Demand for Selected Recreational Activities in South Central Oklahoma

John G. McNeely, Jr.

Daniel D. Badger

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Preface

Sincere appreciation is expressed to the city officials from Duncan, Oklahoma, members of the Lakes Staff, and the concession operators. Without the encouragement and assistance from Mayor Nolen Fuqua; Lakes Manager Raymond Beck and his family; City Clerk Theron Capp; and, Robert Brown of The Soil Conservation Service, the data for this study would not have been forthcoming.

We are also indebted to the many recreationists who returned mail questionnaires and to the cabin owners who cooperated in the personal interviews.

This study was done under Oklahoma Station project 1267, "The Demand for Recreation in the Wildhorse Creek Watershed."

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John G. McNeely Jr. and Daniel D. Badger
Department of Agricultural Economics

Outdoor recreational activities have recently been a major source of concern. In addition to the problem of inadequate facilities for recreational needs of the American public, there is the problem of a lack of knowledge by those providing recreational facilities concerning costs and returns. Money cannot be invested wisely to provide recreation facilities without some knowledge of economic benefits to be gained.

Research reported herein was made to estimate the demand for selected water-based recreational activities in Stephens County, Oklahoma. Specific objectives were:

1. To apply and test alternative economic models and methodological procedures applicable to recreation demand analysis.
2. To estimate demand for selected recreational activities from which projections can be made as to the number of visitors using the facilities in the Wildhorse Creek Watershed.

The study area included four lakes owned by the City of Duncan, Oklahoma (Figure 1). The four lakes are a part of the Wildhorse Creek Watershed. Two of the lakes (Humphrey and Fuqua) were constructed as part of the Washita River Watershed project which was authorized under the Flood Control Act of 1944. Lake Duncan was built during the 1930's as a federal government work project. Clear Creek lake was built by the City of Duncan in 1953.

Three of the lakes, Clear Creek with 560 surface acres, Humphrey with 882 surface acres and Duncan with 400 surface acres, were completed and in use for recreational purposes before this study began. The dam for Lake Fuqua (1,500 surface acres) had just been completed at the outset of this study. The lake was opened for recreational use in January, 1967, after this study was essentially completed. Lake Humphrey and Lake Fuqua were constructed primarily for flood prevention with the city paying the cost of raising the height of the dam to provide additional water for municipal storage and recreational uses.

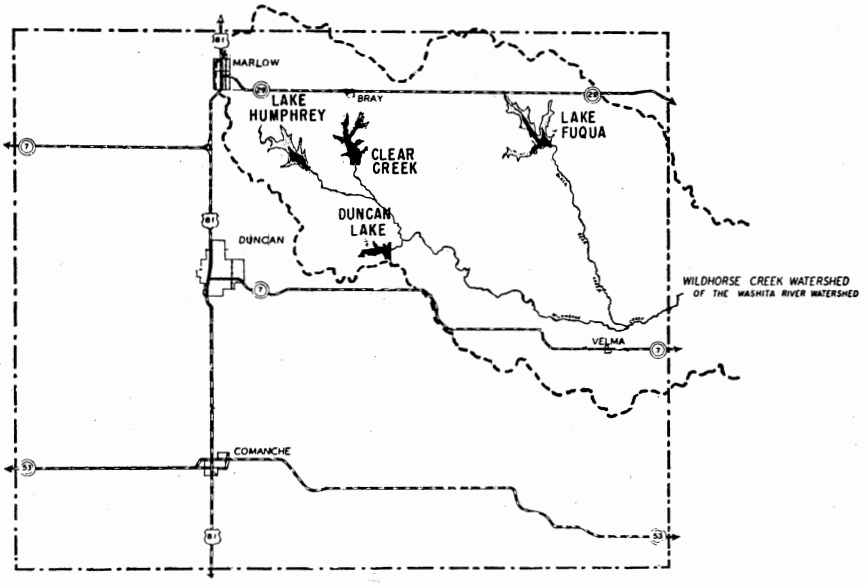

Figure 1. Location of Four City Owned Lakes in the Wildhorse Creek Watershed, City of Duncan, Stephens County, Oklahoma.

Activities at the lakes include fishing, boating, water skiing, hunting, camping and picnicking. Fees are charged only for fishing, boating, water skiing and hunting. Lake lots are available for lease with the stipulation that the lessee shall construct a cabin of certain standards.

Procedure

The following sections are devoted to developing procedures and presenting data for the estimation of demand schedules. After the demand curves were obtained, some of the methods for deriving benefits from these curves were tested. Finally, these estimates of benefits were compared to determine which method provided the most logical and consistent values.

Data Collection Pocedures

The demand analysis for selected recreational activities of the municipal reservoirs required several types of empirical data. The types of data collected and the procedures used in the collection process are discussed below.

Lake Attendance Data

The total paid attendance at the lakes by months for each recreation activity was obtained for the years 1955 through 1964. The town of residence (address) of the purchaser of the permit was obtained in 1965. The distance traveled for each recreationist was determined from their home address and then a sample of recreationists were chosen for the mail questionnaire phase of the study. Socio-economic characteristics such as income, age, occupation, vacation time, work week, education, and marital status were tabulated to determine their effects on recreation participation.

A mail questionnaire was used to collect the above types of information. The questionnaire was sent to a random sample of all recreationists using the facilities during a specific period.

Lake personnel indicated that a small proportion of the users of the lakes came from distances further than 75 miles. A 100 percent sample of these recreationists was taken. This was in addition to the 20 percent sample taken from the permit books, e.g., every fifth permit was selected plus any of the remaining 80 percent that were purchased by a recreationist residing more than 75 miles from the lakes.

Concentric circles were drawn from the center of the recreation complex to permit an orderly grouping of the data concerning the distance traveled by the recreationists (Figure 2). These circles involved the following travel or distance zones:

Zone 1	0-24 miles
Zone 2	25-49 miles
Zone 3	50-74 miles
Zone 4	75-99 miles
Zone 5	100-149 miles
Zone 6	150-200 miles
Zone 7	200 miles and over

The distance zones were determined by air mileage to simplify the analysis. Data were also collected by personal interviews with cabin owners at the lakes. Cabin costs, maintenance and usage were included in the information obtained.

Questionnaire

The expenditures reported for various activities were separated into three catagories: fixed investments, annual costs, and daily costs.

The expenses or costs which were considered fixed were the investments in recreation equipment that recreationists owned. The equipment investments were converted to annual fixed costs by using a rate

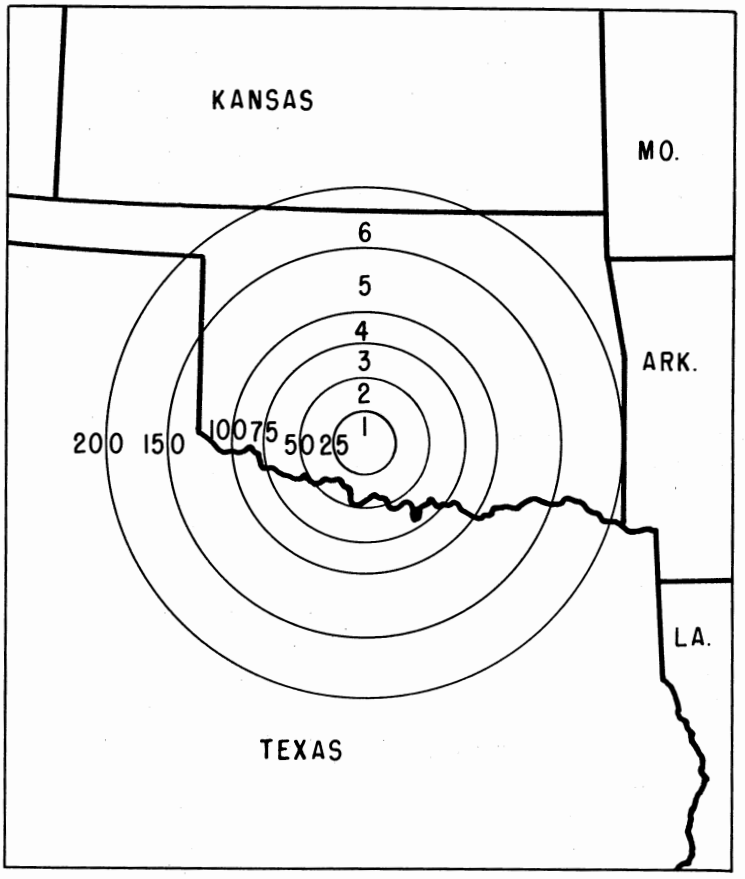

Figure 2. Concentric Travel Zones Around the Duncan Recreation Complex.

of depreciation typical for each of the various types of equipment. The next step was to determine the number of user days the equipment was used during the year, as obtained from the questionnaire. Then, by dividing the annual fixed costs by the user days, the fixed costs per day were determined. The total daily fixed costs for a given recreation activity were determined by aggregating all the various daily fixed costs.

Annual costs differ from fixed costs in that the recreationist has a choice at the beginning of each year as to whether or not he will incur the expense. These expenses would not be incurred if the recreationist decided to forego the activity for a particular year. Examples of annual

costs are hunting and fishing licenses, boat insurance, and annual user-fees.

The annual costs were also converted to a cost-per-user day basis. Since the emphasis of this study was on the Duncan Lake complex, only the annual user-fees incurred at this complex were considered. The total number of user days of the recreation activity consumed during the year at the Duncan complex was divided into the annual user fee to determine the fee cost per day. After completing the conversion of each annual expense into a per-user-day cost, all the costs that were incurred for each activity were combined to provide the annual cost per user day.

The daily expenses were generally in a per user day form but there were several exceptions. For example, the travel costs for a group of persons using a single vehicle had to be divided by the number of persons in the group to determine the cost per user day. A daily water skiing or boating permit would be treated in a similar fashion. After all daily expenses were converted to costs per user day, the various types of costs applicable to each activity were combined as they were for the fixed and annual costs.

The final step was to add the fixed, annual, and daily costs incurred for each activity to determine the total costs of a user day of that activity. This variable was used in subsequent analyses as the price.

