute price. The same three definitions of travel cost were used, as in the previous models. The Western Basin showed itself to be a significant substitute when the cost of travel time was valued at zero. Unlike the previous models, the R^2 in the aggregate model did not undergo significant changes. The point elasticities calculated at the sample mean became smaller (in absolute value) with the inclusion of travel time costs valued at 25% and 50% of the wage rate implying that the demand curve is more inelastic when the above valuations of travel time are used in the model.

The aggregate model was re-estimated in five ways to assimilate travel money, travel time, on-site money and on-site time costs. The explained variances declined with the inclusion of time costs in the model. Surprisingly, the point elasticities increased when on-site and travel time costs valued at 25% and 50% of the wage rate were incorporated in the model, implying greater elasticity of the demand curve corresponding to the two valuations of travel time and on-site time. However, these point elasticities were smaller in absolute value compared to the elasticities obtained when only travel money and travel time costs were used. This suggests that the demand for a fishing/boating trip becomes relatively inelastic when on-site time and money costs are included in the demand function estimates. These results contradict the findings in the previous models which used only two cost components--travel money and travel time. The cost coefficient for the Western Basin was statistically insignificant in all five model estimations. However, it did have the positive sign of a substitute. The results of re-estimating the aggregated data model suggest that inclusion of on-site time and money costs have introduced some bias into the estimates.

Consumer's Surplus Values Compared

Based on the results of the above demand estimates, values of the gross consumer's surplus per trip were calculated. These values were then used to obtain the total willingness to pay for Central Basin recreational boating and fishing. These estimates were made on the basis of total boat angler hours expended in the Central Basin during 1982. Data on recreational boater hours were not available. The aggregate estimates of total willingness to pay computed in this study may therefore underestimate or overestimate the total value of the Central Basin for recreational fishing and boating depending on how the sample respondents represent recreational boating. The gross consumer's surplus values per day together with the aggregate Central Basin figures derived when using the four disaggregated sites and also the single aggregate site are given in Table 30.

Table 30. Per Day and Aggregate Central Basin Total Willingness to Pay, Using Four Disaggregated Sites and Single Aggregated Site.

	Travel Money and Time Costs		
	Time cost = 0	Time cost = 25%	Time cost = 50%
		Disaggregated Sites	
Gross consumer's surplus per day ($)	5.32	9.36	13.68
Aggregate Central Basin figures ($ million) without on-site costs	2.106	3.711	5.420
Aggregate Central Basin figures ($ million) with on-site costs	7.390	18.837	30.391
		Single Aggregate Site	
Gross consumer's surplus per day ($)	7.49	14.60	22.00
Aggregate Central Basin figures ($ million) without on-site costs	2.966	5.786	8.716
Aggregate Central Basin figures ($ million) with on-site costs	8.249	20.914	34.820

Using four disaggregated sites, the gross consumer's surplus per day is $5.32, when time costs are excluded from the model. The corresponding aggregate Central Basin figures are $2.106 million when on-site costs are excluded, and $7.390 million when on-site costs are included. The gross consumer's surplus per day and corresponding aggregate figures increase, as expected, with the inclusion of time costs in the model. These estimates are considered to be the best estimates as they have been made after incorporating the prices of substitutes in the demand functions and are unbiased. The upper bound of willingness to pay is provided when prices of substitutes are excluded from the TC models.

When the single aggregate site is used, the gross consumer's surplus per day is $7.49 which is a close approximation of $5.32 obtained above. The corresponding aggregate figure is $2.966 million when on-site costs are excluded and $8.249 when on-site costs are included. These figures increase when time costs valued at 25% and 50% of the wage rate are added to the model.

Gross consumer's surplus estimates were made after incorporating all cost components in the TCM, and aggregate Central Basin figures of $47.073 million, $75.479 million and $114.320 million were obtained using definitions of costs given in Equations 7.1 to 7.3 (see Chapter V). These estimates are considered to be biased upward because on-site money and time costs are endogenous variables and are a source of bias itself, as these costs are under the control of the sample recreationists.

