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[Article]

Estimating Demand for Urban Fisheries Management: an Illustration of Conjoint Analysis as a Tool for Fisheries Managers

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Abstract.—This paper illustrates the use of discrete-choice analysis, a nonmarket valuation technique, for assessing the effect of different management or fishing site quality variables on demand for urban fisheries. The study was carried out in three fishing ponds that are a part of the Close-to-Home Fishing Program in the Oklahoma City metropolitan area. We found that, on average, anglers were willing to pay more for physical infrastructure improvements, such as flush toilets ($3.81/year) and docks ($1.28/year), than for having larger channel catfish *Ictalurus punctatus* stocked ($0.23/year for a 4-in increase). Willingness to pay for improvements to the ponds was less for minority anglers than for other anglers. Having relative values for potential management changes for a fishery helps to inform fisheries managers about what characteristics are valued most by anglers, allowing managers to better serve the anglers' interest and to justify the costs of implementing these changes.

As the U.S. population becomes increasingly urbanized, angling participation and fishing license sales have declined (USFWS 2007). According to the 2000 U.S. Census, 79% of the U.S. population and 72% of anglers live in metropolitan areas (U.S. Census Bureau 2009; USFWS and U.S. Census Bureau 2002). Compared with rural residents, however, urbanites are less likely to participate in angling (USFWS and U.S. Census Bureau 2002). For example, the 2005 U.S. Census showed that 63.3% of Oklahoma's population lived in metropolitan areas, up from 61% in 1990 (Barta et al. 2007). Although Oklahoma's population has been increasing, the number of angling licenses has not increased proportionately (Summers 2008). The nationwide decrease in fishing and hunting involvement creates a detachment between people and nature (ASA and AFWA 2007), which can lead to reduced support for wildlife management or conservation issues (Kellert and Westervelt 1983; Schramm and Dennis 1993; Siemer and Knuth 2001). Furthermore, state conservation agencies depend on fishing and hunting license sales to fund conservation and maintenance of wildlife areas (Noble and Jones 1999; ASA and AFWA 2007).

Urban fisheries may hold the key to reversing declines in angling participation, maintaining state budgets for wildlife management, and renewing the waning concern for natural resource conservation and the environment (see Eades et al. 2008). Urban dwellers have high opportunity costs for their time, which means that angling opportunities need to be placed close to these urbanites or they will continue to pursue activities that require a lower time commitment (Hunt and Ditton 1996; Fedler 2000; ASA and AFWA 2007). However, quality fishing opportunities that are strategically placed can recruit lapsed anglers back into participation (Fedler 2007).

The interests and factors associated with satisfaction of anglers in urban fisheries can differ from those of rural anglers (Arlinghaus and Mehner 2004). Relatively little is known about what urban anglers value. Therefore, part of building a successful urban fishing program is assessing angler needs and interests so that

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fishing opportunities and amenities can be tailored to what the urban anglers value most (Balsman and Shoup 2008). Different groups of anglers may have different interests (Hunt and Ditton 1997), so amenities may need to vary by location to meet the demands of a diverse urban population (Hunt and Ditton 1997; Toth and Brown 1997). For example, anglers who fish with family members place importance on physical amenities, such as picnic tables, restrooms, and camping facilities, whereas solo anglers place more importance on their ability to catch fish (Hunt and Ditton 1997). The cost of stocking fish and maintaining park amenities can be high. With limited funds, state agencies need to consider the cost–benefit tradeoffs of different options for maintaining urban fishing programs. Environmental and publicly provided goods, such as urban parks, are not commonly valued in the market place, making justification of specific management changes difficult to quantify on a cost–benefit basis. Therefore, tools are needed that allow managers to better assess the costs and benefits of multiple management options.

The objective of this study was to illustrate the use of a nonmarket valuation technique, discrete-choice analysis, for assessing the effect of different management or quality variables on demand for urban fisheries. To do this, we studied three fishing ponds that are a part of the Close-to-Home Fishing Program (CTHFP) in the Oklahoma City, Oklahoma, metropolitan area. As we will illustrate, having relative values for potential management changes for a fishery helps to inform fishery managers about characteristics that are valued most by anglers, allowing the managers to better serve the anglers' interests and to justify the costs of implementing these changes.

Methods

Study site.—Begun in 2002, Oklahoma's CTHFP was designed by the Oklahoma Department of Wildlife Conservation (ODWC) to give Oklahoma metropolitan residents "quality fishing within a neighborhood-based fishing program by focusing on angler desires, use and benefits, and by implementing management techniques on urban ponds" (Gilliland 2005). Over a dozen lakes and ponds in the Oklahoma City metropolitan area are included in this program. Three of these, Kid's Lake North (19.8 acres), Dolese Youth Pond (19.8 acres), and South Lake Park East (3.0 acres), were chosen for this study because they had well-established adult fish populations at the time the study began. Kid's Lake North and Dolese Youth Pond have been open for fishing in the program since 2002, whereas the smaller South Lake Park East was recently renovated and was not opened to fishing until a stable adult population was established in spring 2006. These ponds have established populations of sunfishes *Lepomis* spp., largemouth bass *Micropterus salmoides*, and other centrarchids and are regularly stocked with channel catfish *Ictalurus punctatus*. Dolese Youth Pond is also stocked with rainbow trout *Oncorhynchus mykiss* during the winter. To fish these urban ponds, age-16 and older anglers must hold a state fishing license (US$5 for ages 16 and 17, $20 for ages 18–63, and a $6 lifetime license for seniors at least age 65) and a city fishing license, which is $3 daily or $15/year (seniors and children of age 16 and under are exempt). All largemouth bass that are caught must be released, but the state allows a bag limit of up to six catfish (i.e., some combination of channel catfish and blue catfish *I. furcatus*) with no size limits (ODWC 2008). For all other species, the CTHFP follows the statewide regulations.