Yearly Per Capita Recreation Attendance

Estimation of the yearly per capita recreation attendance at the Duncan Lake complex involved: (1) determining the number of each type of recreation permit sold to residents in each of the seven distance zones; (2) estimating the number of user days that each of the various season permits were used so that the total number of user days of each activity could be determined; (3) estimating the population in each of the distance zones; and (4) calculating the yearly per capita user days for the various recreation activities for each of the seven distance zones, using the results of the first three steps. The procedure used in step 1 to determine the number of the various types of permits sold by residence zone was explained in the preceding section concerning lake attendance data.

In step 2, the fact that several of the permits were sold on an annual basis necessitated the determination of the average number of user days that each of these types of permits was used. The five types of season permits sold were: (1) family fishing; (2) single fishing; (3) water skiing; (4) fishing boat; and (5) fishing barges. An arithmetic mean

was used to determine the average number of times each permit was used. Once these means were determined, they were used to compute the total number of user days of each activity for recreationists from each of the respective distance zones.

The yearly per capita attendance for the respective travel zones required estimating the population within each of these zones. This information was obtained from U.S. Bureau of the Census population statistics. Township rather than county data were used. If a township was totally included in a travel zone except for a town, then the township population minus the town population was included in that zone's population. Any township with over half of its area in a travel zone had its total population included in the zone's total.

The fourth and final step for determining the yearly per capita attendance was to divide each travel zone's user day totals by the population with the zone. This was done for each of the recreation activities offered at the Duncan Lakes complex. An example of this procedure is:

$$\text{Per Capita User Days Fishing in Travel Zone I for a Specific Year} = \frac{\text{Total User Days Fishing for Recreationists from Zone I}}{\text{Population in Zone I}}$$

Estimation of Demand

The cost of a user day of a recreational activity was used as the measure of the price variable and the number of user days of the activity taken during the year was used as the quantity variable.

Each recreationist that participated in a given activity would represent an observation (a point) on a two-dimensional graph. The y-axis would represent the price per user day and the x-axis the number of user days participated in during the year. Then by regression techniques, the demand curve was determined. This curve would represent an average individual demand curve since it was determined from actual price and quantity data for a large number of persons.

Since the demand curves obtained for each activity represent the demand of an average individual, these curves must be aggregated for all the individuals recreating at the lakes to determine the market demand curve for that activity. This was accomplished by determining the number of people who participated in each activity at the lakes during the year.

It was necessary to determine the average number of daily permits for an activity that a person would purchase during the year. Data from

the questionnaires were used to obtain these averages. By dividing the total number of daily permits sold for a given activity by the average number sold to an individual, the number of persons who participated in the activity on a daily basis could be determined. The number of season permits sold for an activity is a direct determination of the number of the persons participating in the activity. Adding the number of individuals purchasing daily permits to the number purchasing season permits provides an estimate of the total number participating in the activity during the year. Finally, the individual demand curves were added horizontally to determine the market demand curve for the activity.

Analysis of Data

Lake Attendance Data

Over the 1955-1965 period the fees charged for the various activities changed. The recreation activities available at the Duncan Lake complex and the fees charged for the years 1955-1965 are presented in Table I. A dashed line indicates that the activity was not available during a particular year. Summaries of the numbers of permits sold and the total fee revenue received for each activity during these years are presented in Tables II and III, respectively. Duncan Lake and Clear Creek Lake were the only lakes in the Duncan Recreational complex in 1955. Lake Humphrey was opened to the public for recreational purposes in June, 1959.

Water skiing was first allowed in 1956, but only on Duncan Lake. In 1959, when Lake Humphrey was opened, Clear Creek Lake also was opened for water skiing. From 1960 on, water skiing permits were sold for both Clear Creek and Duncan Lakes.

Certain changes may be noted in the fees charged for various activities. These changes likely resulted from a combination of: (1) public response to the fees; and (2) changing the fees to find the level that would encourage optimum use of the facilities. Since 1960, the fees remained essentially the same with only some categories of season fishing boat permits eliminated.

The summary of fee revenue totals by year for each of the four general types of recreational activities for which permits were sold indicates that the attendance at the lakes has not been constant (Table II). The revenue increased fairly gradually from 1955 to 1958. The total revenue for 1959 was more than double that for 1958. The total income has been decreasing each year since 1959.

Table I—Activities Available and Fees Charged at the Duncan Lakes Recreation Complex, 1955-1965

	1955	1956	1957	1958	1959	1960	1961	1962	1963	1964	1965
Fishing Permits											
All Lakes Family Season	----	----	----	----	----	10.00	10.00	10.00	10.00	10.00	10.00
All Lakes Single Season	----	----	----	----	----	7.50	7.50	7.50	7.50	7.50	7.50
All Lakes Daily	----	----	----	----	----	.50	.50	.50	.50	.50	.50
Clear Creek Family Season	7.50	7.50	7.50	7.50	7.50	5.00	5.00	5.00	5.00	5.00	5.00
Clear Creek Single Season	5.00	5.00	5.00	5.00	5.00	3.50	3.50	3.50	3.50	3.50	3.50
Clear Creek Daily	.50	.50	.50	.50	.50	.50	.50	.50	.50	.50	.50
Humphrey Family Season	----	----	----	----	10.00	6.00	6.00	6.00	6.00	6.00	6.00
Humphrey Single Season	----	----	----	----	7.50	4.00	4.00	4.00	4.00	4.00	4.00
Humphrey Daily	----	----	----	----	1.00	.50	.50	.50	.50	.50	.50
Lake Duncan Family Season	3.50	3.50	3.50	3.50	3.50	3.50	3.50	3.50	3.50	3.50	3.50
Lake Duncan Single Season	2.50	2.50	2.50	2.50	2.50	2.50	2.50	2.50	2.50	2.50	2.50
Lake Duncan Daily	.25	.25	.25	.25	.25	.25	.25	.25	.25	.25	.25
Fishing Boat, and Barge Permits											
Season	----	----	----	----	----	3.50	3.50	3.50	3.50	----	----
Daily	----	----	----	----	----	.50	.50	.50	.50	----	----
All Lakes—Season	----	----	----	----	----	6.00	6.00	6.00	6.00	6.00	6.00
Humphrey Season	----	----	----	----	6.00	4.00	4.00	4.00	4.00	----	----
Clear Creek Season	4.00	4.00	4.00	4.00	----	4.00	4.00	4.00	4.00	----	----
Duncan Season	3.00	3.00	3.00	3.00	----	4.00	4.00	4.00	4.00	----	1.00
All Lakes Daily	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Lake Humphrey Barge Permit	----	----	----	----	10.00	8.00	8.00	8.00	8.00	8.00	8.00
Water Skiing Permits											
Clear Creek and Duncan Season	----	----	----	----	----	15.00	15.00	15.00	15.00	15.00	15.00
Clear Creek Season	----	----	----	----	20.00	----	----	----	----	----	----
Lake Duncan Season	----	----	23.00	20.00	15.00	----	----	----	----	----	----
Clear Creek and Duncan Daily	----	----	----	----	----	1.50	1.50	1.50	1.50	1.50	1.50
Clear Creek Daily	----	----	----	----	2.00	----	----	----	----	----	----
Lake Duncan Daily	----	2.00	2.00	2.00	1.50	----	----	----	----	----	----
Hunting Permits											
Duck—Daily	----	----	.50	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Duck—Season	----	----	5.00	.50	.50	.50	.50	.50	.50	.50	.50
Quail—Daily	----	----	1.00	5.00	5.00	----	----	----	----	----	----

Table II — Number of Permits Sold for Activities Available at the Duncan Lakes Recreation Complex, 1955-1965

	1955	1956	1957	1958	1959	1960	1961	1962	1963	1964	1965
Fishing Permits											
All Lakes Family Season	----	----	----	----	----	599	546	457	395	344	239
All Lakes Single Season	----	----	----	----	----	291	262	204	197	203	155
All Lakes Daily	----	----	----	----	----	11,460	9,745	8,643	9,070	7,072	44
Clear Creek Family Season	338	374	308	302	188	43	36	27	48	57	34
Clear Creek Single Season	407	388	346	283	180	41	42	40	72	41	43
Clear Creek Daily	11,650	13,167	12,623	10,320	8,155	3,964	3,289	3,583	4,835	4,060	4,289
Humphrey Family Season	----	----	----	----	856	164	169	147	155	150	142
Humphrey Single Season	----	----	----	----	336	82	115	103	109	122	125
Humphrey Daily	----	----	----	----	7,514	942	793	822	1,229	1,073	6,868
Lake Duncan Family Season	73	72	47	113	----	7	8	8	7	4	3
Lake Duncan Single Season	73	71	24	98	----	6	4	11	8	3	6
Lake Duncan Daily	5,628	5,636	5,364	4,648	3,250	1,524	1,049	1,680	1,801	901	1,055
Fishing Boat and Barge Permits											
Season	----	----	----	----	----	3	1	2	1	----	----
Daily	----	----	----	----	----	36	26	39	62	----	----
All Lakes—Season	----	----	----	----	----	170	152	133	142	283	251
Humphrey Season	----	----	----	----	363	109	91	93	90	----	----
Clear Creek Season	178	189	170	172	----	5	16	14	24	----	----
Duncan Season	24	22	14	25	----	2	----	----	2	----	----
All Lakes Daily	50	112	181	141	817	383	288	307	383	430	363
Lake Humphrey Barge Permit	----	----	----	----	28	51	53	49	53	36	39
Water Skiing Permit											
Clear Creek and Duncan Season	----	----	----	----	----	214	201	199	203	171	168
Clear Creek Season	----	----	----	----	83	----	----	----	----	----	----
Lake Duncan Season	----	----	47	100	28	----	----	----	----	----	----
Clear Creek and Duncan Daily	----	----	----	----	----	1,270	963	1,114	1,348	1,128	1,164
Clear Creek Daily	----	----	----	----	861	----	----	----	----	----	----
Lake Duncan Daily	----	136	860	966	565	----	----	----	----	----	----
Hunting Permits											
Quail—Daily	----	----	150	257	147	134	118	120	189	178	238
Duck—Daily	----	----	151	397	100	----	----	----	----	----	----
Duck—Season	----	----	----	68	32	----	----	----	----	----	----
Senior Citizens	----	----	----	----	----	----	----	----	----	357	187

Table III — Total Recreational Fee Income Received at the Duncan Lakes Recreation Complex, 1955-1965

