

# **Trip Characteristics, Expenditures, and Economic Value of a Trophy Largemouth Bass Fishery: Lake Fork Reservoir, Texas**

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*Abstract:* Anglers who fished Lake Fork Reservoir June 1994–May 1995 were intercepted during creel surveys conducted by the Texas Parks and Wildlife Department (TPWD) and asked to participate in a follow-up, self-administered mail survey. Anglers were asked questions about their fishing activity at Lake Fork, and their motivations, satisfaction, and expenditures on the trip they were intercepted. Lake Fork anglers could be characterized as high specialization anglers, indicating they had been fishing in fresh water for an average of 28 years, and fishing an average of 62 days in the previous year. Additionally, 34% of anglers belonged to a fishing club, and 57% indicated they participated in fishing tournaments. Lake Fork anglers had an average of \$13,174 invested in fishing equipment, twice as much as the average black bass (*Micropterus* spp.) angler in Texas. About 89% of anglers targeted largemouth bass (*M. salmoides*) on their trip which lasted an average of 1.74 days. Most anglers indicated both catch-related and non-catch-related items were important reasons for fishing the reservoir. About 10% of anglers indicated they caught what they consider a trophy bass on their trip; 86% were moderately to extremely satisfied with their trip. Anglers spent an average of \$137 on various trip-related items and were willing to pay \$53 over actual trip expenditures (consumer surplus) before they would have not made this trip. Total consumer surplus was \$10,826,598. When added to total trip expenditures (\$28,073,812), the resultant total economic value of the reservoir for fishing was estimated to be \$38,900,410. Fishery managers and surrounding communities can utilize information from this survey to determine who their customers are and what customers desire from fishing at the reservoir.

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To effectively manage a fishery, managers must have not only a biological understanding of the habitat and its fish population, but knowledge of resource users as

well, particularly anglers. Bain (1987) stated fishery management plans consist of 2 tasks: a fishery analysis and a management evaluation. The fishery analysis consists of biological data, models, and predictions, while the evaluation incorporates social interests (including economics) and practical constraints. When combined with biological information, sociological and economic information can be used to maximize benefits to users of recreational fishery resources (Gordon et al. 1973).

Recognizing a need for more specific water body information associated with a premiere trophy largemouth bass reservoir, TPWD initiated a study to determine angler and trip characteristics, expenditures, and the economic value of the recreational fishery at Lake Fork Reservoir, an 11,211-ha impoundment occupying portions of Wood, Rains, and Hopkins counties in northeast Texas. While the reservoir provides fishing opportunities for crappie (*Pomoxis* spp.), catfish (*Ictalurus* spp.), and sunfish (*Lepomis* spp.), it is the largemouth bass fishery which has claimed widespread recognition. Lake Fork management strategies have been designed to provide a trophy bass fishery. In 1978, before impoundment, the Florida subspecies of largemouth bass (*M. s. floridanus*) was stocked in numerous farm ponds in Wood, Rains, and Hopkins counties that eventually would be inundated by the reservoir. The reservoir was opened in 1980 with a 355-mm minimum length limit and 5 fish/day daily bag limit for largemouth bass; both were the most stringent in Texas at the time. The minimum length limit regulation was changed to a slot-length limit protecting fish 355–457 mm in 1985, and again changed to 355–533 mm in 1988 with a reduction in the daily bag limit to 3 fish in 1992 (only 1 could be >533 mm). In 1995, the daily bag limit was increased to 5 fish/day, with only 1 >533 mm. Largemouth bass have thrived under the management regime and subsequently 36 of the 50 largest bass ever taken from public waters in Texas came from Lake Fork, including the current state record of 8.25 kg.

With its reputation for producing trophy largemouth bass, Lake Fork attracts large numbers of anglers from throughout Texas, bordering states, and elsewhere. In 1995, estimates indicated total fishing effort on the reservoir exceeded 1.81 million hours. Anglers targeting largemouth bass accounted for 91% of total annual effort (1.66 million hours). It is common to find launching ramps filled beyond capacity. Lodging at area motels, cabins, and campgrounds must be arranged months in advance and vacancies are at a premium for much of the year. During peak fishing times, some anglers are often forced to find lodging as far as 1 hour's travel distance from the reservoir. Furthermore, Lake Fork has become the focal point for many current fishery management issues in Texas involving largemouth bass. These issues have biological, social, and economic components. Therefore, it is important that managers gather information on all 3 aspects of the fishery. Information provided from a follow-up survey can help fishery managers to better understand their clientele and prepare them to deal with public response on issues affecting the fishery.

