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ECONOMIC VALUE OF LAKE ERIE SPORT FISHING TO PRIVATE-BOAT SPORT ANGLERS

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THE ECONOMIC VALUE OF LAKE ERIE SPORT FISHING TO PRIVATE-BOAT SPORT ANGLERS

Sport fishing on Lake Erie has increased substantially since 1975. The creel census conducted by the Ohio Department of Natural Resources shows that hours by sport anglers increased from 7.5 million in 1975 to 13.6 million in 1982. Since the average angler fishes about 7 hours per day, this translates into an increase from about one million days fished in 1975 to about 1.9 million in 1982. Walleye harvested by sport anglers increased from 113,000 in 1975 to over 3,000,000 in 1982. The yellow perch harvest increased from about 8 million in 1975 to over 12 million in 1982.

Since September 1980, three studies have been undertaken to estimate how private-boat sport anglers value various components of the Lake Erie fishery: (1) western basin for May-August 15, 1981, called the walleye sample; (2) western basin for August 15-November 1981, called the yellow perch sample; and (3) central basin for 1982. Excluded are anglers who hire the services of charter firms and shore anglers. Charter angler hours were less than ten percent of private-boat angler hours in 1981.

Descriptive statistics of each sample are presented in Table 1. For each sample, private-boat anglers were contacted at a launching or docking site and asked if they would be willing to complete the questionnaire for the study. If an angler was agreeable, we obtained his or her name and address and mailed a questionnaire at the end of the fishing period. For the walleye sample, the respondents were asked to report western basin fishing activity for May-August 15, 1981. A total of 648 anglers were contacted, of which 350 returned completed questionnaires (Table 1).

The mean age, income and group size for the three samples are similar. Nearly all respondents are male. The average respondent in the walleye sample travels the greatest mean distance (86 miles), stays the longest (1.8 days) and fishes the longest (7.4 hours per day). The average respondent to the central basin sample makes the most trips (28.4), but the respondents are mainly local residents traveling an average of 16.8 miles to fish at a central basin site. In addition to fishing, central basin respondents were asked to include recreational boating time and expenditures for non-fishing activities. The respondents reported spending 1.7 hours per day in recreational boating in addition to the 5.3 hours per day fishing.

TABLE 1
DESCRIPTIVE STATISTICS BY SAMPLE

	Walleye 1981	Yellow Perch 1981	Central Basin 1982
<u>Sample Characteristics</u>			
Time Period	May-Aug. 15, 1981	Aug. 15 to Nov. 1981	1982
Sample Size	648	550	730
Useable Responses	350	307	443
<u>Demographics</u> (sample means)			
Age (years)	43.6	45.7	44.5
Income (\$)	26,516.0	24,362.0	24,295.0
Group size (no.)	3.1	2.8	3.2
<u>Fishing Effort</u> (sample means)			
Number of Trips	7.9	6.1	28.4
Days per Trip	1.8	1.7	1.1
Hours per Fishing Day	7.4	6.6	5.3
Distance Traveled (miles)	86.3	73.7	16.8
Number of Anglers	67,900.0	31,200.0	21,300.0
<u>Harvest Rates</u> (sample means per person per fishing day)			
Walleye	2.3	0.9	0.02
Yellow Perch	5.3	21.1	2.4
White Bass			0.6

Combining sample data and creel data, we estimate that 67,900 anglers fished during May-August 15, 1981. Given overlap across samples, we estimate that 74,000 to 83,000 private-boat anglers fished in Lake Erie during 1981. The mean harvest per person per day is 2.3 walleye and 5.3 yellow perch in the walleye sample (Table 1).

Research Methodology

The travel cost methodology is used to estimate the value placed on sport fishing by private-boat anglers. The travel cost methodology consists of two steps. First, the travel cost demand curve is estimated. Second, total willingness to pay for Lake Erie sport fishing is derived from the estimated demand curves.

A demand curve shows the relationship between the quantity purchased of a good for some time period and the price of that good, e.g., between ice cream cones purchased per week and the price of ice cream cones. We expect the demand curve to slope downward to the right as shown by line AB in Figure 1. As the price of ice cream cones (P) declines, more cones (Q) will be purchased by each week.

