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Measuring the Location Value of a Recreation Site

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The demand for sport fishing on the Snake River reservoirs was estimated using the travel cost method. A short-run demand model was specified with location value for anglers who have the option to access a follow-on site if fishing conditions are poor. Willingness to pay for a fishing trip to the site was $18.52 for anglers who did not have a follow-on site and $43.48 for anglers who did. A location value of $24.96 accrued only to anglers with a follow-on site. Total annual site value was understated by as much as 40% ($0.78 million) if location value for anglers with a follow-on site was excluded from the benefit estimate.

Key Words: contingent behavior, count data, endogenous stratification, follow-on site, location value, multiple destination, option value, short-run demand, travel cost method

Introduction

A comprehensive environmental impact statement (EIS) evaluated alternatives to restore endangered and threatened salmon and steelhead, including the alternative of breaching the four dams on the lower Snake River (U.S. Army Corps of Engineers, 2002). The lower Snake River reservoirs provide anglers with a wide variety of fish species, excellent catch rates, stable water levels, vast reservoir acreages, and easy access. Flatwater recreational fisheries would not exist without dams. Thus, the EIS considered the foregone value of the 140-mile flatwater fishery in a comprehensive measure of the costs and benefits of breaching the dams (Loomis, 2002).

Conventional wisdom holds that the value of a recreational site is likely to be overstated because some of the benefits of visiting other sites during a trip are "mistakenly" attributed to the study site (Haspel and Johnson, 1982). This outcome implicitly assumes that other sites must be substitutes and ignores cases where some sites may be complements. Complementary follow-on sites can contribute to location value and increase the Snake River reservoir site's benefits by reducing the risk of a "failed" recreational trip when fishing conditions are poor at the first site visited.

Location value is an option value that occurs if a complementary follow-on site exists. Option values occur when visitors face time constraints but have an opportunity to visit a follow-on site after they have traveled to the first site. The following contingent behavior question was posed to anglers at Snake River reservoirs to determine if anglers consider

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follow-on sites: "Will you typically leave the site where you were surveyed for alternate reservoirs, lakes, or streams if fishing conditions are bad here?" Of course, some anglers may simply have a preference to visit more than one fishing site during a trip regardless of fishing condition risk. Those anglers will have a higher willingness to pay to visit Snake River reservoirs when a second site is available to them during the trip. Thus, the value of having a follow-on site includes the value of risk reduction to anglers who may visit a second site when fishing conditions at the first site are poor, and the value of access to multiple sites for anglers who generally prefer multiple-site fishing trips.

The travel cost method (TCM), with a focus on location prices, was used to estimate recreational fishing value for Snake River reservoirs. Satisfaction derived from recreation activities, such as fishing, is inherently risky due to factors such as weather, crowding, or day-to-day fishing conditions. Consequently, recreationists are likely to plan for follow-on sites. A recreation site, such as the Snake River reservoirs, has a fishing use value to anglers who did not have a follow-on site and, for some anglers, additional location value because of access to a follow-on site. Willingness to pay for the first site should be higher if anglers have the option of continuing on to a second site where they believe fishing conditions may be acceptable. Location value, which has been omitted or misstated in previous research, should be considered for accurate assessments of recreation site benefits.

The goal of this study is to estimate location value for visitors who have the option of continuing to a follow-on site. We develop a short-run travel cost demand model for a fishing site where recreation conditions are uncertain or risky. The travel cost model is augmented by variables including risk, option value, measurement of site location value, and specification implications of short-run decisions.

Methods

A TCM trip demand is imputed indirectly from observed behavior, making the demand coefficients sensitive to estimation and specification. The model applied to the Snake River reservoir site needs to account for truncated and endogenously stratified count data and model specification with respect to: (*a*) income and time constraints, (*b*) own-price or travel costs, and (*c*) cross-prices of closely related goods. A follow-on site, which generates location value, is a closely related (complementary) good. Thus, trip demand would be misspecified if the value of follow-on sites is omitted.