This paper focuses on angler characteristics, expenditures, and economic value of trips associated with fishing Lake Fork Reservoir. Specifically, the objectives are to describe the type of anglers fishing at Lake Fork, describe characteristics of their fishing trips, estimate their expenditures associated with these trips, and estimate the economic value (consumer surplus) of the recreational fishery at Lake Fork.

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## Methods

Because of time constraints associated with on-site creel surveys, follow-up mail surveys to anglers encountered through creel surveys allow fishery managers the opportunity to explore angler and trip characteristics, and expenditures incurred on trips in much greater detail. Initiating a follow-up mail survey of Lake Fork anglers required developing a sampling frame of anglers who fish the reservoir. This was accomplished by collecting mailing addresses from anglers who were intercepted on creel surveys, in addition to standard catch and harvest information. The creel survey was an access-point intercept survey which intercepted anglers at 1 of 4 randomly selected public boat ramps 36 days (9/quarter) between 1 June 1994 and 31 May 1995. Additionally, to increase sample size, a creel assistant was randomly assigned to 1 of the 4 public boat ramps on every weekend day when a TPWD creel survey was not being conducted to solicit additional names and addresses from anglers. Extra sampling days were used to ensure a sufficient number of out-of-state anglers were represented. A total 2,200 angler names and addresses were collected from both of these efforts.

Most ( $N = 1,652$ ) of the anglers intercepted were non-local Texas residents who lived outside the 3 counties bordering the reservoir. This was more than adequate, so a random sample of 300 non-local Texans were selected from this group. These were combined with the full listing of local Texas anglers ( $N = 199$ ) and out-of-state anglers ( $N = 349$ ) to obtain a final sample size of  $N = 848$ . After taking into account survey nonresponse, this sample size would provide a sufficient number of respondents to be representative of Lake Fork anglers (Krecjie and Morgan 1970). Results presented in this paper were weighted according to each segment's proportion in the fishery as determined from creel surveys: 0.11 for local Texas anglers, 0.74 for non-local Texans, and 0.15 for out-of-state anglers. This allows generalizing the results to all Lake Fork anglers.

An 11-page questionnaire was used to collect information from anglers. First, a demographic profile was sought, and anglers were asked their age, gender, race, ethnic origin, and annual household income. Second, anglers were asked about their fishing experience in general: years fishing freshwater, days fishing in the previous 12 months, club membership, tournament participation, their ability compared to other anglers in general, and their replacement costs for various fishing-related equipment. Third, for comparison purposes, anglers were asked about their fishing experience at

Lake Fork: years fishing the reservoir, and days fishing the reservoir in the previous 12 months.

Next, anglers were asked 10 questions about the fishing trip when they were intercepted by TPWD creel assistants (the date was inserted into the questionnaire to facilitate recall). Anglers were asked how far they traveled (1 way) to get to the reservoir, if this was the first time they visited the reservoir, how many days they spent fishing on their trip, who they fished with on their trip, and species targeted. Also, anglers were asked how important each of 17 items was as a reason for fishing the reservoir on this trip. Eleven motive statements developed and tested by Driver (1977) and Driver and Cooksey (1978) dealt with generic benefits sought in most outdoor recreation activities (activity-general), and 6 motive statements dealt with the experience elements associated only with recreational fishing (activity-specific). Additionally, anglers were asked how satisfied they were with their trip on a 5-point satisfaction rating scale. Also, they were asked what length and weight they considered a trophy largemouth bass, and if they agreed or disagreed with the statement "I caught what I considered a trophy bass on this trip." Finally, anglers were asked how much money they spent (individually) in Texas on their trip for 13 trip-related items: automobile transportation, other transportation, boat rental, boat operation, boat launch fees, entrance/parking fees, lodging, restaurant meals, groceries, bait/tackle, fishing guide fees, fishing licenses, and other miscellaneous expenses.