	1955	1956	1957	1958	1959	1960	1961	1962	1963	1964	1965
Fishing Income	--	--	--	--	--						
All Lakes Family Season	--	--	--	--	--	5,990.00	5,460.00	4,570.00	3,950.00	3,440.00	2,380.00
All Lakes Single Season	--	--	--	--	--	2,182.50	1,965.00	1,530.00	1,477.50	1,522.50	1,162.50
All Lakes Daily	--	--	--	--	--	5,730.00	4,872.50	4,321.50	4,535.00	3,510.50	22.00
Clear Creek Family Season	2,535.00	2,805.00	2,310.00	2,265.00	1,410.00	215.00	180.00	135.00	240.00	285.00	170.00
Clear Creek Single Season	2,035.00	1,940.00	1,730.00	1,415.00	900.00	143.50	147.00	140.00	252.00	143.50	150.50
Clear Creek Daily	5,825.00	6,583.50	6,311.50	5,160.00	4,077.50	1,982.00	1,644.50	1,791.50	2,417.50	2,030.00	2,144.50
Humphrey Family Season	--	--	--	--	8,560.00	984.00	1,014.00	882.00	930.00	900.00	852.00
Humphrey Single Season	--	--	--	--	2,520.00	328.00	460.00	412.00	436.00	488.00	500.00
Humphrey Daily	--	--	--	--	7,514.00	471.00	396.50	411.00	614.50	536.50	3,433.50
Lake Duncan Family Season	255.50	252.00	164.50	395.50	--	24.50	28.00	28.00	24.50	14.00	10.50
Lake Duncan Single Season	182.50	177.50	60.00	245.00	--	15.00	10.00	27.50	20.00	7.50	15.00
Lake Duncan Daily	1,407.00	1,409.00	1,341.00	1,162.00	812.50	381.00	262.25	420.00	450.25	225.25	255.50
Totals	12,240.00	13,167.00	11,917.00	10,642.50	25,794.00	18,446.50	16,439.75	14,668.50	15,347.25	13,102.75	11,096.00
Fishing Boat and Barge Income											
Season	--	--	--	--	--	10.50	3.50	7.00	3.50	--	--
Daily	--	--	--	--	--	18.00	13.00	19.50	31.00	--	--
All Lakes—Season	--	--	--	--	--	1,020.00	912.00	798.00	852.00	1,415.00	1,250.00
Humphrey Season	--	--	--	--	2,178.00	436.00	364.00	372.00	360.00	--	--
Clear Creek Season	712.00	756.00	680.00	688.00	--	20.00	64.00	56.00	96.00	--	--
Duncan Season	72.00	66.00	42.00	75.00	--	8.00	--	--	8.00	--	--
All Lakes Daily	50.00	112.00	181.00	141.00	817.00	383.00	288.00	307.00	383.00	430.00	353.00
Lake Humphrey Barge Permit					280.00	408.00	424.00	392.00	424.00	288.00	312.00
Totals	834.00	934.00	903.00	904.00	3,275.00	2,303.50	2,068.50	1,951.50	2,157.00	2,133.00	1,915.00
Water Skiing Income											
Clear Creek & Duncan Daily	--	--	--	--	1,660.00	--	--	--	--	--	--
Clear Creek Season	--	--	--	--	420.00	--	--	--	--	--	--
Lake Duncan Season	--	--	1,081.00	2,000.00	--	3,210.00	3,015.00	2,940.00	3,045.00	2,565.00	2,430.00
Clear Creek & Duncan Daily	--	--	--	--	--	1,905.00	1,444.50	1,671.00	2,022.00	1,692.00	1,746.00
Clear Creek Daily	--	--	--	--	1,722.00	--	--	--	--	--	--
Lake Duncan Daily	--	272.00	1,720.00	1,449.00	847.50	--	--	--	--	--	--
Totals	--	272.00	2,801.00	3,449.00	4,649.50	5,115.00	4,459.50	4,611.00	5,067.00	4,527.00	4,176.00
Hunting Income											
Quail—Daily	--	--	150.00	257.00	147.00	134.00	118.00	120.00	189.00	178.00	238.00
Duck—Daily	--	--	75.50	198.50	49.00	--	--	--	--	--	--
Duck—Season	--	--	--	340.00	160.00	--	--	--	--	--	--
Totals	--	--	225.50	795.50	356.00	134.00	118.00	120.00	189.00	178.00	283.00
Grand Totals	13,074.00	14,373.00	15,846.50	15,791.00	34,074.50	25,999.00	23,085.75	21,351.00	22,760.75	19,670.75	17,425.00

The grand opening of Lake Humphrey in 1959 was accompanied by a large amount of local advertising that caused permit sales for that year to reach an all time high. This caused crowded conditions at the lakes and sales dropped back in 1960 to a level that was more typical of the demand for recreation at the lakes. The subsequent decrease in fee revenue from 1959 through 1965 resulted from several factors of which the most important was low lake levels. Another factor was decreasing sales of season fishing permits and increasing sales of daily permits. Apparently many purchasers of the annual fishing permits found that they did not use the lakes enough times to justify the purchase of the yearly permit and therefore switched to daily permits. This has in effect resulted in decreased recreational revenue to the city since 1959.

In 1964, the policy of giving a season fishing permit to senior citizens (over 65 years of age) was initiated. These permits are permanent and provide the same privileges to the senior citizen as the $7.50 single season fishing permit. Thus, these permits may represent a loss of revenue equivalent to as much as $2677 in 1964 and $4080 in 1965. This assumes that all permits issued to senior citizens would have been purchased anyway.

The fluctuations in yearly water skiing revenue since 1960 has not been of the magnitude of that for fishing. Low lake levels probably represent the major factor causing the lower income from water skiing.

Activities and Distance Traveled

One of the most important variables affecting attendance at a given recreation site is the distance that recreationists must travel to engage in this pastime. The numbers of each type of recreation permit sold to recreationists from the seven distance zones are presented in Table IV. These travel zones are indicated in Figure 2. These data give the total purchases of each type of permit, and also provide complete information concerning the origin of each recreationist.

A large percentage of the recreationists have residences in Zone 1, the closest travel zone (Table IV). This relationship holds regardless of the type of recreation activity participated in by the recreationists. The percentages for Zone 1 are also higher for season permits for the same activity. This would be expected since local recreationists would be more likely to use the nearby lakes throughout the year than would recreationists located at greater distances.

Zones 2 and 3 have very similar attendance patterns (Table IV). Zone 2 has a slightly higher fishing attendance while Zone 3 has a higher

Table IV — Number and Percentage of Recreationists from each Distance Zone Purchasing Each Type of Recreational Permit, Duncan Lakes Recreation Complex, 1965

	Distance Zones														
	Zone 1		Zone 2		Zone 3		Zone 4		Zone 5		Zone 6		Zone 7		Total
	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	No.
All Lakes Fishing															
Family Season	227	95.0	7	2.9	5	2.1	--	--	--	--	--	--	--	--	239
Single Season	151	97.4	3	1.9	1	.7	--	--	--	--	--	--	--	--	155
Daily Season	37	89.1	-	-	2	.4.5	--	--	--	--	--	--	5	11.4	44
Clear Creek Lake															
Family Season	25	73.5	5	14.7	4	11.8	--	--	--	--	--	--	--	--	34
Single Season	39	90.7	3	7.0	1	2.3	--	--	--	--	--	--	--	--	43
Daily Season	3074	71.7	639	14.9	428	10.0	17	.4	11	.3	19	.4	101	2.3	4289
Lake Humphrey															
Family Season	115	81.0	12	8.4	12	8.4	--	--	--	--	--	--	3	2.1	142
Single Season	105	84.0	8	6.4	8	6.4	--	--	--	--	3	2.4	1	.8	125
Daily Season	4104	59.8	961	14.0	1471	21.4	37	.5	50	.7	30	.4	215	3.1	6868
Lake Duncan															
Family Season	3	100.0	-	-	-	--	--	--	--	--	--	--	--	--	3
Single Season	6	100.0	-	-	-	--	--	--	--	--	--	--	--	--	6
Daily Season	934	88.5	58	5.5	39	3.7	3	.3	10	.9	4	.4	7	.7	1055
Skiing-Clear Creek-Duncan															
Season	158	94.0	6	3.6	4	2.4	--	--	--	--	--	--	--	--	168
Daily	782	67.2	123	10.6	222	19.1	--	--	4	.3	12	1.0	21	1.8	1164
Fishing Boat Permit															
3 Lakes Season	207	82.5	22	8.8	19	7.6	--	--	--	--	--	--	3	1.2	251
3 Lakes Daily	168	46.3	60	16.5	121	33.3	--	--	4	1.1	5	1.4	5	1.4	363
Daily Quail Permit	207	87.0	7	2.9	24	10.1	--	--	--	--	--	--	--	--	238
Lake Humphrey Barge	35	89.7	3	7.7	1	2.6	--	--	--	--	--	--	--	--	39
Senior Citizen	178	95.2	5	2.7	4	2.1	--	--	--	--	--	--	--	--	187

water skiing attendance. These differences are easier to observe when these data are converted to user days as shown in the following section.

The rate of attendance from travel zones 75 miles and further from the lake complex is very low. The fact that Zone 7 has a higher attendance than the next three closer travel zones may seem surprising at first. But, this zone has a much larger population base because it includes the total population of persons residing 200 or more miles from the lake complex.

Annual Use of Season Permits

An arithmetic mean was used to determine the number of times each permit was used. Means were computed for cabin owners, for other recreationists and for both groups combined (Table V). The statistical t' test indicated no difference between the means. Therefore, the pooled means were used in the analysis.

The pooled values in Table V were used to determine the average number of user days for each type of season permit. For both types of season fishing permits the pooled averages represent the number of user days that the respective season permits were used. For the other permits, the number of people using a ski boat, fishing boat, or barge were estimated so that average number of user days of a season permit could be estimated. This was because a ski boat, fishing boat, or barge was usually used by more than one person. The number of user days associated with an occasion of water skiing was 6.315. This was determined by an arithmetic mean of the number of people usually water skiing together. This number (6.315) is applied not only to the number of occasions a water skiing permit is used, but also to daily water skiing permits. The average number of people using a fishing boat is two persons. This was the estimate given by the lake's caretaker. A barge usually accomodates three persons.