Several methods for considering multiple destinations in the TCM have been suggested. Smith and Knopp (1980) propose the most direct solution—discard multiple-site visitors from the sample. This practice is adequate only if multiple-site visitors are rare. Discarding valuable observations creates an estimation bias when tastes, prices for closely related goods, time constraints, and income constraints differ systematically between the included and excluded samples. More important, discarding multi-site visitors precludes measurement of site location values. Haspel and Johnson (1982) and Knapman and Stanley (1991) assigned a fraction of total travel costs to multiple destinations, and then estimated separate demand functions for each site. Mendelsohn et al. (1992) treated combinations of sites as a single site, each with its own demand function, within a system of equations to capture the substitution between the single site and combinations of sites. However, the presence of alternate sites creates the need for large data sets. Both the Haspel and Johnson, and Mendelsohn et al. methods arbitrarily designate sites or travel costs, and assume that all alternate sites are substitutes. Hence, they do not identify or measure the location value of a recreation site.

The Two-Step Decision Model

A travel cost model was specified as a conditional (on predetermined long-run labor market choices) recreation demand function, based partly on Barnett's (1979, 1981) two-step consumer decision model without time-saving (McKean, Johnson, and Taylor, 2003; McKean et al., 2005). The conventional long-run equilibrating labor market methodology was not appropriate for most recreationists in our sample because of stringent conditions imposed by the model. The traditional single-step demand model (Becker, 1965) assumes that each purchase of a time-consuming good would require resolving long-run labor/leisure tradeoffs to jointly maximize satisfaction from earned income and time. However, close to 90% of the sample had no foregone income while recreating and thus did not exchange money wage income for time.

At least three situations can make the equilibrating labor market model irrelevant: (*a*) the recreationist is retired, a student, self-employed, unemployed, or otherwise has no wage-based income; (*b*) the recreationist is subject to the dictates of an employer who sets work rules, thereby precluding consumer choice of hours worked so that the labor market is non-equilibrating (Bockstael, Strand, and Hanemann, 1987); or (*c*) the recreationist makes consumption decisions using a two-step decision process (Barnett, 1979, 1981) which results in a non-equilibrating labor market as described in the following section. One or more of these situations are likely to apply for some recreationists. In each case, a wage rate either does not exist or it fails to provide a competitive market-clearing price for labor, rendering the equilibrating labor market model inappropriate.

Separating short-run and long-run consumer decision making had a limited history (Abbott and Ashenfelter, 1976; Barnett, 1979, 1981; Deaton and Muellbauer, 1980) before being applied to recreation (Bockstael, Strand, and Hanemann, 1987; Ward, 1989; Shaw and Feather, 1999; McConnell, 1999; McKean, Johnson, and Taylor, 2003; McKean et al., 2005; Palmquist, Phaneuf, and Smith, 2005). Two-step decision models assume consumers resolve long-run labor/leisure tradeoffs and then allocate resulting endowments of available time and income among individual goods.

Larson and Shaikh (2001) and Shaikh and Larson (2003) depict step 1 as the labor market. Specifically, in their 2001 work (p. 429), they write: "The money and time budgets . . . can be thought of as resulting from a predetermined labor-supply decision by the individual, which results in discretionary income and time to be allocated to leisure-time activities and goods consumption." Their approach apparently assumes that both step 1 and step 2 involve long-run consumer decisions. In contrast, Barnett assumes that step 1 involves long-run consumer decisions, while step 2 is associated with short-run consumer decisions. In the short run, consumers can potentially augment their free time by purchasing less time-intensive goods.