The demand curve for fishing is similar in concept; as the price of fishing trips declines, an angler is expected to make more fishing trips. Unlike ice cream cones, one does not walk into a store and purchase a fishing trip. While fishing equipment is purchased, it is the fishing trip itself that is the appropriate unit of measure for the quantity purchased. The travel cost demand curve methodology obtained its name from the definition of the price of a fishing trip as the costs of traveling to and from the fishing site. In recent work, the costs of fishing are also included as costs of a fishing trip.

Total willingness to pay for sport fishing is derived from the demand curve estimates. Total willingness to pay is the total dollars a sport angler would be willing to spend for Lake Erie fishing rather than go without Lake Erie fishing (in this study for the period and area covered by each sample). Willingness to pay has three components: (1) the costs of traveling to and from the fishing site; (2) the on-site costs of fishing; and, (3) net consumers surplus (Figure 2). In this study, only travel costs are used to determine the price of a fishing trip for estimation of the demand curve. The mean value of on-site costs (a constant) is then added to the price to locate the demand curve at the correct level.

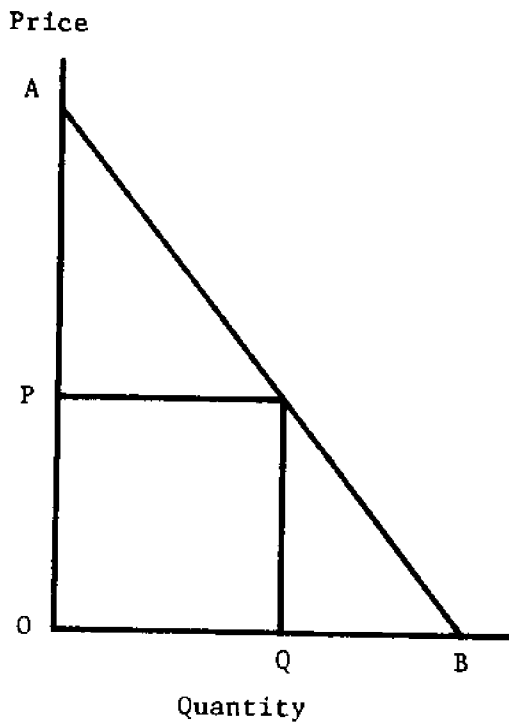


Figure 1. Demand curve

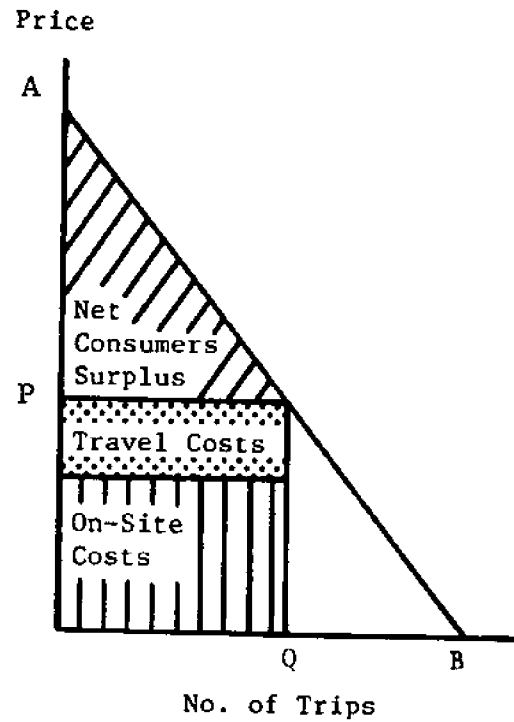


Figure 2. On-site costs, travel costs, and net consumer surplus.