By applying these averages to permit sales for 1965, the total number of user days for each type of recreation was estimated for each distance

Table V — Average Number User Days Each Type of Season Permit Is Used by Cabin Owners and other Recreationists, and Pooled Mean

	Fishing Single	Fishing Family	Fishing Boat	Water Skiing	Barge
Cabin Owners	29.750	45.348	30.583	22.429	31.667
Other Recreationists	26.178	41.857	23.723	18.710	20.000
t' value	2.115	2.021	2.037	2.340	2.239
Pooled Mean	27.115	43.431	26.699	19.395	27.000

zone and for the lake complex. The results are presented for (1) fishing, (2) water skiing, and (3) fishing boat and barge use, in Tables VI, VII, and VIII, respectively.

People traveling 24 miles or less made up nearly 84 percent of the total fishing attendance expressed in user days. Over 98 percent of the fishing use was by persons traveling 74 or fewer miles (within two hours driving time). Thus, the geographic area from which the lake draws most of its fishing enthusiasts is fairly small.

For water skiing, nearly 87 percent of attendance was from 24 miles or less. Over 99 percent of the water skiing attendance was from the first three travel zones.

Table VI — User Days of Fishing for Each of the Seven Distance Zones and the Total for the Duncan Lakes Recreation Complex, 1965

Zone of Residence	Type of Fishing Permit	Permits Sold	User Days Per Permit	Total User Days For Each Type Permit	Total User Days Fishing From Zone	Percent of Lake Total
			—Number—			
1	Family Season	370	43.43	16,069.5		
				8,161.6		
	Single Season	301	27.11			
	Daily	8149	1.00	8,149.0		
	Senior Citizens	178	27.11	4,826.5		
					37,206.6	83.8
2	Family Season	24	43.43	1,042.3		
	Single Season	14	27.14	379.6		
	Daily	1658	1.00	1,658.0		
	Senior Citizens	5	27.11	135.6		
					3,215.5	7.2
3	Family Season	21	43.43	912.1		
	Single Season	10	27.11	271.1		
	Daily	1940	1.00	1,940.0		
	Senior Citizens	4	27.11	108.5		
					3,231.7	7.3
4	Family Season	--	43.43	0.0		
	Single Season	--	27.11	0.0		
	Daily	57	1.00	57.0		
					57.0	.1
5	Family Season	--	43.43	0.0		
	Single Season	--	27.11	0.0		
	Daily	71	1.00	71.0		
					71.0	.2
6	Family Season	--	43.43	0.0		
	Single Season	3	27.11	81.3		
	Daily	53	1.00	53.0	134.3	.3
7	Family Season	3	43.43	130.3		
	Single Season	1	27.11	27.1		
	Daily	328	1.00	328.0		
					488.4	1.1
	Total for Lakes				44,401.5	100.0

Table VII — User Days of Water Skiing for each of the Seven Distance Zones and the Total for the Duncan Lakes Recreation Complex, 1965

Distance Zone	Type of Permit	Permits Sold	Occasions Per Permit	User Days Per Occasion	Total User Days For Each Type Permit	Total User Days Skiing From Zone	Percent of Lake Total
			—Number—				—Percent—
1	Season	158	19.39	6.31	19,351.7		
	Daily	782	1.00	6.31	4,938.3		
						24,290.0	86.9
2	Season	6	19.39	6.31	734.9		
	Daily	123	1.00	6.31	776.7		
						1,511.6	5.4
3	Season	4	19.39	6.31	489.9		
	Daily	222	1.00	6.31	1,401.9		
						1,891.8	6.8
4	Season	---	---	---	0.0		
	Daily	---	---	---	0.0		
						0.0	0.0
5	Season	---	---	---	0.0		
	Daily	4	1.00	6.31	25.3		
						25.3	.1
6	Daily	---	---	---	0.0		
	Daily	12	1.00	6.31	75.8		
						75.8	.3
7	Season	---	---	---	0.0		
	Daily	21	1.00	6.31	132.6		
						132.6	.5
Total For Lakes						27,927.0	100.0

Table VIII — User Days Barge and Boat Use for each of the Seven Distance Zones and the Total for the Duncan Lakes Recreation Complex, 1965

Distance Zone	Type of Permit	Permits Sold	Occasions Per Permit	User Days Per Occasion	Total User Days For Each Type Permit	Total User Days From Zone	Percent of Lake Total
				—Numbers—			—Percent—
1	Boat, Season	207	26.7	2	11,053.4		
	Boat, Daily	168	1.0	2	336.0		
	Barge	35	27.0	3	2,835.0		
						14,224.4	82.2
2	Boat, Season	22	26.7	2	1,174.8		
	Boat, Daily	60	1.0	2	120.0		
	Barge	3	27.0	3	243.0		
						1,537.8	8.9
3	Boat, Season	19	26.7	2	1,014.6		
	Boat, Daily	121	1.0	2	242.0		
	Barge	1	27.0	3	81.0		
						1,337.6	7.7
4	Boat, Season	---	---	-	---		
	Boat, Daily	---	---	-	---		
						0.0	0.0
5	Boat, Season	---	---	-	---		
	Boat, Daily	---	1.0	2	8.0		
						8.0	.1
6	Boat, Season	---	---	-	---		
	Boat, Daily	5	1.0	2	10.0		
						10.0	.1
7	Boat, Season	3	26.7	2	160.2		
	Boat, Daily	5	1.0	2	10.0		
						170.2	1.0
Total For Lakes						17,288.0	100.0

The attendance distribution for fishing boats and barge usage was very similar to that for fishing. This was expected since the boat usage was in conjunction with fishing. The percentage of use from the first travel zone was over 82 percent while the percentage from the first three zones together was nearly 99 percent.

The three recreation activities all had a lower use from travel zones 4, 5 and 6 than from zone 7. The population in zone 7 consists of the entire geographic area farther than 200 miles from the Duncan lake complex.

Population in the Travel Zones

Using the 1960 census, population estimates were compiled for each of the first six distance zones. The procedure used for determining these population estimates was discussed earlier. One aspect of the procedure not mentioned, however, was that the proportions of each county's population included in each zone and determined from the 1960 census were applied to 1965 county population estimates. Thus, the population estimates and the empirical data on attendance from the travel zones were for the same year.

The population estimates for 1960 and 1965 for each distance zone are presented in Table IX. Part of Texas is included in five of the zones and part of Arkansas and Kansas are included in Zone 6 (Figure 2). Although the area within each of the distance zones increases as the zones become further removed from the Duncan recreation complex, the populations do not increase accordingly. The population increases for the first three zones, decreases for Zone 4, increases for Zone 5, and decreases for Zone 6. The reason for this fluctuation is that Zones 3 and 5 have major cities within their bondaries while Zone 4 does not. Zone 5 has Dallas and Fort Worth within its boundaries while Zone 6 has Tulsa as its largest city.

User Days of Recreation Activities Per Capita

The data presented in the previous two sections concerning the population and user days of the various recreation activities for each of the distance zones were used to determine user days per capita for these zones. The computations necessary to obtain the per capita consumption for each recreation activity for each zone was determined by dividing the user days of the recreation in each zone by that zone's population.

$$\text{User Days of Recreation Activity Per Person Per Year in Distance Zone} = \frac{\text{User Day of Activity in Zone}}{\text{Population in Zone}}$$

Table IX — Population Estimates for Six Concentric Distance Zones Described About the Duncan Lakes Recreation Complex, 1960 and 1965

Distance Zone	1960[1]					1965				
	Oklahoma	Texas	Kansas	Ark.	Total	Oklahoma[2]	Texas[3]	Kansas[4]	Ark.[4]	Total
Zone 1 (0-24mi.)	55,167	--			55,167	58,213	--			58,213
Zone 2 (25-49 mi.)	197,014	2,442			199,456	211,578	2,284			213,862
Zone 3 (50-74 mi.)	629,360	148,332			777,692	713,405	132,838			846,243
Zone 4 (75-99 mi.)	237,058	57,005			294,063	229,950	58,962			288,912
Zone 5 (100-149 mi.)	411,282	1,733,395			2,144,677	414,803	1,938,623			2,353,426
Zone 6 (150-199 mi.)	706,678	660,936	76,846	6,157	1,450,617	761,203	709,834	76,846	6,157	1,554,040
Totals	2,236,559	2,602,110	76,846	6,157	4,921,672	2,389,152	2,842,541	76,846	6,157	5,314,696

[1] U.S. Department of Commerce, Bureau of the Census, *U.S. Census of Population for 1960.*

[2] James D. Tarver, *Yearly Population Estimates for Oklahoma Counties for 1961-1966,* Unpublished Data obtained from the Department of Sociology, Oklahoma State University.

[3] Population Research Center, *Population Estimates For Texas Counties, April 1, 1965,* Department of Sociology, The University of Texas.

[4] The population estimates for Kansas and Arkansas for 1965 were unavailable and, therefore, the 1960 estimates were used. If the populations within zone six of these two states had been somewhat larger, some projection technique would have been used.

The user days per capita for fishing, water skiing, and boating for each of the seven distance zones are presented in Table X. The population in the Oklahoma portion of the zones was used in addition to the total population in the zones to compute the per capita attendance. Attendance from out-of-state was very small compared to that from in-state, even where the out-of-state portion of population was greater than the Oklahoma portion. Per capita use falls greatly after the high intensity of use in the nearest zone for all recreation activities.

Socio-Economic Characteristics

Income

Income is a major factor affecting participation in recreational activities. The usual use of the income factor is for predicting future attendance for selected types of recreational activities. Family incomes of the recreationists surveyed were compared to family incomes in Oklahoma and in Stephens County. Stephens County incomes were used because the Lakes of Duncan were within its boundaries and the majority of the recreationists visiting the lakes resided within the county.