The valuation of time costs are a subject of controversy in the recreational literature. Wilman (1980), Bishop and Heberlein (1980) and Cesario (1976) are some of the economists who have argued for the inclusion of time costs in the TCM. Based on the theoretical arguments given earlier, it was decided that inclusion of time costs would be preferable to ignoring them. The models using time costs valued at 25% of the wage rate seem to give better results in terms of explained variances. Using travel money and time costs valued at 25%, the aggregate value of the Central Basin fishing and boating can be estimated as $18.837 million for 1982.

Another important finding of this study is that the Central Basin fishery is a very localized one compared to the Western Basin, where anglers travelled a mean one-way distance of 86.3 miles (Winslow, 1982, Chapter III), while the average distance travelled by the Central Basin recreationist is only 16.5 miles. Winslow also reported that the mean trip length, in her sample, was 1.8 days while 96.07% of the sample members in this study made one day trips and the average trip length was 1.13 days. In 1982, the boat angler hours in the Central Basin were 2.1 million compared to the Western Basin total of 11.5 million.

From the feedback obtained from the sample recreationists (see Chapter III) it seems that there is a need to expand the present facilities like artificial reefs, marines, and launching sites in the Central Basin.

Implications

The own price elasticities derived from the demand function estimates for the four Central Basin sites imply that the demand for a recreational boating/fishing trip to the Central Basin is highly inelastic; the only exception is Ashtabula. The recreationist if faced with higher prices of boat fuel, fishing equipment and bait, increase in launching/docking fees, etc. would not reduce the number of trips to the Central Basin in proportion to the price increase.

Another implication which arises from the data analysis is that values of net consumer's surplus obtained on a per day basis for each Central Basin site can be aggregated using the total boat anglers hours in the Central Basin during 1982, to provide an estimate of the expenditures which can be made to develop the Central Basin facilities. The model which provided the "best" estimate of the Central Basin sport fishing and recreational boating was used to calculate the aggregate net consumer's surplus which is estimated to be $1.640 million. This estimate represents the maximum expenditures which the Ohio Department of Natural Resources could incur in developing/expanding facilities in the Central Basin.

Limitations of the Study

This study was based on data obtained through a questionnaire mailed to the sample members at the end of 1982, asking for information about their fishing/boating activities during 1982. The accuracy of using the TCM lies in correct specification of the dependent variable, which in this case was the number of visits made to a site in the Central Basin. So, the data relied on how much sample members could recall about their trips to the Central Basin. Since only a few persons stated their difficulties in remembering with accuracy, this may not have been much of a problem.

Secondly, it was not possible to choose the correct values of time costs, as there are no specifications in the literature. Wilman (1980) and Bishop and Heberlein (1980) have argued that travel time should be valued between one-quarter and one-half the wage rate while Cesario (1976) recommended the use of travel time valued at 25% and 50% of the wage rate. But all these valuations have been based on studies of travel time of commuters and not recreationists. Travel time and on-site time were valued at 25% and 50% of the wage rate in this study, but which of them is the correct valuation still remains inconclusive.

Next, it was not possible to use on-site money costs and on-site time costs in the models which estimate demand for each of the four sites as it was not possible to allocate the aggregated information, available for the entire Central Basin, between each of the four sites.

Lastly, information on recreational boating hours in the Central Basin was not available so the total willingness to pay calculated on the basis of the Central Basin boat angler hours is an underestimation.

Recommendations for Research

One of the ambiguities which remains in this study is the correct valuation of time costs. The use of on-site time and money costs are not widespread in the literature, so both issues need to be resolved. Another issue is the use of on-site costs in addition to travel costs as surrogate prices in the TCM. Because it is difficult to control variations in costs across the sample respondents on-site costs have to be standardized across the sample and an appropriate method of doing that must be found.

APPENDIX A

INSTRUMENTS FOR DATA COLLECTION

OSU

The Ohio State University

Department of
Agricultural Economics
and Rural Sociology

2120 Fyffe Road
Columbus, Ohio 43210

Phone 614 422-7911

December 10, 1982

Dear Lake Erie Anglers and Boaters:

Last summer, we asked you to take part in a survey of recreational boating and fishing in the Central Basin during 1982. Now that the season has ended, we have prepared the questionnaire that is attached to this letter. We ask you to take a few minutes to fill it out.