We assume consumers cannot exchange work hours (or money income) for free time in the short run. Recreationists either have no foregone income or cannot renegotiate work hours with employers each time they make an individual purchase of a time-consuming good. This distinction is important to the demand model because, in the short run, time and income are not fungible and "full" income is not defined. In the Barnett model, consumers make long-run capital investments in education, occupation choice, place of work, and residence location, which are the preconditions for the exogenous variables specified in the estimated short-run recreation demand:

$$Q_s = f\left(\mathbf{P}, \mathbf{t}, T^*, E^*, \mathbf{O}\right), \tag{1}$$

where vectors **P** and **t** include pecuniary and physical time costs for round-trip travel from home to recreational sites and for closely related goods (including the prices for single versus multi-site trips), T^* and E^* are endowments of time and money income, and **O** represents a vector of tastes and preferences and other exogenous demand shifters. The dependent variable (Q_s) is annual reported trips from home to a Snake River fishing site. The two-step decision model is detailed in the appendix, and definitions of variables in the trip demand equation are presented in table 1.

Location Prices and Option Value

Demand for recreation sites with potential multiple destinations can be analyzed via a travel cost model when price measures related to location are included in the demand function [equation (1)]. The value of a recreation site is affected by its location vis-á-vis visitor population centers and complementary as well as substitute sites. Thus, we account for location effects with (*a*) money and time prices paid by Snake River reservoir anglers with a follow-on site (P_{ms} and t_{ms}) which are separate from the prices paid by Snake River reservoir anglers without a follow-on site (P_{ss} and t_{ss}); (*b*) the pecuniary price to travel from a Snake River site to a follow-on site, if any (P_{md}); and (*c*) the pecuniary price (P_a) of the most preferred substitute site which could replace visiting the Snake River reservoir site on the first leg of a trip. Note that the price for a follow-on site (P_{md}) is not based on the distance from home to that site, but rather on the distance from a Snake River site to a follow-on site (if any).

Willingness to pay for a recreation site visit can include a location value in addition to its fishing use value. Residence location is a long-run (step 1) decision in the Barnett model (or implicitly in any single-equation TCM). Location of a residence in the short run is exogenous and the locations of substitute and complementary sites are fixed, making the location attribute (*loc*) of a Snake River site exogenous and unique for each visitor. Visitors are constrained by available blocks of free time of length (*bft*) for their trips (such as weekends), which precludes extensive searches for an optimal fishing site and restricts many visitors to a single site (Palmquist, Phaneuf, and Smith, 2009). Hence, two exogenously determined categories of anglers visit the Snake River reservoirs—those with and those without a follow-on site.

We denote consumer surplus fishing use value at the first site as CS_1 and consumer surplus fishing use value at a follow-on site as CS_2. An angler with no follow-on site will have an expected trip value for a Snake River site as shown by:

$$\text{(2)} \qquad \mathrm{E}\big(WTP_{ss} \mid (loc, bft)\big) = \mathrm{E}(CS_1).$$

Specifically, the value of a trip is the expected consumer surplus from fishing at a Snake River site. Assume a “threshold fishing use value” Ω which denotes a minimum level of consumer surplus so that the first site is acceptable for fishing, i.e., $CS_1 \geq \Omega$. If this condition is not met, an angler either returns home or engages in nonfishing recreation during a trip.

An angler with a follow-on site has two possible outcomes—to either visit or not visit a second site. If $CS_1 \geq \Omega$, a follow-on site is not visited. However, if $CS_1 < \Omega$, an angler leaves the first site where conditions are known to be unacceptable and tries a follow-on site. (The value of a trip to the first site is determined prior to starting the trip. Thus, both sites are risky in terms of recreation value when deciding to visit a Snake River site.)