Survey design.—Conjoint analysis is a marketing tool for analyzing consumers' demand for multi-attribute goods—in this case, a recreational experience. Many factors influence an angler's preferences for recreational sites. Therefore, conjoint analysis is an ideal tool for analyzing angler preference because it provides a framework for estimating demand for different combinations of potential qualities of the site, such as docks, restrooms, bag limits, and size and type of fish stocked. Data for conjoint analysis can be obtained using a survey technique that presents respondents with a set of choices. Each option represents a potential management scenario with varied attributes (e.g., Figure 1). The respondent is asked to pick one of several options on each set of choices according to his or her preferences about that set of attributes for that bundle of site characteristics and the angling experience at the location. Price can be included as one of the attributes to elicit a willingness to pay for a bundle in each choice set, which allows for the computation of implicit marginal prices of the other attributes (Haab and McConnell 2002; Baarsma 2003; Freeman 2003). In this study, a discrete-choice experiment was used whereby the respondent chose his or her preferred option as opposed to ranking the options (a similar method called conjoint ranking); discrete-choice and conjoint ranking techniques are both subsets of conjoint analysis. Surveys to estimate recreation demand for angling and hunting have been used for the past 20 years. Some of these survey techniques have used actual data on trips (revealed preference data) such as travel cost models (Parsons 2003). However, when it is difficult to survey for quality differences at many sites and to control for unknown differences, the travel cost method may not yield clear answers. In these cases, stated preference

Below you will find three management scenarios being considered to improve the close to home fishing program. Please choose **one** of the following options below.

Attribute	Option A	Option B	Option C
Size of Catfish Stocked	8 inches	8 inches	**NO CHANGE:** I would rather keep the management of this pond the way it is today and not pay any increase in the city license fee.
Length Limit on Catfish taken	No length limit	12 inches	
Bag Limit for Catfish per day	4	6	
Type of Fish in the Pond	Catfish only	Catfish only	
Fishing Dock	None	1 open dock	
Restrooms	Porta-potties	None	
Increase in the yearly city license (Dollar)	$2 increase	$2 increase	
I would choose (Please check only one)	☐**A**	☐ **B**	☐ **C** (I would not want either A or B

FIGURE 1.—Example form for a discrete-choice set used to assess angler willingness to pay for management options at Close-to-Home Fishing Program ponds in the Oklahoma City metropolitan area from 2006 to 2008.

methods, such as contingent valuation (Loomis 2006) and conjoint analysis (discrete-choice and ranking experiments), have the advantage of eliciting preferences when management scenarios are hypothetical (Freeman 2003).

Discrete-choice experiments have been widely used to value environmental amenities, several of which focus on demand for outdoor recreation, such as river flow (Adamowicz et al. 1994), wildlife viewing and conservation (Adamowicz et al. 1988), rock climbing (Hanley et al. 2001), and waterfowl hunting (Mackenzie 1990). This approach is particularly well suited to determining the values of urban anglers for alternative hypothetical management approaches, allowing managers to better evaluate the costs and benefits of the different options (Freeman 2003). Fisheries economists have begun to examine angler preferences for management alternatives via conjoint techniques but have yet to conduct such studies in an urban setting or in conjunction with an on-site creel survey (Aas et al. 2000; Gillis and Ditton 2002). While the effort required to collect such data can be expensive by mail or on site, choice set surveys can easily be added to traditional creel surveys that may already be planned, thus allowing for collection of needed data at little or no additional cost or effort.

Interviewing anglers on site is known to result in two sources of bias, avidity bias and selection bias. Avidity bias occurs when responses have a disproportionate representation of users who frequently use the fishery because such users are more likely to be interviewed. Thomson (1991) showed that on-site surveys were more likely to inflate expenditures and trip cost estimates per person than mail surveys. We are unaware of any such studies conducted for conjoint-choice studies, but it is likely that avid anglers' preferences may differ from those of other anglers and that estimates of visitation numbers based solely on the creel survey will also be upwardly biased. We cannot assume that expenditures will also be upwardly biased in the CTHFP since urban catfish angling expenditures are probably very different from Thomson's (1991) sample of saltwater anglers, who are more likely to use boats and who travel longer distances. Second, there is a potential for selection bias in that on-site surveys do not include nonusers who might be attracted to a site if improvements in amenities are made. Furthermore, current users may make more trips if improvements are made. Therefore, selection bias is likely to result in underestimating the total welfare improvements due to attraction of potential users. This is a shortcoming of using a creel survey and economic survey together, but the direction and ordering of preferences are unlikely to be affected. Furthermore, although conducting the conjoint on-site survey with planned creel activities may be cost effective, it does not provide insight on whether nonanglers might decide to participate should the proposed hypothetical management changes occur.