We used a close-ended contingent valuation (CVM) question to ascertain the amount anglers were willing to pay in addition to actual expenditures, before they would have not made this trip. Each angler was presented non-iteratively with a random offer from a preselected range of 10 bid values (\$5 to \$95 in increments of \$10). Consumer surplus was evaluated using logistic regression, which is appropriate when the dependent variable is a binary indicator variable (e.g., "yes" or "no"). Logistic regression determines the possibility of a "yes" response and thus the threshold level ( $P[\text{yes}] = P[\text{no}] = 0.5$ ) of an angler's willingness to pay (Agresti 1990). This technique enables determination of the dollar value at which 50% of anglers would accept and 50% would reject the bid value. This dollar value is angler's average willingness to pay above actual expenditures (Fisher 1986).

Data were requested between September 1994 and June 1995 from each selected Lake Fork angler. The follow-up mail survey was conducted in 4 waves at the end of each creel quarter. This was essential in reducing effects of recall bias on expenditure items (Hiatt and Worrall 1977, Chase and Godbey 1983, Chase and Harada 1984). Survey procedures were based partly on findings of Dillman (1978) and partly on experience gained through previous data collections in Texas (Ditton et al. 1991, Hunt et al. 1991, Ditton and Hunt 1996a). Three personalized mailings were sent to each angler (as necessary) with a reminder postcard sent 10 days after the first mailing.

A telephone survey of nonrespondents was completed to test for nonresponse bias in the survey results (Bethlehem and Kersten 1985, Fisher 1996). Questions included days of fishing at Lake Fork in the previous 12 months, distance traveled on the trip they when intercepted by TPWD, who they fished with on their trip, days spent fishing on their trip, and total expenditures on their trip. Telephone calling resulted in

39 completed surveys from a sample of 45 nonrespondents. Using the Mann-Whitney U or chi-square test, as appropriate, we found no significant differences between non-respondents and respondents on trip related variables at the  $\alpha = 0.05$  level.

## Results

There were no significant differences in response rates among the 4 survey waves (range 72%–78%), so they were combined for reporting purposes. A total of 619 anglers responded to the mail survey. When non-deliverables ( $N = 8$ ) were excluded from consideration, an effective response rate of 74.6% was obtained. Returned questionnaires were checked for completeness of response; 10 surveys were returned but were not usable because respondents reported they no longer fished ( $N = 2$ ), refused to answer ( $N = 6$ ), or were reported as deceased ( $N = 2$ ), leaving a total of 609 usable questionnaires.

Almost all anglers fishing Lake Fork were white (98%) males (98%). Their average age was 42 years. Only 2% were of Spanish/Hispanic origin. Anglers' median household income was \$40,000–\$49,999. Anglers had been fishing in fresh water for an average of 28 years, and had fished Lake Fork for an average of 5.5 years. Respondents fished in fresh water an average of 62 days in the previous year and fished Lake Fork an average of 24 days. About 34% belonged to a fishing club or organization, and 57% reported they had participated in fishing tournaments. Those fishing in tournaments indicated they fished an average of 9 tournaments in the previous year. When asked to compare their fishing ability to that of other anglers, 6% indicated they were less skilled, 64% indicated they were equally skilled, and 30% felt they were more skilled. When asked their replacement costs for fishing-related equipment, respondents indicated it would cost an average of \$515, \$467, \$799, \$544, and \$10,849 to replace their reels, rods, tackle, electronic equipment, and boat/motor/trailer, respectively ( $\bar{x} = \$13,174$ ).

Anglers traveled an average of 163 1-way km to get to Lake Fork on their trip. About 6% said this was their first trip to the reservoir. About 51% made their trip with friends, 29% with family, 10% alone, 6% with family and friends together, and 4% of trips were made with clubs. Most (89%) anglers fished primarily for largemouth bass on their trip. Although 11% of anglers fished for species other than largemouth bass, most of them indicated they fished for largemouth bass as well.