The purpose of this survey is to estimate the economic value of the Lake Erie water resource. Accordingly, please answer all questions as accurately as possible. All survey responses are strictly confidential.

Except for part of question two, the questions deal only with the boating and fishing you did in the Central Basin of Lake Erie, a map of which is shown on the second page of the questionnaire. We are interested in <u>all</u> Central Basin trips you took during 1982.

The quality and accuracy of our research results depend on your completion of the entire questionnaire and on accurate responses to the survey questions.

Please return the questionnaire as soon as possible. Thank you.

Sincerely,

Leroy J. Hushak
Professor

~~Nilima Dutta~~
Graduate Associate

LJH/ND/km

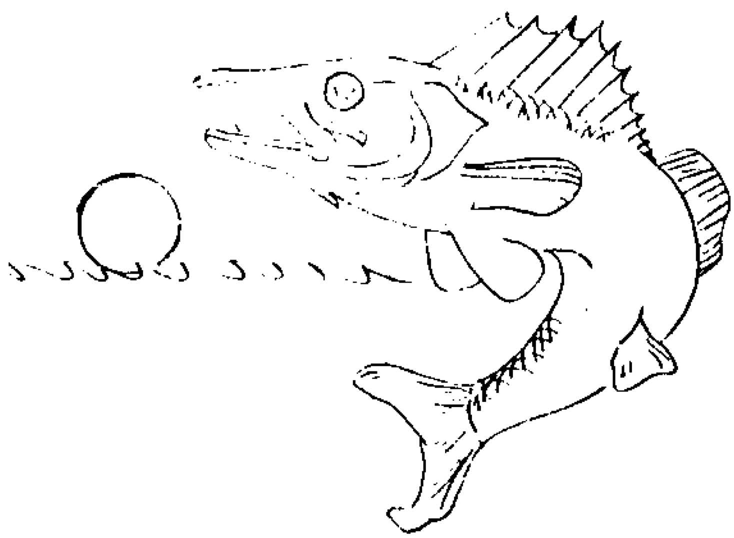
Attachment

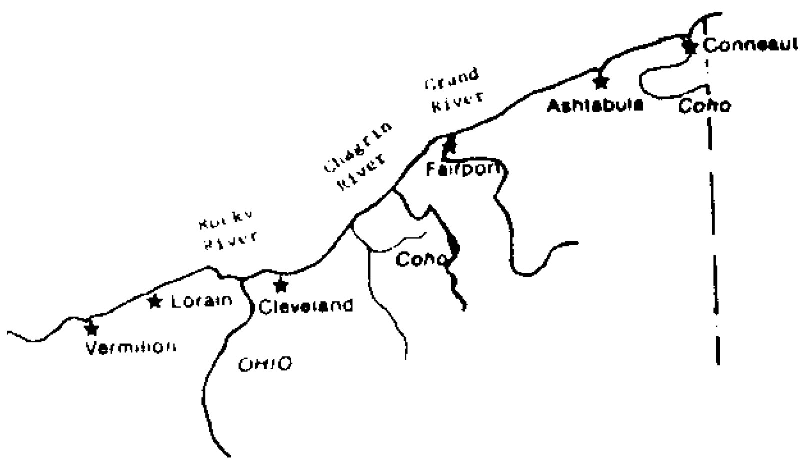
OHIO SEA GRANT
LAKE ERIE SPORT FISHING SURVEY
CENTRAL BASIN, 1982

IT IS IMPORTANT THAT THIS QUESTIONNAIRE BE COMPLETED BY THE PERSON TO WHOM IT IS ADDRESSED.

Please try to answer every question since a single missing answer will decrease the value of all your other answers. Answer what you believe is true for you. The best answer is the one which most closely reflects your own feelings and beliefs or what you actually did.

We realize that you may have boated or fished many times in the Central Basin of Lake Erie during 1982, and thus you may find it difficult to remember exact details about the past season. The details, however, are important. We ask you to take a moment and think back to the times you went boating or fishing this last year and then try to answer the questions as accurately as possible.