Data for this study were collected as part of a larger study that assessed fish stock size, growth rates, and mortality in combination with a creel survey conducted to ascertain angler demographics, catch and harvest data, and level of satisfaction. The creel survey was conducted from September 2006 to August 2008 at the three ponds by using a roving creel clerk design. A convenience sample of all individuals on site was used. In this case, the majority of anglers on site were interviewed, resulting in a 97% response rate (Balsman 2009). Anglers were asked basic demographic information and trip characteristics for their current fishing trip. Each angler was also presented with two conjoint choice sets for potential management at the pond. Each choice set had three options, of which the third was always the status quo at the pond where the angler was interviewed. Table 1 lists seven pond attributes and their associated levels, which were used to construct the survey options; the attributes included the size of channel catfish stocked, length limit on catfish taken, type of fish stocked, availability of a fishing dock, availability of restrooms, and an increase in the annual fishing license fee. The choice sets were orthogonally designed to eliminate collinearity between choices. Seven measurable attributes with CTHFP experiences of two, three, or four levels were included, thus creating a total of 768 (i.e., $2^4 \times 3^1 \times 4^2$) possible combinations (management scenarios). Each combination (option A) was then randomly paired with another combination (option B). A third combination (option C) represented the status quo or no change. Lusk and Norwood (2005) demonstrated that using a random assignment of profiles from the full factorial performs well in terms of efficiency of the willingness-to-pay estimates. Respondents were asked to compare the three alternatives (options A, B, and C) simultaneously and to choose one of them (see Figure 1 for an example). The survey design of randomized choice sets was created by generating a full factorial combination of all attribute levels and randomly assigning each potential combination with a different random combination in Microsoft Excel 2007; this can also be done in automated routines, such as FACTEX in the Statistical Analysis System (SAS 2004). A full survey design can also be created in SAWTOOTH software (Sawtooth Software, Inc., Sequim, Washington).

Model development.—We used a random utility model to estimate the likelihood of respondent choice (Train 2003). We assumed that when asked to choose between options A, B, and C, respondents chose the option that gives them the highest utility (a measure of welfare or happiness). This condition is represented by

$$U_{ij} > U_{ik}, \tag{1}$$

where U is the utility of individual respondent i. A respondent will select option j over option k only if k is not equal to j (i.e., the chosen option always gives the respondent the highest satisfaction).

However, we do not know the real utility of the respondent. We can only observe the indirect utility function of respondent i for choice j, denoted as V_{ij}; the unobservable part of the utility that is unknown is denoted as ε_{ij}. Therefore, the utility can be represented as

$$U_{ij} = V_{ij} + \varepsilon_{ij}, \tag{2}$$

where j denotes the option (A, B, or C) being selected by the respondent. The indirect utility function can be observed by using the answers to the discrete-choice questions in which the attributes are arguments. Therefore, V_{ij} can be expressed as a function of policy attributes accompanying each alternative and the unobservable part of the utility that is unknown (denoted as ε_j). Therefore, the utility can be represented as (Alberini et al. 2007)

$$V_{ij} = \mathbf{X}_{ij}\boldsymbol{\beta}, \quad \forall_j \in \mathrm{C}, \tag{3}$$

where $\mathbf{X}_{ij}$ is the vector of policy attributes, $\boldsymbol{\beta}$ is a vector of unknown coefficients, and j is the alternative in choice C for individual i. For simplicity, we assume that V_{ij} is linear in $\mathbf{X}$, so the deterministic part of utility may be modeled as

TABLE 1.—Site attributes and levels for the discrete-choice survey assessing angler willingness to pay for management options at Close-to-Home Fishing Program ponds in the Oklahoma City metro area (2006–2008).

Attribute	Attribute levels
Size of channel catfish stocked	8 in
	12 in
Length limitation of catfish taken	No limit
	12 in
Daily bag limit for catfish (number of fish)	4
	6
	8
	10
Type of fish stocked in ponds	Bass, bluegills, and catfish
	Catfish only
Fishing dock	None
	One open dock
Restroom	None
	Portable toilets
	Restroom with flush toilets and running water
Increase (US$) in the yearly city license fee	$0
	$2
	$4
	$6

$$V_{ij} = \beta_0 + \beta_1(S_{ij}) + \beta_2(L_{ij}) + \beta_3(T_{ij}) + \beta_4(B_{ij}) + \beta_5(F_{ij}) + \beta_6(\mathrm{PR}_{ij}) + \beta_7(\mathrm{FR}_{ij}) + \beta_8(P_{ij}), \quad (4)$$

where S = the size of channel catfish stocked,
L = the length limit of catfish taken,
T = the type of fish stocked in ponds,
B = the daily bag limit for catfish,
F = whether a fishing dock is provided in ponds,
PR = a dummy variable for portable toilets,
FR = a dummy variable for restrooms with flush toilets and running water, and
P = the increase ($) in the yearly city license fee.

The β coefficients represent the parameters to be estimated, and β_0 is the alternative-specific constant, which captures the effect in utility of a respondent's selection of option C (the status quo) more often than options A and B in the sample (i.e., this measures whether there is a status quo bias among respondents). We refer to this as basic model 1 because it does not include any interaction terms (i.e., all ponds and demographic groups are considered the same with respect to the attributes that lead to utility).