Most anglers rated "for the challenge or sport" (83%), "for the experience of the catch" (83%), "for relaxation" (81%), "to be outdoors" (76%), "to get away from the regular routine" (74%), and "to experience adventure and excitement" (71%) as very to extremely important reasons for fishing at Lake Fork (Table 1). Other items rated very to extremely important by most anglers included "to experience unpolluted natural surroundings" (69%), "to get away from the demands of other people" (62%), "to be close to the water" (57%), "to develop my skills" (57%), "to obtain a trophy fish" (56%), and "to be with friends" (54%). Most anglers rated "to obtain fish for eating" (84%), "to win a trophy or prize" (67%), and "to test my equipment" (59%) as not at all or only slightly important as a reason for fishing Lake Fork.

**Table 1.** Percent of Lake Fork Reservoir anglers by the importance they attributed to various reasons why they fished the reservoir on their trip, ranked by percentage of anglers responding very to extremely important ( $N = 609$ ).

Reasons for fishing Lake Fork on this trip	Not at all important	Slightly important	Moderately important	Very important	Extremely important
For the challenge or sport	2.6	1.9	12.6	33.2	49.7
For the experience of the catch	1.6	2.3	13.2	24.6	58.2
For relaxation	3.6	3.5	12.0	29.9	51.0
To be outdoors	1.7	5.5	17.2	41.4	34.1
To get away from the regular routine	3.6	3.4	18.9	33.0	41.2
To experience adventure and excitement	2.8	5.4	20.7	29.0	41.9
To experience unpolluted natural surroundings	4.3	6.3	20.9	30.6	37.8
To get away from the demands of other people	9.2	10.9	18.5	23.8	37.7
To be close to the water	5.8	10.5	27.0	29.0	27.6
To develop my skills	10.9	10.0	22.6	25.1	31.4
To obtain a "trophy" fish	14.9	8.2	21.3	17.1	38.6
To be with friends	14.5	7.1	24.3	31.4	22.8
To experience new and different things	16.6	13.2	29.3	25.2	15.6
For family recreation	24.9	9.4	23.9	24.4	17.3
To win a trophy or prize	58.3	8.9	13.5	6.0	13.3
To test my equipment	34.1	24.9	24.8	8.6	7.6
To obtain fish for eating	71.0	12.7	7.3	4.0	5.0

Thirty-eight percent of the anglers were very to extremely satisfied, 48% were moderately satisfied, and 14% were not at all or only slightly satisfied with their trip. About 10% agreed they caught a trophy bass on their trip. Most anglers felt a trophy bass was 533–650 mm in length (90%) and weighed between 3.5 and 6.0 kg (93%).

Anglers reported an average expenditure of \$137.12 on their trip (Table 2). The trip averaged 1.74 days in length, with an average daily expenditure of \$78.80. About

**Table 2.** Average costs incurred for various items on a Lake Fork Reservoir fishing trip ( $N = 595$ ).

Expenditure item	Percent of anglers with an expenditure on item	Average dollars spent per trip by anglers with an expenditure on item	Average dollars spent per trip by all anglers
Automobile transportation	98.0	\$40.93	\$39.78
Other transportation (airplane, etc.)	0.3	16.75	0.02
Boat rental	1.0	26.01	0.40
Boat operation (fuel, etc.)	90.8	17.92	15.68
Boat launch fees	22.5	4.83	1.03
Entrance/parking fees	3.0	9.59	0.20
Lodging (hotel, condo, rental, etc.)	39.4	92.11	22.73
Restaurant meals	65.6	30.83	18.94
Groceries (food, drinks, ice)	82.0	20.94	17.12
Bait, tackle	62.1	18.77	10.16
Fishing guide fees	3.3	120.05	1.27
Fishing license fees	47.2	22.25	6.48
Anything else for bass trips	7.3	49.37	3.32
Average trip expenditure			\$137.12

58% indicated their fishing trip was a 1-day trip, 21% a 2-day trip, 12% a 3-day trip, and 8% indicated their trip lasted  $\geq 4$  days. Costs per trip for automobile transportation (\$39.77), lodging (\$22.73), restaurant meals (\$18.94), food, drinks, and ice (\$17.12), and boat operation (\$15.68) were the 5 largest individual expense categories. When combined, these items accounted for 83% of total trip expenditures.