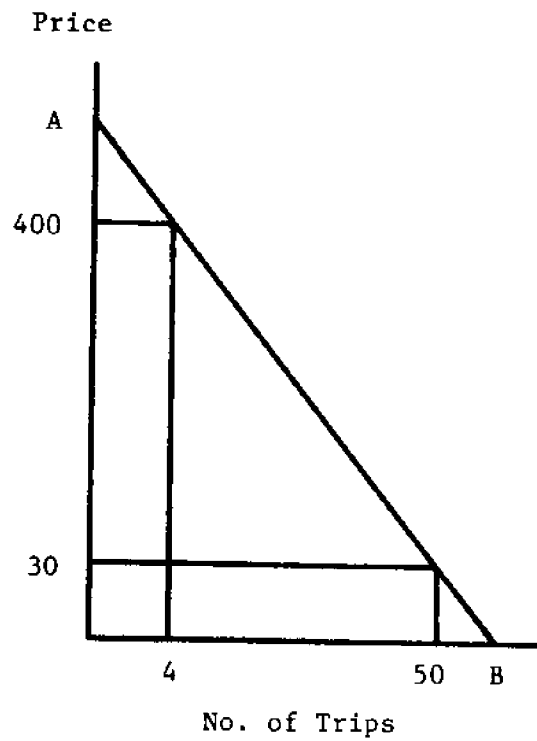


Figure 3. Effect of proximity to Lake Erie on costs and net consumers surplus

Travel costs and on-site costs each consist of two components: (1) the money costs incurred for travel (vehicle wear and tear and fuel) and for fishing (boat fuel and maintenance, fishing equipment, and bait); and, (2) human time costs. Both travel and fishing are time-consuming activities. Lake Erie sport anglers could be working or participating in other activities (other fishing, hunting, religious, political, etc.) if they were not fishing at Lake Erie. If the person would be working if not fishing at Lake Erie, the value of the human time for sport fishing is the wage rate while working. If the alternative activity is another recreation activity, a religious activity, or other non-work activity, the value of human time is probably less than the wage rate.

In this paper, we present estimates which value human time at zero, 25 and 50 percent of the wage rate implied by reported income. Several studies of commuters suggest that commuting time is valued at 25 to 50 percent of the wage rate. Further, most respondents were male and many of them are heads of households whose fishing groups consist of other family members (spouse and children) whose values of human time are much less than the respondent's wage rate. While it is not possible to determine a precise value of human time while fishing on Lake Erie, it does appear that zero and 50 percent of the wage rate are reasonable lower and upper limits.

Net consumer surplus is the triangular area above the price and below the demand curve in Figure 2. It is the value of Lake Erie fishing to the private-boat sport angler over and above the economic costs (travel and on-site, money and human time). Net consumer surplus must be included in valuing the Lake Erie fishery for two reasons. First, since the Lake Erie fishery is a unique resource, substitute fishing sites which are equally attractive cannot be established, i.e., only imperfect substitutes exist or can be developed. Second, since a significant component of fishing cost is travel cost, we would in many cases conclude that someone traveling 200 miles per trip for four trips per year ($\$400 \times 4$), for example, values the Lake Erie fishery more highly than someone traveling ten miles per trip for 50 trips per year ($\$30 \times 50$) (Figure 3). This happens because much of the value of fishing to the angler who lives near the lake is captured without cost because of location near the lake.

Results

Estimates of total willingness to pay and each of its components for western basin walleye, western basin yellow perch and the central basin are presented in Tables 2, 3 and 4, respectively. Each table contains estimates with human time valued at zero, 25 and 50

percent of the wage rate, where the estimates are stated per trip, per day and for the appropriate aggregation over angler hours from the Ohio Department of Natural Resources creel surveys.

In Table 2, western basin walleye respondents incur average money travel costs of \$15.28 per trip (with human time valued at zero). When human time is valued at 25 percent of the wage rate, travel costs average \$21.62 per angler and when human time is valued at 50 percent, travel costs average \$34.88 per angler. Money on-site costs have a mean value of \$69.60, with human time valued at zero. On-site costs are higher when human time is valued at higher rates. Net consumer surplus increases from \$33.98 when human time is valued at zero to \$62.06 when human time is valued at 50 percent of the wage rate. The summation of travel costs, on-site costs and net consumer surplus yields total willingness to pay estimates of \$118.85, \$178.30 and \$262.00 per trip when human time is valued at zero, 25 and 50 percent of the wage rate, respectively.