Table X — Per Capita User Days of Recreation by Activity for Each Distance Zone and the Oklahoma Portion by Zone at the Duncan Lakes Recreation Complex, 1965

Disance Zone	in Zone User Days	Total Population in Zone	Oklahoma Population in Zone	Per Capita User Days in Zone	Per Capita User Days For Oklahoma Portion of Zone
		Fishing			
Zone 1	37,206.6	58,213	58,213	.63914	.63914
Zone 2	3,215.5	213,862	211,578	.01504	.01520
Zone 3	3,231.7	846.243	713,405	.00382	.00453
Zone 4	57.0	288,912	229,950	.00020	.00025
Zone 5	71.0	2,353,426	414,803	.00003	.00017
Zone 6	134.3	1,554,040	761,203	.00009	.00018
Zone 7	485.4				
		Water Skiing			
Zone 1	24,290.0	58,213	58,213	.41726	.41726
Zone 2	1,511.6	213,862	211,578	.00707	.00714
Zone 3	1,891.8	846,243	713,405	.00223	.00265
Zone 4	0.0	288,912	229,950	.00000	.00000
Zone 5	25.3	2,353,426	414,803	.00001	.00006
Zone 6	75.8	1,554,040	761,203	.00005	.00010
Zone 7	132.6				
		Boating			
Zone 1	14,244.4	58,213	58,213	.24435	.24435
Zone 2	1,527.8	213,862	211,578	.00719	.00727
Zone 3	1,337.6	846,243	713,405	.00158	.00187
Zone 4	0.0	288,912	229,950	.00000	.00000
Zone 5	8.0	2,353,426	414,803	.00000	.00002
Zone 6	10.0	1,554,040	761,203	.00001	.00001
Zone 7	170.2				

Income distribution of the families surveyed are presented in Table XI. The percentage distributions of family incomes for the state of Oklahoma and for Stephens County are also presented in this table. People with higher family incomes tend to visit the Duncan lake complex more than those with lower incomes. Almost 72 percent of those surveyed had a family income of $5,000 or more. This compares with 37 percent of the family income above $5,000 for the state and 50 percent for Stephens County.

In this study, people with lower incomes tended to fish and hunt more and water ski less than people with higher incomes (Table XII). Those in the highest income group evidently did not come just to water ski. Some obviously did water ski, but also fished as well (Table XII).

Table XI — Percentage Distributions of Family Incomes of Those Surveyed for this Study Compared with Data for the State of Oklahoma and for Stephens County

Income	The Study	Oklahoma[1]	Stephens County[1]
Dollars		—Percent—	
Under 3,000	12.43	42.10	26.38
3,000-3,999	6.07	10.66	11.38
4,000-4,999	9.54	10.22	11.68
5,000-6,999	24.28	17.33	26.74
7,000-9,999	29.19	11.63	15.58
10,000-14,999	11.56	5.45	5.33
15,000 and over	6.94	2.60	2.91
Total	100.00	100.00	100.00

[1] Bureau of the Census, U.S. Dept. of Commerce, *U.S. Census of Population for Oklahoma, General Social and Economic Characteristics* 1960, pp. 164 and 234.

Table XII — Percentage Distributions of Family Incomes of Recreationists Surveyed by Type of Permit Purchased, Duncan Lakes Recreation Complex, 1965

Income	Fishing	Fishing W/Boat	Type of Permits Purchased: Water Skiing	Water Skiing and Fishing	Quail Hunting
			—Percent—		
Under 3,000	16.44	11.11	7.69	1.69	57.14
3,000-3,999	4.11	7.41	11.54	33.39	28.57
4,000-4,999	12.33	9.26	3.85	5.09	14.29
5,000-6,999	26.03	21.30	19.23	30.51	0.00
7,000-9,999	28.08	26.85	30.77	38.98	0.00
10,000-14,999	8.22	15.74	26.92	6.78	0.00
15,000 and over	4.79	8.33	0.00	13.56	0.00
Total	100.00	100.00	100.00	100.00	100.00

The quail hunters all came from the lower income levels. An explanation for this might be that persons from the higher income levels probably had private areas where they hunted and where the competition was not as keen for birds as on the public land around the lake complex.

Age

Data obtained from the questionnaires concerning age in relation to the outdoor activities provided at the Lakes of Duncan appeared to concur with conclusions reached by other reports (5). The person who responded to the questionnaires in most cases was the head of the family and this was the age reported. Thus, the lower age groups were not reported, although children were included in most cases as members of the recreation party visiting the lakes. The percentage age distributions of those replying to the questionnaires by the category of permits purchased are presented in Table XIII.

People participating in only fishing seem to be fairly evenly distributed in the age groupings above 25 years of age. Those in the lower ages either had their permits purchased for them by their parents or did not have to purchase permits because they were under 16 years of age.

Persons fishing from boats were concentrated in the 35 and older age groups with the 35-50 age group making up the bulk of these users. A similar distribution was found for water skiing except that the participation for the over 50 age group was much smaller. The low participation rates of the lower age groups again was due to the head of the household answering the questionnaire in nearly all cases. Thus, the data for the

Table XIII — Percentage Distributions of the Ages of Recreationists Surveyed by Type of Permit Purchased, Duncan Lakes Recreation Complex, 1965

Age	The Study	Fishing	Fishing W/Boat	Skiing	Skiing and Fishing
			—Percent—		
19 & under	1.73	2.74	.93	0	0
20-24	3.18	3.43	.93	7.69	5.08
25-29	7.81	11.64	3.70	11.54	5.08
30-34	7.23	8.22	3.70	0.00	13.56
35-39	13.87	11.64	12.04	26.92	18.64
40-44	14.16	12.32	11.11	11.54	27.12
45-49	17.34	13.70	21.30	23.08	16.95
50-54	9.54	7.54	12.04	15.38	8.47
55-59	9.25	9.59	12.96	3.85	3.39
60-64	7.80	10.57	9.25	0.00	0.00
65 & over	8.09	8.90	12.04	0.00	1.69
Total	100.00	100.00	100.00	100.00	100.00

25 years and over groups were the most relevant for determining the role age plays in the participation in outdoor recreation activities.

Education

Data obtained from the questionnaires indicated that persons with more education participate more in outdoor recreation activities where fees are charged than those with less education (Table XIV). Approximately 78 percent of those who purchased permits at the lakes had completed high school. However, only about 40 percent of the population of Stephens County and of the white population of the state had finished high school or further schooling.

The educational attainment of recreationists participating in water skiing is higher than that for fishing. (Table XV). Over 90 percent of the water skiers had a high school education or above. Thus, the level of education appears to have a significant effect on the participation in both fishing and water skiing.

The effects of each of the socio-economic variables on participation in the outdoor recreation activities provided at the Duncan lakes complex imply that these characteristics should be considered in recreation planning. If persons with low income levels and low educational attainments do not participate in recreational activities to the same extent as persons with higher incomes and education, planning agencies should take this into consideration in locating and developing facilities.

Recreational facilities could be planned so that they would more nearly suit the population that would use the facilities. This planning would apply to both public and private facilities.

Table XIV — Percentage Distributions of the Education of Recreationists Surveyed for this Study Compared with Data for the State of Oklahoma and for Stephens County

Education Attainment	The Study	Oklahoma[1]	Stephens County[2]
		—Percent—	
7th Grade or Less	2.02	15.11	14.34
7th to 8th Grade	10.12	24.86	23.27
9th to 11th Grade	10.12	18.08	21.96
Completed High School	34.10	23.69	25.55
1 to 3 years of College	28.32	10.08	8.35
4 or more Years of College	15.32	8.18	6.53
Total	100.00	100.00	100.00

[1] Bureau of the Census, U.S. Department of Commerce, *U.S. Census of Population for 1960, Oklahoma General Social and Economic Characteristics,* Table 47, p. 149.

[2] W. Nelson Peach, Richard W. Poole and James D. Tarver, *County Building Block Data for Regional Analysis*: Oklahoma State University Research Foundation, March, 1965, p. 493.

Table XV — Percentage Distributions of the Education of Recreationists Surveyed by Type of Permit Purchased, Duncan Lakes Recreation Complex, 1965

Educational Attainment	Fishing	Fishing W/Boat	Water Skiing	Skiing & Fishing
6th grade or less	2.74	1.85	0	1.69
7th or 8th Grade	13.02	12.04	3.85	0.00
9th or 11th Grade	9.59	12.04	3.85	8.48
Completed High School	30.82	33.33	38.46	40.68
1 to 3 years of College	26.71	26.85	38.46	33.90
4 or more years of College	17.12	13.89	15.38	15.25
Total	100.00	100.00	100.00	100.00

Estimating the Demand for Selected Recreational Activities

The quantity of recreation demanded by an individual will depend upon the price he must pay, his income level, and the prices of alternative recreational pursuits. At a given income level and with prices of alternatives constant, there likely would be a downward sloping schedule of alternative price-quantity combinations consistent with his behavior.

Presumably, participation at a price (cost) may be interpreted as a point on an individual's demand schedule. The delineation of the demand schedule for each participant would require additional evidence. Alternative price-quantity combinations selected when the income level and prices of alternatives were held constant would be required. Opinions of participants as to expected participation at alternative prices could provide estimates, but there would be uncertainty associated with actual decisions matching opinions on probable actions.

The demand schedule for a representative participant could be estimated under certain assumptions concerning the participants. The first assumption concerns tastes and preferences. If it could be assumed that all participants in a recreational activity such as fishing had the same tastes and preferences with respect to this activity, the existence of different prices (or costs) for individual participants would result in a series of alternative price-quantity combinations on the same demand schedule.

The second assumption concerns the level of income. It is obvious that not all participants have the same income. However, participants within a given income level may also have different costs which would

result in a series of alternative price-quantity combinations on a demand schedule for participants with a given income level. A representative demand schedule based on all participants would require the assumption that the average income is about the same for any particular price-quantity combination.

The third assumption concerns the prices of alternatives for the recreational activity. A representative demand schedule based on all participants would require the assumption that the prices of alternatives are about the same for any particular price-quantity combination on the representative demand schedule.

A representative or average individual demand schedule was estimated from the price-quantity combinations for each participant under the assumptions of: (1) homogeneous tastes and preferences of participants; (2) approximately the same income level for each level of participation; (3) approximately the same prices of alternatives for each level of participation; and (4) different cost or supply conditions for participants at the Duncan Lake complex. The price or cost of participation was used as the dependent variable. The number of user days of the recreational activity was used as the independent variable.

The choice of price for the dependent variable and quantity for the independent variable was arbitrary. However, the price or cost variable used in this study involved both fixed and variable elements which resulted in costs which were dependent on the level of participation. The variable costs for an individual participant at a given location were assumed to be the same per user day regardless of the quantity of recreation taken from the Duncan Lake complex during the year. The fixed costs, on the other hand, would be constant in total dollars, but average fixed costs per day would decrease as the number of user days of the recreational activity increased. The influence of the level of participation on average fixed costs and on the average total costs was the most important reason for selecting quantity as the independent variable.