Angler characteristics expected to affect willingness to pay included 1) number of days fishing in the previous 12 months, 2) years of fishing experience, 3) expenditures/Lake Fork trip, 4) annual household income, and 5) participation in fishing tournaments. The intercept between number of days fished and years of fishing experience was not statistically significant ( $P > 0.05$ ) and was not included in the final model. The parameter estimates indicate the probability of a "yes" response to the presented bid decrease as the bid value increases, and increases as probability of tournament participation, total trip expenditures, and annual household income increases (Table 3). From the results of the logistic regression model, the average willingness-to-pay in addition to expenditures was \$52.88/trip (\$30.39/day).

Results from creel survey estimates indicated there were 204,739 1-person fishing trips taken to Lake Fork during the study period. This was determined by dividing the estimated total number of days fishing during the study period (356,246) by the average trip length (1.74 days). When total trips are multiplied by the average trip expenditure and average willingness-to-pay more per trip, we estimate a total of \$28,073,812 was spent in Texas from June 1994 through May 1995 as a result of fishing the reservoir, with a consumer surplus of \$10,826,598. When added together the present total annual economic value of the Lake Fork fishery for anglers was estimated to be \$38,900,410.

## Discussion

Specialization is defined as a "continuum of behavior from the general to the particular reflected by equipment and skills used in fishing and activity/setting prefer-

**Table 3.** Logistic regression model of willingness-to-pay for an increase in Lake Fork Reservoir trip expenses.

Variable description	Parameter estimate (and SE)	Chi-square value	$P >$ Chi-square
Bid value	-0.0310398 (0.003836)	61.7	0.0001
Total \$/trip	0.00458265 (0.000731)	39.2	0.0052
Income	0.00001355 (0.00000439)	9.5	0.0020
Tournament participation	0.55093621 (0.207125)	7	0.0078
<i>N</i>	595		
Consumer's surplus	\$52.88 <sup>a</sup>		

<sup>a</sup>Calculated using means of \$126.67/trip, annual household income of \$52,042, and proportion of anglers fishing in tournaments (0.57).

ences" (Bryan 1977). At 1 end of the continuum is the least specialized group of anglers who do not fish often because they are just learning how to fish, for whom fishing is not a central life interest, or is but one of their recreational pursuits. At the other end of the continuum are high specialization anglers. These anglers exhibit higher levels of self-reported skill and years of participation, greater resource dependency, a greater appreciation for both catch- and non-catch-related aspects of the fishing experience, and have a greater overall investment in fishing (Bryan 1977). Based on the high annual frequency of fishing participation by anglers, previous research would suggest that high specialization anglers are over-represented in the Lake Fork recreational fishery (Bryan 1977, Graefe 1980, Ditton et al. 1992).

The disproportionate number of high specialization anglers in the recreational fishery at Lake Fork becomes clearer when anglers are compared to the statewide population of black bass anglers (Ditton and Hunt 1996b). First, Lake Fork anglers fished an average of twice as many days in fresh water than black bass anglers in general (62 vs. 30 days) in the previous year. Second, Lake Fork anglers were nearly 4 times more likely than black bass anglers to rate themselves as more skilled compared to other anglers (30% vs. 8%). Third, Lake Fork anglers were over twice as likely to belong to a fishing club or organization (34% vs. 15%), and almost 3 times more likely to indicate they have participated in fishing tournaments (57% vs. 21%). Finally, Lake Fork anglers indicated they had nearly double the amount of money invested in fishing than black bass anglers in general (\$13,174 vs. \$6,555). Thus, Lake Fork anglers can be characterized as having high avidity levels and they are heavily invested in recreational fishing.

Trip characteristics also show that a Lake Fork fishing trip may provide a different experience for those fishing the reservoir than elsewhere. When asked their reasons for fishing Lake Fork on their trip, anglers placed more importance on "for the challenge or sport," "for the experience of the catch," and "to obtain a trophy fish." The percentage of Lake Fork anglers rating these items as very to extremely important as a reason for fishing were 19%, 7%, and 28% greater, respectively, than black bass anglers in general. Also, nearly 50% of all Lake Fork trips were made with friends, whereas only 28% of black bass anglers in Texas fished mostly with friends. Enjoying camaraderie with friends is an important aspect of fishing Lake Fork. For most black bass anglers in Texas, fishing is a family-oriented activity. Furthermore, the relatively large expenditures and number of non-local anglers at the reservoir suggest Lake Fork fills an important "niche" for anglers seeking a challenging trophy bass fishing opportunity with their friends.