In addition to the model specified in equation (4), two separate models were used to test for differences in preferences at different ponds and among different demographic groups as distinguished by income, race, age, and having children. By including ponds and demographic characteristics as an interaction terms for each attribute, the impacts are allowed to vary among respondents with different demographics. The first pond model (i.e., model 2) is specified as

$$V_{ij} = \beta \mathbf{X}_{ij} + \delta(\mathbf{X}_{ij} \times \mathbf{POND}), \quad (5)$$

where **X** is a vector of variables specified in equation (4). The δ coefficient represents the parameters to be estimated. The term **POND** is a vector of ponds, which is made up of Dolese Youth Pond and South Lake Park East, with Kid's Lake North as the reference pond. Model 3, the interaction model, also includes demographic characteristics:

$$V_{ij} = \beta \mathbf{X}_{ij} + \delta(\mathbf{X}_{ij} \times \mathbf{POND}) + \alpha(\mathbf{X}_{ij} \times \mathbf{Y}) + \gamma(\mathbf{X}_{ij} \times \mathbf{AGE}) + \theta(\mathbf{X}_{ij} \times \mathrm{CHILD}), \quad (6)$$

where **X** is a vector of variables specified in equation (4); **Y** is a vector of income, which is separated into five categories; and **AGE** is a vector of age, which is separated into four dummy variables that are coded as 1 if the individual is in that age-group and 0 otherwise. A dummy variable, CHILD, represents households with children and is coded as 1 if a respondent has at least one child living in the household and 0 otherwise. The α, γ, and θ are the coefficients that represent the interaction parameter estimates.

From the choices made in each of two choice sets presented to an angler, a conditional logit model was employed to estimate equations (4), (5), and (6). The models estimate the probability that management option j would be chosen given option k as an alternative, where j does not equal k. We did this first using all data. We then estimated parameters for a basic model (equation 4) with interaction terms for two of the three ponds (equation 5), with the third pond (Kid's Lake North) serving as the reference pond. This

TABLE 2.—Conditional logit regression results (standard errors in parentheses, calculated using sandwich estimator of variance) for a discrete-choice survey designed to evaluate angler willingness to pay for various management options in the Close-to-Home Fishing Program in Oklahoma City (2006–2008, US$). Asterisks indicate significance ($P < 0.10$*, $P < 0.05$**, $P < 0.01$***). Each of the 568 respondents saw two choice sets with three options, resulting in 3,408 observations in the model. Robust standard errors accounted for clustered responses within each respondent's two choices. Models estimated include basic model 1 (all ponds pooled together with no interactions), pond model 2 (allows heterogeneity among respondents by lake; Kid's Lake North is the comparison or base lake with nonsignificant interactions eliminated), and interaction model 3 (tests for differences in responses among respondents by minority status, age, income, and presence of children in home). The alternative-specific constant (ASC) captures the effect in utility of a respondent repeatedly selecting the status quo (option C) compared with the utility gained from selecting options A and B (i.e., this measures whether there is a status quo bias among respondents).

Variable	Basic model 1	Pond model 2	Interaction model 3
Size of channel catfish stocked	0.04*	0.05**	0.06
	(0.02)	(0.02)	(0.062)
Length limitation on catfish taken	0.12	0.06	0.15
	(0.08)	(0.08)	(0.13)
Daily bag limit of catfish	0.15***	−0.05*	−0.14**
	(0.03)	(0.03)	(0.06)
Channel catfish-only stocking	−0.05**	−1.21***	−1.27***
	(0.021)	(0.11)	(0.11)
Fishing dock	0.25***	0.33***	0.35***
	(0.09)	(0.09)	(0.10)
Portable toilets	0.19*	0.25**	0.26**
	(0.10)	(0.12)	(0.12)
Restroom with flush toilet	0.73***	0.18	0.20
	(0.11)	(0.22)	(0.23)
License fee	−0.19***	−0.21***	−0.19***
	(0.02)	(0.02)	(0.02)
Pond interactions			
Dolese Youth Pond × bag limit		0.05*	0.06**
		(0.02)	(0.03)
South Lake Park East × flush toilet		0.54**	0.51*
		(0.27)	(0.29)
Dolese Youth Pond × flush toilet		1.00***	0.98***
		(0.26)	(0.27)
Minority interaction			
Minority × license fee			−0.10
			(0.06)
Age interactions			
Age 0–30 × size of stocked channel catfish			−0.02
			(0.06)
Age 31–45 × size of stocked channel catfish			−0.06
			(0.04)
Age 46–60 × size of stocked channel catfish			−0.01
			(0.04)
Age 0–30 × bag limit			0.10**
			(0.05)
Age 31–45 × bag limit			0.11**
			(0.06)
Age 46–60 × bag limit			0.04
			(0.06)
Income interaction (k = ×1,000)			
>20k–30k × size of stocked channel catfish			−0.11
			(0.08)
>30k–50k × size of stocked channel catfish			0.08
			(0.07)
>50k–100k × size of stocked channel catfish			0.01
			(0.06)
>100k × size of stocked channel catfish			0.05
			(0.10)
>20k–30k × bag limit			0.07
			(0.06)
>30k–50k × bag limit			0.02
			(0.05)
>50k–100k × bag limit			0.04
			(0.05)

TABLE 2.—Continued.