Individual and Market Demand Curves

Individual Demand Curves for Fishing and Water Skiing

The estimated equation for the representative demand schedule for fishing, using cost per user day (P) as the dependent variable and the annual number of user days of fishing (Q) as the independent variable, was:

$$P = 12.757\ Q^{-.37539} \qquad 1.1$$

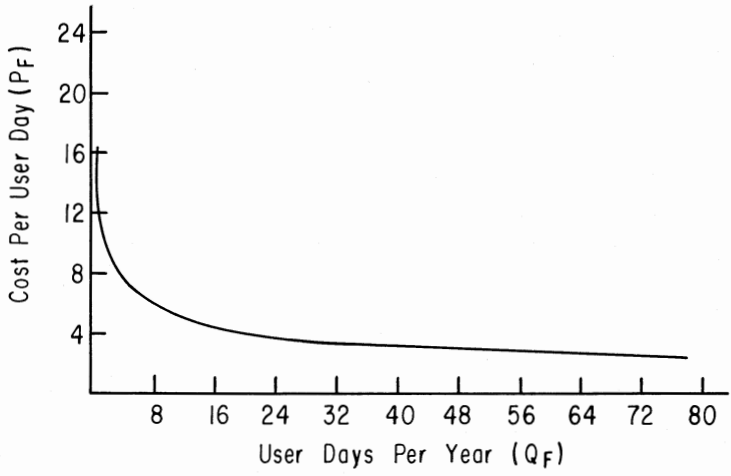

Figure 3. Average Individual Demand Curve for Fishing.

The coefficient of determination (R^2) for equation 1.1 was .3984 and $S = .02628$. The means were $\overline{P} = \$5.04$ per user day and $\overline{Q} = 11.91$ user days participation per year. The equation is presented graphically in Figure 3.

Estimates were also obtained for regression equations using quantity as the dependent variable and price or cost as the independent variables. The equations obtained for each activity are presented in Appendix A.

The representative individual demand curve for water skiing was obtained in the same way as for the fishing activity. The estimated equation using cost per user day as the dependent variable and user days per year as the independent variable was:

$$P = 22.468\ Q^{-.40728} \qquad 1.2$$

The coefficient of determination for the equation was $R^2 = .4486$ and the standard error was $S = .04986$. The means were: $\overline{P} = \$4.80$ and $\overline{Q} = 44.2$. On the average, over six persons use a ski boat during each occasion. Thus, the 44.2 user days of water skiing actually represents approximately 7 occasions per year. Equation 1.3 is presented graphically in Figure 4.

Exponential equations of the form used in the analysis have a constant price flexibility equal to the value of the exponent. Since the inverse of the price flexibility is an estimate of the price elasticity, the form of the equations was changed to reflect the elasticities of demand

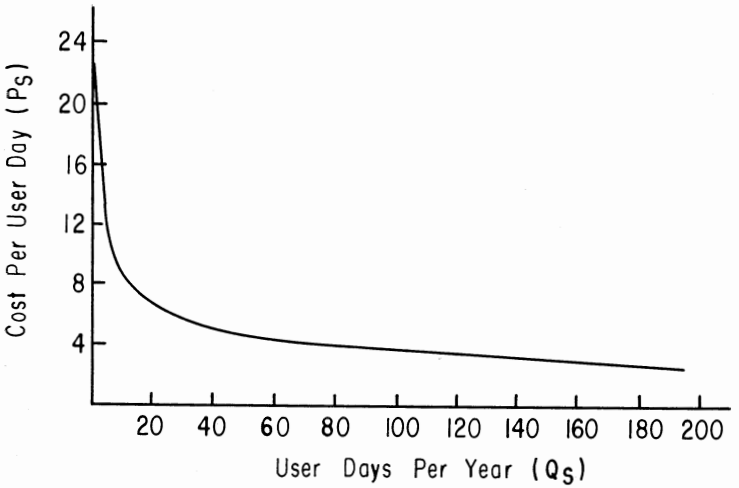

Figure 4. Average Individual Demand Curve for Water Skiing.

with respect to price. Equation 1.3 based on equation 1.1, and equation 1.4 based on equation 1.2 are as follows:

$$Q = 882.25\ P^{-2.6639} \qquad 1.3$$

$$Q = 2082\ P^{-2.4553} \qquad 1.4$$

The estimated elasticity of demand with respect to price for the individual demand curves were —2.6639 for fishing and —2.4553 for water skiing. Both of these estimates are considerably higher than the approximately unitary elasticity estimates obtained for the quantity dependent equations.

Market Demand Curves For Fishing and Water Skiing

The aggregation of individual demand curves into a market demand curve involved estimates of the number of individuals that constituted the market. The present study had an advantage in this respect because the total sales of the various categories of permits was known as a result of the tabluation of the permit receipt books. The market demand curve was estimated by multiplying the respective quantities of each price on the average individual demand curve by the total number of individuals involved in the recreational activity.

The total number of individuals that made up the market for a given activity at the Duncan Lakes complex was determined from the permit sales for that activity. Each season permit represented one individual or group and the individuals associated with these permits

were totaled. The procedure for daily permits was more involved. The estimation of the number of individuals purchasing daily permits required: (1) an estimate of the number of times recreationists from each of the travel zones would, on the average, purchase a daily fishing permit during the year; and (2) total sales of daily permits by zones. Dividing the total sales of daily permits for each travel zone by the average number of times purchased during the year and summing over zones gave an estimate of the number of individuals purchasing daily permits for that activity. The following formula is a summary of this estimation procedure:

$$\text{Number of Individuals in the Market for the Recreational Activity} = \sum_{i=1}^{7} \text{Season Permits}_i + \sum_{i=1}^{7} \frac{\text{Daily Permit Sales}_i}{\text{Mean Number of Permits Purchased by an Individual}_i}$$

Using this technique, the number of individuals participating in the fishing, and water skiing activities was estimated for 1965 and the results are presented in Tables XVI and XVII respectively.

There were 2,493 individuals participating in the fishing activity and 430 individuals participating in water skiing. The expansion of the average individual demand equations for fishing and water skiing (equations 1.2 and 1.3) by the respective number of individuals participating in the activities provided estimates of the market demand equations. The market demand curve for fishing (equation 2.1) and the market demand curve for water skiing (equation 2.2) are as follows:

$$P = 240.25\ Q^{-.37539} \qquad 2.1$$

$$P = 9{,}643.3\ Q^{-.40728} \qquad 2.2$$

Table XVI — Total Number of Different Recreationists Fishing at the Duncan Lakes Recreation Complex, 1965

Residence Zone	Average Number of Daily Permits Purchased	Total Number of Daily Permits Sold	Number of Individuals Purchasing Daily Permits	Total Number of Season Permits Sold	Total Individuals From Zone
1	10.3	8,149	793	671	1,464
2	6.5	1,658	254	38	292
3	3.5	1,940	548	31	579
4	3.5	57	16	--	16
5	3.5	71	20	--	20
6	2.0	53	27	3	30
7	3.7	328	88	4	92
Total			1,746	747	2,493

Table XVII — Total Number Recreationists Water Skiing at the Duncan Lakes Recreation Complex, 1965

Residence Zone	Average Number of Daily Permits Purchased	Total Number of Daily Permits Sold	Number of Individuals Purchasing Daily Permits	Total Number of Season Permits Sold	Total Individuals From Zone
1	6.0	782	130	158	288
2	2.2	123	57	6	63
3	4.0	222	56	4	60
4-7	2.0	37	19	0	19
Total				168	430

Equation 2.1 is presented graphically in Figure 5 and equation 2.2 is presented in Figure 6.

Four points appear on each of the two figures (Figure 5 and 6). These points represent alternative estimates of points on the market demand curve. Each point represents the total number of user days of an activity participated in by recreationists from a particular travel zone and the mean cost per user day as reported in Table XVIII.

The four points lie fairly close to the estimated market demand curve for the fishing activity and with the exception of zones 2 and 3 and the four points are close to the market demand curve for water skiing. The

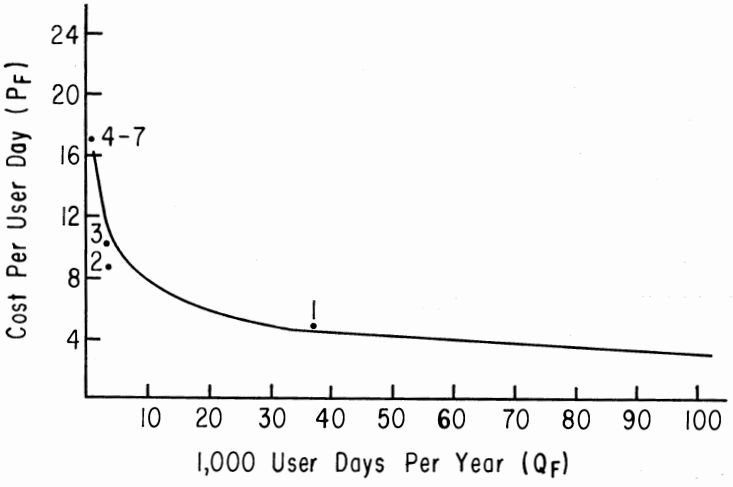

Figure 5. Market Demand Curve for Fishing.

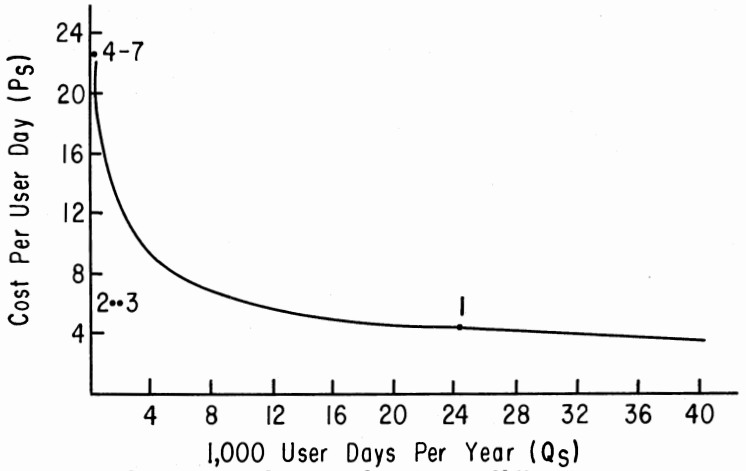

Figure 6. Market Demand Curve for Water Skiing.