Table 1. Definitions of Variables

Variable [a]	Units	Mean	Definition
Q_s	trips/year	19.22	Annual trips from home to Snake River reservoir fishing site (dependent variable)
P_{ss}, P_{ms}	\$/trip	9.11, 8.89	P_{ss} is pecuniary round-trip travel cost to Snake River reservoir site for anglers without a follow-on site; P_{ms} is pecuniary cost for anglers who had a follow-on site
P_s	\$/trip	8.99	Aggregate model; P_s is pecuniary travel cost for all anglers
L(t_{ss})	hours/trip	3.89	Round-trip travel time from home to Snake River reservoir site for anglers without a follow-on site
L(t_{ms})	hours/trip	5.28	Round-trip travel time from home to Snake River reservoir site for anglers who had a follow-on site
L(P_a)	\$/trip	12.04	Pecuniary travel cost from home to a substitute fishing site away from the Snake River reservoirs
L(t_{as})	hours/trip	7.54	Time on-site at a secondary fishing site away from the Snake River reservoirs during the trip
L(t_{os})	hours/trip	26.83	Time on-site fishing at the Snake River reservoir during the trip
P_{md}	\$/trip	2.08	Pecuniary travel cost for the second leg of the trip from Snake River reservoir site to a follow-on site for anglers using the site
L(E^*)	\$/year	42,698	Annual family wage and non-wage income
L(T^*)	days/year	108.46	Discretionary non-work time available per year
L(*E*(*catch*))	fish/day	7.21	Expected catch rate per day at the reservoirs, based on past experience
L(*taste*)	hours/day	6.55	Angler's typical number of hours fished per day
FEXP	years	13.53	Angler's total fishing experience at the reservoir
A	years	45.05	Angler's age
AS	$(\text{years})^2$	2,202.04	Angler's age squared

[a] "L" denotes a log transform.

Let P^* denote the probability that $CS_1 \geq \Omega$. Anglers without a follow-on site have expected consumer surplus from fishing of $(P^*)\text{E}(CS_1)$ because, by the consumer's threshold rule, the first site is not used for fishing unless $CS_1 > \Omega$, which has a probability P^*. An angler with a follow-on site will have expected trip value = CS_1 if conditions at the first site are acceptable, and expected trip value = CS_2 if conditions at the first site are unacceptable. Assuming a follow-on site is used, the first (Snake River) site creates no benefit. Thus, the expected outcome for an angler with a follow-on site is:

$$\text{(3)} \qquad \text{E}\left(WTP_{ms} \mid (loc, bft)\right) = (P^*)\text{E}(CS_1 \mid CS_1 \geq \Omega) + (1 - P^*)\text{E}(CS_2 \mid CS_1 < \Omega).$$

Location value is the difference in expected consumer surplus with or without a follow-on site and is obtained by subtracting equation (2) from equation (3):

$$\text{(4)} \qquad \eta \mid (loc, bft) = \text{E}(WTP_{ms}) - \text{E}(WTP_{ss}) = (P^*)\text{E}(CS_1) + (1 - P^*)\text{E}(CS_2) - (P^*)\text{E}(CS_1),$$

which reduces to:

$$\eta \mid (loc, bft) = (1 - P^*)\mathrm{E}(CS_2). \tag{5}$$

Location value shown in equation (5) is the product of the probability that a Snake River site is not acceptable and expected consumer surplus of fishing at the follow-on site. If the threshold fishing use value (Ω) applies to the follow-on site as well as to the first site, then $\mathrm{E}(CS_2) > \Omega$ (or it would not be a relevant site). The ex ante expectation is for location value η to be positive, i.e., $\eta \mid (loc, bft) = (1 - P^*)(CS_2 > \Omega) > 0$. Therefore, all anglers with follow-on sites would have positive expected location or option values. However, some anglers (48%) are precluded from having a follow-on site because of relative site locations (*loc*) and limited blocks of free time (*bft*) available for a trip. The reciprocal of the price coefficient on travel cost from a Snake River site to a follow-on site can be used to estimate the added value of continuing on to a second site (i.e., $CS_2 = 1/{-B_{md}}$).[1] The expected value of visiting a second site is calculated as the product of the added value of the second site visit and the fraction $(1 - P^*)$ of anglers choosing to do so. Equations (2)–(5) show that the expected value of a second site visit, $(1 - P^*)\mathrm{E}(CS_2 \mid CS_1 < \Omega)$, provides a measure of location value for a Snake River reservoir site.