Conneaut
Ashtabula
Coho
Grand
River
Chagrin
River
Fairport
River
Coho
Lorain
Cleveland
Vermilion
OHIO

THE OBJECTIVE OF THIS STUDY IS TO ESTIMATE THE ECONOMIC VALUE OF RECREATIONAL BOATING AND/OR PRIVATE BOAT SPORT FISHING IN THE CENTRAL BASIN OF LAKE ERIE DURING 1982. PLEASE RESPOND TO ALL QUESTIONS. WHEREVER EXACT FIGURES ARE NOT AVAILABLE, PLEASE PROVIDE YOUR BEST ESTIMATES.

1. Do you boat for (CIRCLE ONE)

   Fishing

   Recreational boating

   Both

   If both, what percent of time is spent fishing? ______ %

2. How many recreational or boating trips have you made from your home to each of the following sites during 1982?

Central Basin sites	Number of trips
Conneaut	________
Ashtabula	________
Grand River	________
Chagrin River	________
Wildwood Park	________
East 72nd Street	________
Edgewater Park	________
Rocky River	________
Lorain Harbor	________
Other Central Basin	________
Other sites	
Western Basin of Lake Erie	________
Lake Erie east of Ohio border	________
Other than Lake Erie (Please list top three)	
________	________
________	________
________	________

3. How many trips of different duration did you make to the Central Basin sites? (Please give the number in the blanks below)

   I traveled to a Central Basin site and returned the same day ________

   I was away from home 1 night. ________

   I was away from home 2-3 nights. ________

   I was away from home 4-5 nights. ________

   I was away from home more than 5 nights. ________

4. When you stayed overnight while on a fishing/boating trip, did you normally (CHECK ONE)

_____ Camp
_____ Stay in a hotel or motel
_____ Did not ever stay overnight
_____ Other (Please specify) ____________________

5. When fishing or boating from the Central Basin sites, how many people are normally in your boat (include yourself)?

_____ persons

6. How much did you and your group spend in total, on the following items for boating and/or fishing trips to the designated Central Basin sites during 1982? (Please include what percentage of these expenditures were made within 20 miles of the launching site.)

	Expenditure	%
Gas & oil for land transportation	_____	_____
Gas & oil for boat	_____	_____
Boating supplies	_____	_____
Launching fees & other docking supplies	_____	_____
Repairs on boat	_____	_____
Boat charters	_____	_____
Fishing equipment	_____	_____
Bait	_____	_____
Food & beverages	_____	_____
Overnight lodging	_____	_____
Other (Please specify)	_____	_____

7. Do you personally own the boat that you use for fishing and/or recreational boating?

Yes ________ No ________

If yes, please state the following:

County in which purchased ________________

Length of boat ______ feet.

Date of purchase ________ 19___

Price paid ______________

8. In what type of vehicle do you usually travel during fishing and/or boating trips to the designated Central Basin sites?

Make ____________________

Year ____________________

Highway miles per gallon ___________

9. In what year did you first boat for recreation or fishing from the designated Central Basin sites?

19_____

10. Since you first began going to the Central Basin site(s), how often have you been going? (CHECK ONE)

_____ Every year since I first started

_____ Most years since I first started

_____ Half the years since I first started

_____ Occasionally since I first started (Please give an approximate number) ______________

_____ Very seldom (Please give an approximate number) ______________

11. Of your typical day pursuing Central Basin recreational activities how do you spend your time?

Traveling from and to home	_____ hours
Fishing	_____ hours
Recreational boating	_____ hours
Other recreation (sightseeing, etc.)	_____ hours
Camping	_____ hours
Other	_____ hours

12. Please indicate approximately how many of each type of fish you caught in the Central Basin during 1982 and how many you kept? (Please list additional species caught in Central Basin in 1982)

Species	Number caught	Number kept
Walleye	________	________
Yellow Perch	________	________
Salmon/Trout/Steelhead	________	________
White Bass	________	________
Smallmouth bass	________	________
Sheepshead	________	________
________	________	________
________	________	________
	________	________

13. What do you think are the most important needs for boating/fishing recreation in the Central Basin area? (Check the three most important)