Variable	Basic model 1	Pond model 2	Interaction model 3
>100k × bag limit			−0.15**
			(0.07)
Child interaction			
Size of stocked channel catfish × children in household			0.04*
			(0.02)
Channel catfish-only stocking × children in household			0.07
			(0.05)
Length limit × children in household			−0.18
			(0.17)
ASC	−0.606***	−0.87***	−0.83***
	(0.207)	(0.22)	(0.28)
Log likelihood	−1,452.101	−1,376.39	−1,349.90
Number of observations	3,408	3,408	3,408

allowed us to see if there were pond-specific differences in the factors associated with utility. Pond model 2 is presented in Table 2 as an abbreviated model, reported after the full set of interactions was run. In addition, to test the differences among demographic groups, model 3 (equation 6) was estimated and reported as the interaction model in Table 2. To estimate the willingness to pay, the pond attribute coefficients β_1–β_7 were divided by the negative of the coefficient of city license fee ($-\beta_8$) for each model (Train 2003). The delta method in Stata version 10 (Stata 2007) was used to compute the significance of the willingness-to-pay methods because both the pond attributes and fee coefficient have different standard errors. The resulting value is the marginal value or price (in 2008 U.S. dollars, the same units used for the options for the city license fee) that the respondent was willing to pay for that attribute.

Results and Discussion

A total of 568 respondents filled out the discrete-choice questions. Descriptive statistics of these respondents are given in Table 3. The largest group of anglers ranged from age 31 to 45 (35.56%), and 45.07% of all anglers reported their household income as greater than \$50,000/year. A separate study showed that the percentage of survey respondents at lower-income households are underrepresented in the study compared with those in the general public (based on information on U.S. postal zip codes; Balsman 2009). That is, in 2007, the median household income in Oklahoma County was \$41,598 (2007 U.S. Census).

The majority of our respondents were non-Hispanic white (72.68%). Other minority racial and ethnic groups observed included Asian, Hispanic, African-American, and American Indian. Soliciting information on ethnic and racial identity can be problematic. In our study, the most basic distinction was made between non-Hispanic or non-Latino whites versus all other ethnic and minority groups to illustrate that race and ethnicity has an effect on preferences, even when controlling for differences in income. Often, a more detailed analysis of both race and ethnic backgrounds should be considered. Policy managers interested in specifically comparing racial and ethnic composition with census data often use the census categories available from the U.S. Census Bureau (www.census.gov) or the Office of Management and Budget (2000). Additional guidance on treatment of race in survey design is available from Stanfield and Dennis (1993).

The estimated valuation models provided coefficient estimates (β values) for all variables tested. Interpretation of these models is similar to linear multiple regression in that (1) only coefficients (β) that are significantly different from zero should be considered, (2) coefficients with significant negative values indicate that respondents were less likely to choose an option containing that attribute, and (3) coefficients with significant positive values indicate that respondents were more likely to choose an option containing the variable. By dividing the estimated value of the coefficient by the negative of the fee coefficient, we can compute the marginal willingness to pay (i.e., value) for an attribute, such as larger channel catfish stocked. For example, the value of an increase in the bag limit for catfish was negative ($\beta_4/\beta_8 = -[0.15/-0.19] = -\$0.79$; Train 2003). This is interpreted, for example, as the willingness to accept the imposition of a daily bag limit of two catfish if the yearly license fee was \$0.79 less per year. If the daily bag limit is raised to four catfish, the fee would have to be \$1.58 lower per year to make anglers willing to accept it. In this case, the angler dislikes the management change, as shown by the negative value, and must be compensated by a lower fee to make the respondent as satisfied with the angling experience as before the change. In our

TABLE 3.—Descriptive statistics of attribute level and angler respondents using Close-to-Home Fishing ponds in the Oklahoma City metropolitan area (2006–2008). Mean is based on a total of 568 collected surveys; 39 respondents chose not to report their annual income.

Variable	Definition	Mean
Size of channel catfish stocked	8 if 8 in, 12 if 12 in	9.33
Length limit on catfish taken	1 if 12 in, 0 if no limit	0.34
Channel catfish-only stocking	1 if catfish only, 0 if bass, bluegills, and catfish	0.38
Daily bag limit for catfish		3.92
Option 1	4 if 4-catfish limit	
Option 2	6 if 6-catfish limit	
Option 3	8 if 8-catfish limit	
Option 4	10 if 10-catfish limit	
Fishing dock	1 if 1 open dock available, 0 if none	0.35
Restroom		
None (base)	1 if no restroom, 0 otherwise	0.23
Portable toilets	1 if portable toilets, 0 otherwise	0.22
Restroom with flush toilets	1 if restroom with flush toilets, 0 otherwise	0.22
License fee		2.03
Option 1	0 if no increase in the yearly city license fee	
Option 2	2 if $2 increase in the fee	
Option 3	4 if $4 increase in the fee	
Option 4	6 if $6 increase in the fee	
Age (years)		
<31	1 if age is <31, 0 otherwise	23.39%
31–45	1 if age is 31–45, 0 otherwise	35.56%
46–60	1 if age is 46–60, 0 otherwise	25.18%
>60 (base)	1 if age is >60, 0 otherwise	15.87%
Yearly income (US$)		
<$20,000 (base)	1 if yearly income is <$20,000, 0 otherwise	13.38%
$20,001–30,000	1 if yearly income is $20,001–30,000, 0 otherwise	16.02%
$30,001–50,000	1 if yearly income is $30,001–50,000, 0 otherwise	25.52%
$50,001–100,000	1 if yearly income is $50,001–100,000, 0 otherwise	38.38%
>$100,000	1 if yearly income is >$100,000, 0 otherwise	6.69%
Minority	1 if minority, 0 if white	
White (non-Hispanic)		72.68%
Minority	Asian, African-American, American Indian, other race, or Hispanic (ethnicity)	27.32%
Children in household	1 if there are children in household, 0 if none	43.66%
By pond		
Dolese Youth Pond		46.48%
South Lake Park East		30.81%
Kid's Lake North		22.71%

case, fee increases or decreases could be accomplished by changing the price of the required fishing license. The alternative-specific constant for the status quo was statistically significant and negative for all three models, indicating a specific preference against maintaining the management status quo at the lakes. This means that, on average, respondents for these two models were significantly likely to choose any option (A or B) that proposed changes in the management of the lakes in those models.