The per day estimates in Table 2 are equal to the per trip estimates divided by 1.8 days per trip (Table 1). When the value of human time is 25 percent of the wage rate, average total willingness to pay is \$96.80 per day. Creel data from the Ohio Department of Natural Resources are used to estimate the aggregate western basin walleye willingness to pay. Total western basin angler hours for May-August 1981 from the creel census come to 8.0 million. Division of angler hours by the sample mean of 7.4 hours per fishing day (Table 1) yields a total of 1,081,075 angler days. Multiplication of the per day estimates of travel costs, on-site costs, net consumer surplus, and willingness to pay by western basin angler days yields the aggregate estimates. The total willingness to pay for, or the total value placed on, western basin summer (walleye) fishing over the May-August 1981 period was \$69.16 million, \$104.64 million, or \$154.91 million when human time is valued at zero, 25 or 50 percent of the respondent's wage rates, respectively.

The estimates for yellow perch fishing for autumn 1981 are presented in Table 3. The per trip and per day estimated values for yellow perch are quite similar to those for the walleye data in Table 2. The aggregate estimates for September-October 1981 are much less because there are fewer angler hours during the autumn period. For September-October 1981, 1.3 million angler hours are reported in the creel census. Division of angler hours by 6.6 hours per fishing day (Table 1) yields an estimated 202,130 angler days. Multiplication of angler days by the per day estimates of travel costs, on-

TABLE 2
ESTIMATED EXPENDITURES, NET CONSUMER SURPLUS AND
TOTAL WILLINGNESS TO PAY PER PERSON,
WESTERN BASIN WALLEYE, 1981

Per Trip			
	<u>Human Time as % of Wage Rate</u>		
	0	25	50
Number of Trips	7.95	7.95	7.95
Travel Costs (\$)	15.28	21.62	34.88
On-Site Costs (\$)	69.60	117.33	165.06
Net Consumer Surplus (\$)	<u>33.98</u>	<u>39.35</u>	<u>62.06</u>
Willingness to Pay (\$)	118.85	178.30	262.00
Per Day			
Travel Costs (\$)	8.22	12.58	20.97
On-Site Costs (\$)	37.46	63.98	90.49
Net Consumer Surplus (\$)	<u>18.29</u>	<u>21.18</u>	<u>33.40</u>
Willingness to Pay (\$)	63.97	96.80	142.66
Aggregate Western Basin Walleye May-August 1981			
Travel Costs (\$ Mil.)	8.89	12.58	20.97
On-Site Costs (\$ Mil.)	40.50	69.16	97.83
Net Consumer Surplus (\$ Mil.)	<u>19.77</u>	<u>22.90</u>	<u>36.11</u>
Willingness to Pay (\$ Mil.)	69.16	104.64	154.91

TABLE 3
ESTIMATED EXPENDITURES, NET CONSUMER SURPLUS AND
TOTAL WILLINGNESS TO PAY PER PERSON,
WESTERN BASIN YELLOW PERCH, 1981

Per Trip			
	<u>Human Time as % of Wage Rate</u>		
	0	25	50
Number of Trips	6.26	6.26	6.26
Travel Costs (\$)	15.70	23.07	31.01
On-Site Costs (\$)	55.49	96.90	138.32
Net Consumer Surplus (\$)	<u>39.24</u>	<u>45.86</u>	<u>58.77</u>
Willingness to Pay (\$)	110.43	165.83	228.10
Per Day			
Travel Costs (\$)	9.24	13.57	18.24
On-Site Costs (\$)	32.64	57.00	81.36
Net Consumer Surplus (\$)	<u>23.09</u>	<u>26.98</u>	<u>34.57</u>
Willingness to Pay (\$)	64.96	97.55	134.17
Aggregate Western Basin Yellow Perch September-October, 1981			
Travel Costs (\$ Mil.)	1.87	2.74	3.69
On-Site Costs (\$ Mil.)	6.60	11.52	16.45
Net Consumer Surplus (\$ Mil.)	<u>4.67</u>	<u>5.45</u>	<u>6.99</u>
Willingness to Pay (\$ Mil.)	13.13	19.71	27.12

site costs, net consumer surplus, and willingness to pay yields the aggregate western basin yellow perch estimates. Total willingness to pay for western basin autumn (yellow perch) fishing by private-boat anglers is \$13.13 million, \$19.71 million or \$27.12 million when human time is valued at zero, 25 or 50 percent of the wage rate, respectively.