Table XVIII — Average Cost Per User Day and Total User Days by Zones, Duncan Lakes Recreation Complex, 1965

Travel Zone	Fishing		Water Skiing	
	Average Cost Per User Day	Number of User Days	Average Cost Per User Day	Number of User Days
	Dollars		Dollars	
1	$4.87	37,207	$4.27	24,290
2	8.71	3,215	5.95	1,512
3	10.43	3,232	6 05	1,892
4-7	17.38	748	22.72	234

fact that these points were determined in a different way supports the judgment that a market demand curve could be estimated from the individual demand schedule approach adopted in this study.

Estimation of Recreation Benefits From Demand Curves

Monopoly Revenue Method

The value of a resource may be determined by the monopoly revenue method. Essentially, this entails finding which level of fees a profit maximizing monopolist would charge for selected recreational activities, given the demand schedule for each of the activities. The fee

or price that would yield the maximum profit to the monopolist would be the measure of value of the resource.

The demand curves obtained for both the fishing and water skiing activities have constant elasticities of demand which are greater than unity. Those results imply that total revenue would always increase as the number of user days of recreation increases. From the standpoint of the city of Duncan, the demand curves may be assumed to be those faced by a monopolist. With this assumption, benefits may be determined which are equal to the total revenue a monopolist would receive if he were the producer of the recreation opportunities at the Duncan lakes complex.

A monopolist with the objective of profit maximization would take into consideration both costs and revenue. In any given year, the costs of providing the recreational facilities are essentially fixed. Construction costs already have been incurred; labor costs are approximately the same regardless of attendance at the lakes; and cleanup and maintenance costs do not increase proportionately with attendance. Therefore, marginal costs would be approximately zero. Assuming sufficient demand in the area to utilize the lakes, the major limiting factor on recreational attendance at the lakes would be the capacity of the lakes. Total revenue would be maximum at this point.

The attendance in 1960 was used as the capacity of the lakes. This year represented the first full year that the three lakes were open to the public, and with the exception of 1959 when Lake Humphrey was opened, was the year of greatest receipts. The permit sales for 1960 were converted to user days in the same manner as the 1965 permit sales. With this procedure the capacities for fishing and water skiing were obtained. The fishing capacity was estimated at approximately 65,000 user days and the water skiing capacity was estimated at approximately 35,000 user days. These capacities were applied to the market demand curves to determine the prices that would be expected at the respective number of user days. The estimates of annual benefits were obtained by multiplying the estimated prices times the capacity number of user days. These estimates are presented in Table XIX.

In addition, for comparison purposes, the benefit evaluation approach currently used by the Soil Conservation Service was applied to the capacity user days of each activity [11, Chap. 9, p. 4]. In this approach a single unit value was assigned to each user day of recreation expected at the lakes. Since, the Soil Conservation Service assigns a single unit value of $1.50 to fully developed facilities such as those provided

Table XIX — Estimation of Recreational Benefits for Fishing and Water Skiing Using the Monopoly Revenue Method and the Single Unit Value Method

Recreation Activity	Capacity Quantity	Method: Monopoly Revenue Price-per-User Day	Method: Monopoly Revenue Benefits	Method[1]: Single Unit Value Unit Value	Method[1]: Single Unit Value Benefits
	(User Days)	—Dollars—		—Dollars—	
Fishing	65,000	3.75	243,802	1.50	97,500
Water Skiing	35,000	3.74	130,970	1.50	52,500
Total Benefits for Both Activities			374,772		150,000

[1] SCS uses interim values to apply equally to all types of recreation. A unit value is assigned to each user day of recreation expected at the recreation facility. A unit value of $1.50 is suggested for fully developed recreation facilities [11, Chap. 9, p. 4].

at the Duncan lakes complex, a value of $1.50 was used. The estimates of benefits by this method are also presented in Table XIX.

The estimates of benefits by the Monopoly Revenue Method were twice as large as those estimated by the Single Unit Value approach. This was expected because the prices used for the Monopoly Revenue Method were more than twice the unit values used.

The major advantages of these two approaches are their simplicity. The Single Unit Value, as used in this section, takes into consideration the quality of the recreational facilities and considers supply limitations such as capacity. However, it does not consider the demand for the recreational facilities which is a major weakness of the approach.

The Monopoly Revenue Method of benefit estimation does consider the supply limitations and does take into account the prices per user day that recreationists have indicated they are willing to pay for that number of user days of the respective activities. But, this method does not take into consideration the differences in the number of user days and prices-per-user day of recreationists from different residence zones. Thus, both of these methods have weaknesses but they are useful as bench marks for comparison with estimates of benefits obtained by other methods.

Consumer's Surplus Methods

Several alternative ways of estimating consumer's surplus from demand curves for the selected outdoor recreational activities were considered. Each of these alternatives rested upon the basic idea that consumer's surplus can be measured by the area under the demand schedule and for the activity.

One major difference in the alternatives depended on whether the "average" individual demand curve was used or whether the aggregate market demand curve was used. Another difference in the alternatives depended on whether a single measure of consumer's surplus was used for all travel zones or whether consumer's surplus was estimated for each zone separately. A third difference was whether the average prices for the respective zones were used in the computation of consumer's surplus or whether estimated prices from the demand schedule corresponding to the estimated user days of recreation for the zones was used.

Consumer's Surplus Estimates from Market Demand Curves

Consumer's surplus was first estimated from the market demand curves using the average costs-per-user day as shown in Table XVIII. The procedure was to estimate the consumer's surplus between the average price paid by recreationists of one distance zone and the average price paid by the recreationists from the next zone. This estimate constitutes the benefits (consumer's surplus) for the closer zone. By determining the benefits for each zone, the total consumer's surplus for a given activity was obtained. In general, the procedure involved converting the market demand equations from the $P = AQ^b$ form to the form $Q = A^{\frac{-1}{b}} P^{\frac{1}{b}}$. Then, the integral of the converted equations was computed as follows:

$$\int_a^{\sim b} A^{\frac{-1}{b}} P^{\frac{1}{b}} \, dP$$

where a = average price-per-user day for the reaction activity for the closer residence zone

and b = average price-per-user day for the recreation activity for the next closer resident zone.

The consumer's surplus for the closer zone was found by determining

$$\frac{bA^{\frac{-1}{b}} \quad P^{\frac{1}{b}} + 1}{1+b} \Bigg|_a^b$$

the area between these two prices. The resulting estimates of consumer's surplus for fishing and water skiing are presented in Table XXI. This method is denoted as Method 1 in the table.

In the previous application of the consumer's surplus principle, the average prices paid by recreationists from the various residence zones were used. An alternative approach was to use the quantities of user

days of a given activity for a given residence zone to determine the price paid per user day based on the market demand curve. The quantities of user days and the resulting prices for fishing and water skiing are presented in Table XX.

There are two assumptions that are required when using the market demand curves to estimate consumer's surplus from several prices as in Methods 1 and 2. The first assumption is that the consumer's surplus estimate obtained between two prices is associated with a price change and not a zone change. The second assumption is that at each price, all the recreationists are assumed to be confronted by it. For example, the average price for zones 4-7 is arbitrarily assumed to be the maximum price. Thus, no consumer's surplus was estimated for it. But, the price for zone 3 is assumed to be faced by all recreationists, and the consumer's surplus associated with this change in price (from the zone 4-7 price to the zone 3 price) represents the addition to consumer's surplus because of the price change. Therefore, these two methods (1 and 2) provide estimates of the addition to consumer's surplus as a result of price changes instead of direct estimates of the consumer's surplus for each zone.

Method 2 resulted in higher estimates of consumer's surplus for both activities than did Method 1. But, the estimates for travel zones 2 and 3 were higher from Method 1 than from Method 2. In cases where the average prices may be available for various distance zones but the number of user days may be unavailable, Method 1 could be used. Method 2 would be used if the number of user days from various distance zones were known and costs-per-user days were not known.

Table XX — User Days and Associated Prices on the Demand Schedules for Fishing and Water Skiing at the Duncan Lakes Recreation Complex, 1965

Residence Zone	Fishing		Water Skiing	
	User Days	Cost Per User Day	User Day	Cost Per User Day
		Dollars		Dollars
1	37,207	3.75	24,290	4.34
2	3,215	11.60	1,512	13.45
3	3,232	11.57	1,892	12.28
4-7	748	20.04	238	28.81

The estimates of consumer's surplus using the prices in Table XX and the same procedure as for Method I are presented in Table XXI as Method 2.

Table XXI — Consumer's Surplus Estimation of Recreational Benefits from Market Demand Curves for Fishing and Water Skiing at the Duncan Lakes Recreation Complex, 1965

Residence Zone	Method 1		Method 2	
	Fishing	Water Skiing	Fishing	Water Skiing
		—Dollars—		
1	58,278	28,435	81,010	58,494
2	9,900	1,099	—79	—1,986
3	15,280	26,992	13,471	11,350
4-7	0	0	0	0
Subtotals	83,458	56,526	94,402	67,858
Total for Both Activities	139,984		162,260	

Consumer's Surplus Estimates from Average Individual Demand Curves

Consumer's surplus estimates were also obtained from the average individual demand curves. The procedure used was somewhat different from that for the benefit estimation from market demand curves. Consumer's surplus was estimated as the area under the demand schedule between the average prices-per-user day for the respective travel zones and the maximum price-per-user day [the weighted price for Zones (4-7) is considered to be the maximum price.] Thus, for each residence zone there was an estimate of consumer's surplus for an average resident from that zone. Multiplying these average individual estimates of consumer's surplus by the number of individuals using the lake complex, the total consumer's surplus for the zone for the activity was obtained (Table XXII, Method 3).

An alternative approach was employed which used the area under the average individual demand curve between the mean price per user day paid by all recreationists engaging in the activity and the maximum price-per-user day. This provides one estimate of consumer's surplus for all recreationists participating in the recreational activity at the lake complex. Multiplying this estimate by the number of individuals at the lake complex provides the total estimate of consumer's surplus for the zones (Table XXII, Method 4).

Method 3 estimates of benefits were smaller than Method 4 estimates for all zones except the first for both recreational activities. Method 3 also had the smallest total benefit estimates for both activities.