Over 86% of anglers indicated they were moderately to extremely satisfied with their fishing trip to Lake Fork. This suggests most anglers are receiving the benefits they sought from fishing the reservoir. Additionally, the 10% of anglers that indicated they caught a trophy bass on their trip suggests the reservoir yields a large number of trophy bass, as defined by anglers themselves. With over 204,000 trips taken to the reservoir, this means roughly 20,000  $\geq$ 3.5-kg largemouth bass (about 1.9 trophies/ha) were caught during the study period. Maintaining such a high trophy catch rate will be a challenge to reservoir managers. The newly instituted daily bag limit which



allows each angler only 1 largemouth bass >533 mm may help in this effort by protecting some trophy fish from harvest, and distributing trophy fish more evenly among anglers.

As evidenced by their trip expenditures, Lake Fork anglers pay more to fish this reservoir than other black bass anglers in Texas spend for a typical fishing trip (\$78.80 vs. \$55.00). Along with the large amount of effort exhibited at the reservoir, this suggests there is a particular segment of the recreational fishing market in Texas willing to pay more for a trophy fishing experience. However, recognizing the diversity and expenditure levels of black bass anglers across the state, it would probably be unwise to manage all reservoirs for trophies. Other reservoirs in Texas probably satisfy the black bass angler segments who would rather catch many fish each trip, as opposed to a few larger ones. Finding the right combination of waters which can satisfy a diversity of angler's preferences, and providing these experiences will be another challenge facing fishery managers in the future.

Since an angler's actual expenditures are only a partial measure of the true value of the fishery, they are not a useful measure of its economic value (Huppert 1983). We know that a fishing trip has much greater social value to individuals than the costs associated with trip expenditures. Testing one's skill, experiencing the challenge and excitement that accompanies trophy fishing, the experience of the catch, and camaraderie with friends are just some of the more important experiential components of a trophy fishing trip that also provide value. Measures of willingness to pay in excess of trip expenditures can be used to estimate the value of these additional benefits (consumer surplus) to anglers (Huppert 1983). This is an important concept because it represents an increase in the social welfare of the local region and Texas as a result of the opportunity to fish for trophy largemouth bass. The consumer surplus for the Lake Fork Reservoir recreational fishery was \$10,826,598 (\$30.39/day), and is the dollar value representing the replacement cost of that opportunity to anglers if it were to be taken away. This can also be viewed as the additional amount anglers could be induced to pay for their trips (Palm and Malvestuto 1983). This value should not be taken for granted as anglers may assign correspondingly lower values to black bass fishing trips in response to reductions in trophy fish abundance and/or catch per unit of effort. The daily consumers surplus value is slightly less than the \$35/day reported by the U.S. Fish and Wildlife Service (USFWS 1994) for Texas. We would expect to see a lower value here since the USFWS study valued anglers opportunity to fish for black bass in Texas, not for a specific trip. Nevertheless, results show Lake Fork anglers value fishing trips to the reservoir almost as much as the general population of anglers in Texas values black bass fishing altogether.

Results from this study can be used by fishery managers and local communities to determine who their customers are, what they desire, and how changes in the fishery may affect customers and local businesses. By knowing who fishes the reservoir, and their attributes, attitudes, and opinions, managers can better understand their clientele and provide more satisfying fishing experiences. Additionally, this information can be used for promoting the type of fishery the reservoir provides, in turn attracting new clientele. Finally, this information provides managers with some expectations

of who will be affected by possible changes in the management regime. On a reservoir with as high a profile as Lake Fork, regulation changes, or responses to current issues will be scrutinized and magnified by the media and the public. By knowing who will be affected by changes, fishery managers can be better prepared to deal with public response on issues affecting the reservoir's fishery.

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