In the basic model that included all observations, all of the variables except the length limit on catfish significantly affected willingness to pay (Table 2). Each respondent saw two choice sets with three options, resulting in 3,408 observations in the model. Respondents were more likely to choose an option that had larger stocked channel catfish, a fishing dock, portable toilets, and restrooms with flush toilets. Anglers significantly preferred restrooms with flush toilets ($\beta = 0.73$) to portable toilets ($\beta = 0.19$; within a single model, the coefficient that is higher and significant is preferred, on average, over another significant coefficient). However, both facility choices were preferred over the absence of a restroom facility, as theoretically expected. Respondents were significantly less likely to choose options with only channel catfish stocked (other species might still be present but would not be maintained through stocking), more liberal daily bag limits on catfish, and higher license fees.

Table 4 gives the average angler's dollar values (willingness to pay) for each change in the level of attributes for each model. An increase in stocked channel catfish size from 8 to 12 in was valued at $0.23 per year for the average angler (Table 4). Having only channel catfish stocked rather than a mixture of largemouth bass, bluegills *L. macrochirus*, and channel catfish was worth −$0.23 per year on average, meaning that diversifying the pond stock should be worth $0.23 per year for an average angler. A preference for a diverse fishery has been found in other community fishing surveys (Hunt and Ditton 1996). Increasing the daily bag limit of catfish takes away \$0.79 of value for every two additional fish an angler can keep. Anecdotal evidence from the creel clerks indicated that anglers perceived higher bag limits as lowering their own fishing success rather than resulting in more catfish to take home. Other studies have similarly found that anglers generally are highly supportive of bag restrictions (Hardin et al. 1988; Reed and Parsons 1999; Edison et al. 2006), including anglers in urban environments (Hunt and Ditton 1996). Furthermore, support for bag limits is higher from anglers in more densely populated areas (Edison et al. 2006), as in our study. Having a fishing dock would increase an angler's willingness to pay for an annual license by \$1.28. Anglers were willing to pay \$3.81 annually for flush toilets compared with having no restroom facilities (the willingness to pay for portable toilets was not significant when calculated using the delta method). Within the model, these results may be interpreted relatively to mean that the highest willingness to pay for a management change is for flush toilets followed by construction of a fishing dock.

Because choice-based analysis allows for estimated marginal values of each attribute, the individual willingness to pay may be seen as a relative measure of the benefit to the angler. However, the researcher's choice of payment mechanism (e.g., higher license fees versus something such as a property tax increase) can affect an individuals' willingness to pay or even result in protest responses, as shown in the contingent valuation method literature (Champ et al. 2003). In this case, pretesting did not result in protest bids, and changes in license fees offered the most realistic payment vehicle. These results also allow for cost–benefit analysis of these options, even if there is no intention to actually raise license fees to cover the cost. For example, if park managers have actual or estimated visitation rates from the creel survey, the total value per year of having portable toilets could be computed (willingness to pay $\times$ number of anglers who buy the city license) and compared with the rental and maintenance rate for portable toilets (after adjusting for sampling bias). Unfortunately, Oklahoma City did not keep records on annual license sales, so such an analysis was not possible in this study. Furthermore, while useful, such multiplication would still provide a lower bound on value because improvements might attract new users to visit a site. That is, using the discrete-choice survey only on site with the creel survey excludes unsurveyed potential users, although at an additional cost they might be surveyed by mail or internet (note that telephone surveys are ill-suited for the visual display needed for the choice sets). A multiyear benefit–cost analysis that allows benefits and costs in each year of occurrence to be catalogued and then discounted to the present could be performed for extensive infrastructure or biological improvements that have longer project lifetimes (Boardman et al. [2006] provide an excellent text).

Results from pond model 2 showed that willingness to pay for some pond management attributes (e.g., bag limits and flush toilets) significantly varied by pond (Table 2). Willingness-to-pay differences were estimated by interacting each attribute with Dolese Youth Pond and South Lake Park East dummy variables for these two management attributes in order to test which attributes were significant ($\alpha = 0.10$) and should be included in a more limited model. Pond model 2 was then estimated and reported (Table 2) including only these two interactions that were significant ($P < 0.10$) in the initial model. Compared with Kid's Lake North and South Lake Park East, anglers at Dolese Youth Pond were more likely to choose scenarios with higher bag limits ($\beta = 0.05$; $P < 0.10$; Table 2), but overall the users at Dolese Youth Pond had a nonsignificant willingness to accept value when computed using the delta method, perhaps because the interaction variable was only marginally significant ($P < 0.10$; Table 4). Table 4 shows that users at the other two lakes had a –\$0.22 value per two-catfish increase in the daily bag limit. In addition, users at both Dolese Youth Pond ($\beta = 1.00$) and South Lake Park East ($\beta = 0.54$) were willing to pay more for flush toilets than users of Kid's Lake North (Table 2), and the computed willingness to pay for flush toilets was significant at \$3.42/year for South Lake Park East and \$5.60/year for Dolese Youth Pond ($P < 0.10$) and was nonsignificant at Kid's Lake North (Table 4). Kid's Lake North anglers did not have a significant willingness to pay, possibly because of this pond's secluded location and high relative abundance of trees and brush that provide cover to anglers in lieu of facilities. The differences in willingness to pay among users of these ponds illustrate that while preferences may be similar in direction across a management program, the magnitude and specific issues may differ.