_____ More and/or better launch sites

_____ Better weather information

_____ More boating service & marine fuel facilities

_____ More marinas with permanent dock space

_____ Artificial reefs to attract & concentrate sport fish

_____ Bait & tackle facilities

_____ Shoreline, pier fishing facilities

_____ Additional fishing information (where, when and how)

_____ Other (Please specify) ______________________________

14. Why do you boat and/or fish in the Central Basin area? (Check the two most important)

_____ Close to home

_____ Quality fishing

_____ Easy boat access

_____ Improved water quality

_____ Not crowded

_____ The only place I can catch salmon/trout/steelhead

_____ Other (Please specify) ______________________________

15. In the future, do you intend to use the Central Basin facilities? (CHECK ONE)

More __________? Less __________? About the same __________?

IN THIS SECTION WE WOULD LIKE TO ASK YOU SOME QUESTIONS ABOUT YOUR BACKGROUND WHICH WILL HELP US COMPARE YOUR ANSWERS TO THOSE OF OTHER PEOPLE. ALL OF YOUR ANSWERS ARE STRICTLY CONFIDENTIAL.

1. How old are you? ________ years old

2. Are you ______ male ______ female?

3. Are you currently:

   ______ working full time

   ______ fully retired

   ______ retired, working part time

   ______ presently not employed

   ______ none of the above

4. If you are employed, on the average, how many hours per week do you work?

   ______ hours

5. Please check the response that comes closest to your own individual income before taxes:

Less than $5,000	________	$30,000 - 34,999	________
$ 5,000 - 9,999	________	$35,000 - 39,999	________
$10,000 - 14,999	________	$40,000 - 44,999	________
$15,000 - 19,999	________	$45,000 - 49,999	________
$20,000 - 24,999	________	$50,000 and over	________
$25,000 - 29,999	________		

6. In what city, county, and state do you presently live?

   City: ____________

   County: ____________

   State: ____________

PLEASE RETURN THE QUESTIONNAIRE AT YOUR EARLIEST CONVENIENCE IN THE ENCLOSED, SELF-ADDRESSED, STAMPED ENVELOPE.

THANK YOU AGAIN FOR YOUR HELP AND COOPERATION.

OSU

The Ohio State University

Department of Agricultural Economics and Rural Sociology
2120 Fyffe Road
Columbus, Ohio 43210
Phone 614 422-7911

September 12, 1983

Mr. Gary L. Isbell
Lake Erie Fisheries Unit
P.O. Box 650
Sandusky, OH

Dear Gary:

We our conducting a research project for the Ohio Sea Grant Program which aims at estimating the economic value of sport fishery in the Central Basin of Lake Erie. If you have it, I would appreciate your sending me the following information:

1. Number of boat angler hours expended by sport fishermen in the Central Basin during each of the years 1978-1982. If you do not have boat anglers separated out, then send total.

2. Number and species of sport fish harvested in the Central Basin during 1979 and 1980.

Sincerely,

Leroy J. Hushak
Professor

LJH:km

ODNR

OHIO DEPARTMENT OF NATURAL RESOURCES

September 26, 1983

Leroy J. Hushak, Professor
2120 Fyffe Road
Columbus, OH 43210

Dear Leroy:

I am in receipt of your September 12, 1983 letter to Gary Isbell requesting information on the central basin sport fishery for your estimations of economic values.

We have sport angler data on the central basin of Lake Erie for the years of 1975 to 1977, and 1980 to 1983. Following is the information available that you requested:

CENTRAL BASIN BOAT ANGLER HOURS

1980	1.9 million
1981	1.6 million
1982	2.1 million

CENTRAL BASIN SPORT HARVEST OF MAJOR SPECIES - 1980

Species	Number
Yellow Perch	1,329,953
White Bass	499,714
Walleye	73,270
Smallmouth Bass	23,981
Channel Catfish	14,829
Freshwater Drum	209,782

If we may be of any further assistance, please advise.