Table XXII — Consumer's Surplus Estimates of Recreational Benefits from Average Individual Demand Curves for Fishing and Water Skiing at the Duncan Lakes Recreation Complex, 1965

Zone	Number of Individuals	Method 3		Method 4	
		Individual Consumer's Surplus	Zones Consumer's Surplus	Individual Consumer's Surplus	Zone's Total Consumer's Surplus
		—Dollars—		—Dollars—	
Fishing					
1	1,468	33.47	48,998	31.27	45,770
2	292	9.88	2,888	31.27	9,136
3	579	6.14	3,549	31.27	18,088
4-7	158	0	0	31.27	4,958
Subtotal			55,435		77,947
Water Skiing					
1	288	131.70	37,930	104.55	30,110
2	63	54.45	4,123	104.55	6,587
3	60	62.89	3,773	104.55	6,273
4-7	19	0	0	104.55	1,986
			45,826		45,956
Total for Both Activities			101,261		123,903

Effects of Changes in User Fees On Recreation Attendance and Revenue

The effects of raising or lowering user fees and the resulting attendance were estimated from the demand curves obtained for fishing and water skiing. The user fees are only a small portion of the total costs-per-user day of a receration activity.[1] Thus, an implicit assumption that had to be made was that the recreationist would view the change in the user fee rationally. This implies that he would react in a similar manner to an increase or decrease in the user fee as he would to a change in any of the other costs that were incurred for the day of recreation.

The average costs-per-user day for each of the distance zones for fishing was used as the current price for that zone. The daily user fee for fishing was 50 cents. Persons purchasing season fishing permits may have used their permits enough times to decrease their user day permit costs below this amount. But for this analysis, it was assumed that all fishing permits were of the daily variety. The daily user fees were varied from a 25 cents increase to a 25 cents decrease. The number of user days attendance from each of the travel zones were computed for the

[1] Because of this, even though the demand estimates for both fishing and water skiing are highly price elastic, revenue will increase from an increase in user fees.

new and existing prices, using equation 1.2, where price was the dependent variable. After the quantities associated with the various prices were determined, they were expanded to obtain the market quantities. The results of these computations are presented in Table XXIII.

Applying the total user days estimated to each of the three different user fee levels, the recreational revenue that the City of Duncan would expect at these rates was determined:

1) At the $.25 fishing user fees, the income would be $12,608.
2) At the $.50 fishing user fees, the income would be $22,325.
3) At the $.75 fishing user fees, the income would be $29,907.

It should be apparent that the city would not want to decrease user fees for fishing if it wanted to maintain its current level of receipts from the sale of fishing permits. Decreasing the user fee would decrease income from fishing permit sales. Alternatively the city could increase the fee and increase its income.

A similar analysis was used for water skiing. The average costs-per-user day of water skiing for each of the residence zones were used to represent the current prices. These were also determined from the data obtained from the questionnaire. One slight difference in procedure was needed since slightly over six persons used each ski boat. Thus, by divid-

Table XXIII — Estimated Attendance for Fishing, Utilizing Three Different Levels of Daily Fishing User Fees, Duncan Lakes Recreation Complex, 1965

Travel Zone	Fishing Fee	Cost Per User Day	Average Individual Yearly Attendance	Annual Market Attendance
	—Dollars—		—User Days—	
1	.25	4.62	14.96	37,295
2	.25	8.46	2.99	7,454
3	.25	10.18	1.82	4,537
4-7	.25	17.13	.46	1,147
Total				50,433
1	.50	4.87	13.00	32,409
2	.50	8.71	2.76	6,881
3	.50	10.43	1.71	4,263
4-7	.50	17.38	.44	1,097
Total				44,650
1	.75	5.12	11.38	28,370
2	.75	8.96	2.56	6,382
3	.75	10.68	1.61	4,104
4-7	.75	17.63	.42	1,047
Total				39,903

ing the daily water skiing user fees used by this number of persons, the fee cost per user day was determined. The prices and attendance estimated at user fees of $1.00, $1.50 and $2.00 are presented in Table XXIV.

The City of Duncan would receive the following amounts from the estimated user fees and attendance rates:

1) At $1.00 per day for water skiing (fee cost-per-user day =$.16), income would be $4,316.
2) At $1.50 per day for water skiing (fee cost-per-user day = $.24), income would be $6,258.
3) At $2.00 per day for water skiing (fee cost-per-user day = $.32), income would be $8,068.

Identical conclusions could be drawn for water skiing as that for fishing. A rate increase would increase income from water skiing permit sales to the City even with the reduced attendance.

Although the City may not want to increase the fees for these two activities, it is important that they be aware of the effect of fee changes. If the City wished to increase lake revenue to pay for additional recreational facilities, it could raise the fees as indicated in

Table XXIV — Estimated Attendance for Water Skiing, Utilizing Three Different Levels of Daily Water Skiing User Fees, Duncan Lakes Recreation Complex, 1965

Travel Zone	Daily Water Skiing Fees	Cost Per User Day	Average Individual Yearly Attendance	Annual Market Attendance
	—Dollars—		—User Days—	
1	1.00	4.11	44.44	19,074
2	1.00	5.79	10.47	4,494
3	1.00	5.89	6.70	2,876
4-7	1.00	22.56	1.90	815
Total				27,259
1	1.50	4.27	42.69	18,322
2	1.50	5.95	10.24	4,395
3	1.50	6.05	6.58	2,824
4-7	1.50	22.72	1.88	807
Total				26,348
1	2.00	4.43	41.04	17,614
2	2.00	6.11	10.02	4,300
3	2.00	6.21	6.44	2,764
4-7	2.00	22.88	1.86	798
Total				25,476

Tables XXIII and XXIV. This would increase revenue by $7,582 for fishing, and $1,870 for water skiing, for a total increase of $9,452.

Summary

This study was made to estimate the demand for selected water-based recreational activities at four lakes near Duncan, Oklahoma. Specific objectives were: (1) to apply appropriate economic models and methodological procedures applicable to recreation demand analysis; (2) to assemble primary and secondary data needed to estimate the demand for outdoor recreation; and (3) to estimate the demand for selected recreational activities by persons using the facilities at the Duncan recreational complex.

Over 80 percent of all recreationists using the recreational complex lived within 25 miles of the area, and over 98 percent lived within 75 miles. This implied that most recreationists were not prone to travel more than 75 miles for recreational facilities of this type.

Local recreationists made up the bulk of the total attendance at the lakes. Participation per person per year from Zone 1 (0-24 miles) for the fishing, water skiing and boating activities combined was over 1.3 user days. This compared with .03 and .01 user days per person per year for residents from Zones 2 and 3, respectively (25-49 and 50-74 miles). Per capita participation decreased to essentially zero for zones further than 75 miles from the lakes.

The income levels of recreationists using the Duncan lakes complex were considerably higher than the averages for Oklahoma and for Stephens County. Almost 72 percent of the recreationists surveyed had family incomes of $5,000 or more, while only 37 percent of the families in the state had incomes of this level. Education was another socio-economic characteristic which apparently influenced recreational participation rates. Approximately 78 percent of those who purchased permits at the lakes had completed high school, compared to the state average of 40 percent.

Demand curves were obtained for an "average" individual for fishing and water skiing. It was assumed that the recreationists had homogeneous tastes and preferences, approximately the same level of income for each level of participation, and approximately the same prices for alternative types of recreational activities. Both demand curves exhibited price elasticities of demand that were fairly high. The estimated

elasticities of demand, with respect to price, were —2.7 for fishing, and —2.5 for water skiing.

The number of individuals that constituted the market for each activity was estimated and market demand curves were obtained by horizontal addition of this number of average individual demand curves. The market demand curves had the same elasticities of demand as the individual demand curves.

The Monopoly Revenue Method and Single Unit Value Method could both be rejected on the grounds that they ignore the effects of differences in residences of the recreationists using the recreational facilities.

The consumer's surplus methods of benefit estimation for recreational resources were an improvement over other methods discussed. But, there were certain differences between these methods which resulted in different estimates of consumer's surplus. The first two methods tested obtained etsimates of consumer's surplus from the market demand curves and required several additional assumptions that were not needed for the estimates obtained from individual demand curves. The market demand curve estimates were larger ($140,000 and $162,000 for Methods 1 and 2 respectively, compared to $101,000 and $124,000 for Methods 3 and 4 respectively) and would increase the chances of a proposed project's approval. But, it would seem that the method which required the least number of simplifying assumptions would be the most valid one to use. Thus, the methods using the average individual demand curves to estimate consumer's surplus were considered to be the most appropriate.

Method 3 would be selected over Method 4 because separate estimates of the consumer's surplus for an individual from each residence zone were obtained with it. Method 4 assigns the same estimate of consumer's surplus to all individuals regardless of the zone of residence. Thus, a recreationist from one residence zone would have the identical consumer's surplus as a recreationist from any other zone.

The individual demand curves were also used to estimate differences in attendance resulting from raising and lowering the permit fees for selected activities. Raising the fees resulted in an estimated increase in revenue to the city of $9,392, while lowering them reduced recreational revenue by $11,659.

The large differences in attendance rates by persons from different residence zones indicated that the area of influence of the recreational

resource studied was fairly small. This information, in conjunction with the information concerning the socio-economic characteristics of the recreationists, also should be valuable to planning agencies in estimating expected attendance rates at proposed facilities.

Appendix A

Alternative Estimates of Demand Equations For Fishing and Water Skiing

The equations for the average individual demand curves which used cost per user day (P) as the independent variable and the number of user days participated in during the year (Q) as the dependent variable were obtained in the same way as were equations (1.2) and (1.3) reported in Chapter V. Linear regression techniques were used to fit an exponential equation of the general form $Y = AX^b$ to the price-quantity data. The average individual demand equation for fishing was:

(1) $Q = 66.1377\ P^{-1.0614}$

The coefficient of determination for equation (1) was $R^2 = .3984$ and $S = .0263$. The means were: $\overline{P} = \$5.04$; and $\overline{Q} = 11.91$. The average individual demand equation for water skiing was:

(2) $Q = 248.924^{-1.10158}$

The coefficient of determination for equation (2) was: $R^2 = .4486$ and $S = .0499$. The means were: $\overline{P} = \$4.80$; and $\overline{Q} = 44.2$. The elasticity of demand with respect to price for the individual demand curve for fishing is —1.0614 and for water skiing is —1.1016.

The market demand curves for these two activities were obtained by aggregating the respective average individual demand curves by the number of individuals estimated in Table XVI. The market demand curve for fishing was:

(3) $Q = 164.881\ P^{-1.0614}$

The market demand curve for water skiing was:

(4) $Q = 106{,}838\ P^{-1.10158}$

4-68/2½M