Interaction model 3 shows that anglers' preferences differed by demographic attributes, such as minority status, income, and age, at the CTHFP ponds (Table 2). Compared with Caucasian anglers, minority anglers were less likely to choose options with higher fees for licenses, but since this coefficient was nonsignificant ($\beta = -0.10$; $P > 0.10$; Table 2), we can only interpret the Table 4 willingness-to-pay values that proved significant using the delta method. Table 4 estimates showed that minorities had significantly lower willing-

TABLE 4.—Annual willingness to pay (WTP; US$) for each management attribute as reported by anglers using the Close-to-Home Fishing Program ponds in the Oklahoma City area (2006–2008). Data were collected at South Lake Park East, Dolese Youth Pond, and Kid's Lake North by using a discrete-choice survey. The delta method was used to determine the significance level of WTP; values for which $P < 0.10$ are indicated in bold.

			Interaction model 3									
					WTP based on annual household income (US$, thousands)					WPT based on age-group (years)		
Attribute	Basic model 1 mean WTP	Pond model 2 mean WTP	Mean WTP	Minority WTP	>20–30	>30–50	>50–100	>100	WTP, children in household	<31	31–45	46–60
Size of channel catfish stocked	**$0.23**	**$0.25**	$0.30	$0.20	−$0.29	**$0.70**	$0.35	$0.54	$0.51	$0.18	−$0.02	−$0.24
Length limit on catfish taken	$0.62	$0.30	$0.79	$0.52					−$0.12			
Channel catfish-only stocking	**−$0.23**	**−$5.75**	**−$6.57**	**−$4.34**					**−$6.19**			
Daily bag limit for catfish	**−$0.79**											
Kid's Lake North		**−$0.22**	**−$0.72**	**−$0.48**	−$0.36	**−$0.62**	**−$0.50**	**−$1.50**		−$0.18	−$0.14	**−$0.52**
South Lake Park East		**−$0.22**	**−$0.72**	**−$0.48**	−$0.36	**−$0.62**	**−$0.50**	**−$1.50**		−$0.18	−$0.14	**−$0.52**
Dolese Youth Pond		−$0.03	−$0.43	−$0.28	−$0.07	−$0.32	−$0.21	**−$1.20**		$0.12	$0.15	−$0.22
Fishing dock	**$1.28**	**$1.58**	**$1.82**	**$1.20**								
Portable toilets	$0.98	**$1.19**	**$1.36**	**$0.90**								
Flush toilets	**$3.81**											
Kid's Lake North		$0.84	$1.05	$0.70								
South Lake Park East		**$3.42**	**$3.67**	**$2.43**								
Dolese Youth Pond		**$5.60**	**$6.11**	**$4.05**								

ness to pay than non-Hispanic whites for fishing docks ($1.20 versus $1.82), portable toilets ($0.90 versus $1.36), and flush toilets ($1.24 less at South Lake Park East and $2.06 less at Dolese Youth Pond). The compensation required for accepting increases in daily bag limits on catfish at Kid's Lake North and South Lake Park East was less for minority anglers (–$0.48 for a two-catfish increase) than for non-Hispanic whites (–$0.72 per two-catfish increase). This reduced willingness to pay higher fees would be expected to reduce the values estimated for all tested attributes because willingness to pay for each attribute is calculated by dividing the estimated coefficient for each attribute by the estimated coefficient for the license fee. Households with children were slightly less averse to channel catfish stocking than the average household (–$6.19 versus $–6.57; Table 4). For households with children, variety in the angling activity may not be as important as simply catching a fish.

Age and income also affected willingness to pay for attributes such as the size of channel catfish stocked and catfish bag limits (Tables 2, 4). Compared with anglers over age 60 (the reference age-group), anglers in the age-31–45 group were less likely to choose scenarios with larger channel catfish ($\beta = -0.06$) and more likely to choose higher bag limits ($\beta = 0.11$; Table 2); however, Table 4 shows that the computed willingness-to-pay values were nonsignificant. Anglers less than age 30 were more likely to choose higher bag limits ($\beta = 0.10$), but the willingness-to-pay values also proved nonsignificant. Willingness to pay only differed significantly from that of the reference group (over age 60) at Kid's Lake North and South Lake Park East for the age-46–60 group, which had a –$0.52 value per given increase in size of channel catfish stocked per year (increase from 8 to 12 in; Table 4). (Note that the willingness to pay for interacted categories is computed by adding the interaction term coefficient to the coefficient for the base, dividing by the fee coefficient, and then taking the negative of the result to obtain the categorical willingness-to-pay [WTP] value: $WTP_{[\text{age 46–60} \times \text{bag limit}]} = -[-0.14 + 0.04]/-0.19$; the delta method uses the sandwich standard error to compute the significance of the willingness-to-pay estimate). These results suggest that all groups under age 60 might be more harvest-oriented. Alternatively, older anglers may feel that higher bag limits would decrease their own individual probability of catching fish.