In Table 4, estimates of travel costs, on-site costs, net consumer surplus and total willingness to pay by private-boat anglers in the central basin for 1982 are presented. These estimates include recreational boating activities other than fishing. In contrast to the western basin, the central basin fishery attracts primarily local residents who travel relatively short distances to fishing sites for single day trips. Total willingness to pay per day ranges from 30 to 60 percent of the willingness to pay for western basin walleye or yellow perch fishing.

The aggregate central basin willingness to pay is estimated at \$7.41 million, \$18.85 million or \$30.40 million when human time is valued at zero, 25 or 50 percent of the wage rate, respectively. These estimates are based on the 1982 creel census report of 2.1 million angler hours divided by 5.3 hours per fishing day (Table 1). These values overestimate the willingness to pay for the central basin fishery because they include non-fishing activities. Whether they over- or underestimate the value of total recreational boating depends on whether recreational boating other than fishing is over- or under-represented in the sample.

Conclusion

If we sum the aggregate total willingness to pay estimates for the three fishery components, the total willingness to pay is \$89.7 million when time spent traveling to and fishing in Lake Erie is valued at zero percent of the wage rate, \$143.2 million at 25 percent, and \$212.4 million at 50 percent. If we adjust the central basin estimates to reflect the 1.6 million angler hours estimated for 1981 rather than the 2.1 million for 1982, the respective estimates are \$87.9 million, \$138.7 million and \$205.2 million, an estimate which uses 1981 creel census data in total. While it is not possible to make a precise estimate, it appears that these components of the Lake Erie fishery, over 90 percent of the 1981 angler hours, were valued by sport anglers at \$140 million to \$200 million in 1981.

In generating these values, private-boat sport anglers made total money expenditures estimated at \$64.3 million (the sum of travel and on-site costs from Column

TABLE 4
ESTIMATED EXPENDITURES, NET CONSUMER SURPLUS AND
TOTAL WILLINGNESS TO PAY PER PERSON,
CENTRAL BASIN, 1982

Per Trip			
	<u>Human Time as % of Wage Rate</u>		
	0	25	50
Number of Trips	28.4	28.4	28.4
Travel Costs (\$)	3.40	6.04	8.72
On-Site Costs (\$)	15.06	43.14	71.21
Net Consumer Surplus (\$)	<u>2.68</u>	<u>4.58</u>	<u>6.79</u>
Willingness to Pay (\$)	21.14	53.76	86.72
Per Day			
Travel Costs (\$)	3.01	5.35	7.71
On-Site Costs (\$)	13.33	38.13	63.02
Net Consumer Surplus (\$)	<u>2.37</u>	<u>4.05</u>	<u>6.00</u>
Willingness to Pay (\$)	18.71	47.53	76.73
Aggregate Central Basin 1982			
Travel Costs (\$ Mil.)	1.19	2.12	3.05
On-Site Costs (\$ Mil.)	5.28	15.13	24.97
Net Consumer Surplus (\$ Mil.)	<u>0.94</u>	<u>1.60</u>	<u>2.38</u>
Willingness to Pay (\$ Mil.)	7.41	18.85	30.40

1 of Tables 2, 3 and 4). The balance of the value of Lake Erie sport fishing is composed of the value of human time and net consumers surplus. If we accept the \$140 million to \$200 million range as containing the true value of the Lake Erie fishery, then human time and net consumers surplus comprise 54 to 68 percent of the economic value of private-boat sport fishing on Lake Erie.