Sincerely,

Carl

Carl T. Baker
Wildlife Supervisor
Lake Erie Fisheries Unit
P.O. Box 650
Sandusky, OH 44870

CTB/sjc

cc: Gary Isbell

Richard F. Celeste, Governor · Lt. Gov. Myrl H. Shoemaker, Director

APPENDIX B

CORRELATION MATRICES

Table B1. Correlation Matrix for Lorain Harbour

	C_1	C_2	C_3	C_4	C_5
			Travel time cost = 0		
C_1	1.000	.653	.392	.406	.677
C_2		1.000	.881	.831	.290
C_3			1.000	.974	.189
C_4				1.000	.324
C_5					1.000
			Travel time cost = 25% of the wage rate		
C_1	1.000	.763	.574	.560	.755
C_2		1.000	.907	.849	.395
C_3			1.000	.976	.305
C_4				1.000	.398
C_5					1.000
			Travel time cost = 50% of the wage rate		
C_1	1.000	.792	.640	.618	.752
C_2		1.000	.915	.844	.443
C_3			1.000	.974	.430
C_4				1.000	.536
C_5					1.000

Table B2. Correlation Matrix for Cleveland

	C_2	C_1	C_3	C_4	C_5
			Travel time cost = 0		
C_2	1.000	.878	.043	.123	.748
C_1		1.000	.108	.165	.944
C_3			1.000	.804	.020
C_4				1.000	.397
C_5					1.000
			Travel time cost = 25% of the wage rate		
C_2	1.000	.860	.022	.034	.717
C_1		1.000	-.170	.029	.937
C_3			1.000	.827	-.042
C_4				1.000	.273
C_5					1.000
			Travel time cost = 50% of the wage rate		
C_2	1.000	.859	.032	.077	.718
C_1		1.000	-.138	.100	.937
C_3			1.000	.824	.006
C_4				1.000	.351
C_5					1.000

Table B3. Correlation Matrix for Grand River

	C_3	C_4	C_5	C_1	C_2
			Travel time cost = 0		
C_3	1.000	.593	.170	.028	.020
C_4		1.000	.547	.324	.127
C_5			1.000	.963	.839
C_1				1.000	.938
C_2					1.000
			Travel time cost = 25% of the wage rate		
C_3	1.000	.609	.122	-.037	-.059
C_4		1.000	.392	.112	-.120
C_5			1.000	.947	.787
C_1				1.000	.928
C_2					1.000
			Travel time cost = 50% of the wage rate		
C_3	1.000	.629	.174	.016	-.033
C_4		1.000	.473	.212	-.036
C_5			1.000	.951	.795
C_1				1.000	.931
C_2					1.000

Table B4. Correlation Matrix for Ashtabula/Conneaut

	C_4	C_5	C_1	C_2	C_3
			Travel time cost = 0		
C_4	1.000	.210	.133	.122	.421
C_5		1.000	.980	.921	.517
C_1			1.000	.960	.582
C_2				1.000	.700
C_3					1.000
			Travel time cost = 25% of the wage rate		
C_4	1.000	.188	.076	.111	.558
C_5		1.000	.969	.894	.530
C_1			1.000	.944	.559
C_2				1.000	.690
C_3					1.000
			Travel time cost = 50% of the wage rate		
C_4	1.000	.323	.196	.226	.635
C_5		1.000	.968	.900	.603
C_1			1.000	.948	.609
C_2				1.000	.723
C_3					1.000

APPENDIX C

Definitions of On-Site Money and Time Costs

1. On-site money cost per person per trip $= \sum \frac{\text{Mean expenditures}}{\text{Nupers} \times \text{NTS}}$

2. On-site money cost per person per day $= \frac{\text{On-site money cost per person/trip}}{1.13}$

where Expenditure is the sum of money spent at the recreational site on each of the following items: gas and oil for the boat, boating supplies, launching/docking fees, boat charters, fishing equipment, bait, food and beverages, overnight lodging, miscellaneous items.

Nupers is the number of persons in the recreational group.

NTS is the total number of trips made to the Central Basin sites.

1.13 is the average length of the trip in days.

3. On-site time cost $=$ (.25 or .5) Mean WCS $\times \frac{\text{Mean on-site time}}{\text{Mean trip time}}$

where mean on-site time = 8.3 hours

mean trip time = 9.6 hours

WCS is as defined in Chapter V, page 94 and .25 and .5 are proportions of the wage rate.

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