Although on average, anglers grouped as a whole were willing to pay for larger stocked channel catfish, the levels of willingness to pay varied by income. Anglers with households earning between $30,000 and $50,000 were willing to pay $0.70 more per year for an increase in the size of channel catfish stocked compared with the lowest income bracket (<$20,000/year). Responses from anglers in the top-three income categories suggested that a two-catfish increase in the daily bag limit at Kid's Lake North and South Lake Park East lowered the value of their license (Table 4). At these two ponds, anglers in the $30,000–50,000, $50,001–100,000, and greater than $100,001 household income brackets found that their licenses were devalued by a two-catfish increase in the daily bag limit (i.e., −$0.62, −$0.50, and −$1.50/year, respectively). Thus, the wealthiest anglers were most opposed to bag limit increases, perhaps because of higher opportunity costs of time to fish elsewhere. Finally, anglers in households with an income over $100,000 were slightly less opposed to bag limits at Dolese Youth Pond (willingness to pay = −$1.20/year per two-catfish increase in daily bag limit) than at the other two ponds. Anglers in households earning under $30,000 per year had no significantly different willingness-to-pay values by species stocking, bag limit, and length limit (Table 4), which is an interesting result because urban fishing programs are often intended to serve less-affluent city dwellers who lack the means and opportunity to fish elsewhere (Botts 1984). However, as the demographic data show, individuals between ages 18 and 45 had negative values for increases in the size of channel catfish stocked, but when the results were tested by income the value in stocked channel catfish size increased, particularly for those in the middle income bracket ($30,000–50,000). Little is published on the opinions of anglers by age-group or income level. Our results suggest that differences in opinion among individuals of different ages and incomes should be considered in future studies.

Conclusions

The results of this discrete-choice survey show that anglers are willing to pay for increases in management effort, such as larger stocked channel catfish and increases in variety in fish stocked in CTHFP ponds. However, anglers are willing to pay more for physical amenities, such as docks and restroom facilities, in the urban setting. This is consistent with other studies indicating that amenities are critical to the success of an urban fishing program (see review by Balsman and Shoup 2008). While little information exists on how preferences of urban and rural anglers differ, previous studies have suggested that urban anglers place a higher priority on facilities (Manfredo et al. 1984), but this is not more important than the quality of the fishing (Schramm and Dennis 1993). We also found that anglers do not desire increased bag limits but are less opposed at Dolese Youth Pond. Support for bag restrictions has been observed in other angler surveys, both in urban fishing programs (Hunt and Ditton 1996) and nonurban settings (Hardin et al. 1988; Reed and Parsons 1999; Edison et al. 2006). Our results suggest that Oklahoma City anglers differ in this respect. Length limits were nonsignificant in all models, suggesting that anglers see neither positive nor negative benefits in the potential imposition of a 12-in limit (i.e., this is seen as a nonbinding constraint). Length limits are imposed in this fishery to maintain a longer average length of fish captured than would probably occur without the limit (reproduction is not a consideration in this put-grow-and-take fishery). Although this is a put-grow-and-take fishery, the lack of desire for increased bag limits and the lack of opposition to limits suggest that recreation is more important than harvest to most of the respondents. In terms of providing fishing experiences for minority households, the results show that these groups are willing to pay less on average for most management improvements. Therefore, if an urban program is designed to target these groups, it is important to seek funding from sources other than increased license fees because higher costs may discourage these demographic groups from participating (Balsman and Shoup 2008). While some information exists about how urban and rural angler demographics and behaviors differ (Manfredo et al. 1984; Schramm and Dennis 1993; Arlinghaus and Mehner 2004), almost no information exists on what amenities are most desirable to these two groups. Further research is warranted on this topic.

Given that detailed valuation estimates of anglers' demand for different attributes of managed angling sites can be time consuming and costly, managers may be tempted to use value estimates from another site for application to a new location, something called benefits transfer. Unfortunately, as the pond interaction variables show, such assumptions may miss variation among users. Meta-analysis of multiple studies of value for characteristics might be used to adjust welfare measures of value, but given the lack of studies on urban fisheries, site-specific research is still necessary. Furthermore, the goals of a different project may diverge from those of the CTHFP, which looked at physical amenities for direct use by anglers (i.e., manmade docks, restrooms, and stocking rates). Furthermore, adjustments for study methodology would need to be made (Johnston et al. 2006). However, this study illustrates that valuation data for current users can easily be obtained in conjunction with creel surveys that may already be planned. Using the methods described in this study, these data can be used to determine marginal willingness to pay for management options or amenities, but obtaining the proper expertise for designing the choice experiment is vital. Once obtained, the marginal willingness to pay for a change can be readily compared with the increased cost of implementing the change using benefit–cost analysis. If the willingness to pay is greater than the cost, then the agency should implement the change if the budget allows. Another potential benefit of using conjoint choice in other settings is the ability to value other nonmarket values besides recreational use, such as anglers' willingness to pay for species preservation, maintenance of instream flows for wildlife, or improved water quality.

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