In addition to the location value estimator shown in equation (5), location value for a Snake River site is revealed directly by the added willingness to pay to visit Snake River reservoirs if an angler has a follow-on site. Thus, parsing the Snake River demand price coefficients for anglers with and without follow-on site options provides a second measure of location value. Location value based on the parsed own-price coefficients is:

$$\eta \mid (loc, bft) = (1/{-B_{ms}}) - (1/{-B_{ss}}), \tag{6}$$

where $(1/{-B_{ms}})$ is the consumer surplus per person per trip to visit a Snake River reservoir site for anglers who have a follow-on site, and $(1/{-B_{ss}})$ is the consumer surplus to visit a Snake River reservoir site for anglers who do not have a follow-on site.

Time and Income

As discussed earlier, if consumers preallocate time for work, then work time is not a choice variable in second-step decisions and wage rates are inappropriate measures of short-run time value. If consumers lack a monetary value for time, they must consider separate time and income budgets when allocating available endowments between recreation and other consumer goods. Although work time is fixed in step 2, recreationists could “buy time” and reveal an implicit time value. For example, “time saving” occurs by substituting increased travel expenses for time (e.g., air versus road travel). However, for this study site, anglers are using campers, trailers, or mobile homes to visit multiple sites and they cannot substitute transport modes to save time. Without an operational monetary value for their time, many consumers in our data set must react to separate time and income budgets. Therefore, separate money and time prices and separate income and time constraint variables are specified for all recreationists.

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[1] The Poisson and negative binomial regressions, with a linear relation on the explanatory own monetary price variable, are equivalent to a semilog functional form. Adamowicz, Fletcher, and Graham-Tomasi (1989) show that the annual consumer’s surplus estimate for demand with continuous variables is $\mathrm{E}(Q_s)/{-\beta}$, where β is the estimated slope on price and $\mathrm{E}(Q_s)$ is average annual visits. Consumer’s surplus per trip from home to site is $1/{-\beta}$. The estimate of consumer’s surplus is invariant to the distribution of trips along the demand curve when surplus is a linear function of trips. Thus, it is not necessary to numerically calculate surplus for each data point and sum as would be the case if the surplus function was nonlinear.

The discretionary time constraint variable (T^*) measures available free time. Free time restrictions are expected to reduce the number of trips taken and, as with many previous recreation demand studies, the coefficient on the discretionary time variable is hypothesized to be positive and highly significant.

The income constraint variable (E^*) is average annual family income from non-wage income and wage earnings. The effect of income on demand is determined by differences in tastes among income groups. Although restrictions on income should reduce overall purchases, the constraint may also cause a shift to inferior consumer goods. Thus, in recreation demand models, the sign on the money income coefficient is indeterminate and income is often unimportant or has a negative effect on demand.

Own-Prices

Pecuniary prices are based on Ward's (1983, 1984) restrictive measure—the minimum expenditure required to travel from home to a recreation site and return. Purchases in excess of that minimum are optional. These optional purchases are closely related goods in the demand model. As discussed above, site demand in the pooled model (TCM II) is specified with separate prices for anglers without a follow-on site (P_{ss}) and anglers with a follow-on site (P_{ms}) through the use of binary dummy variables. In addition to pecuniary prices, physical time prices are also included. The variable t_{ss} is the round-trip travel time for anglers without a follow-on site and t_{ms} is the round-trip travel time for anglers with a follow-on site.

Prices of Closely Related Goods

Substitute sites to Snake River reservoirs have a pecuniary price and a physical travel time price. The pecuniary substitute site price (P_a), is the out-of-pocket travel cost from home to an angler's most preferred alternate fishing site. The time substitute site price (t_a) is the round-trip driving time from home to the most preferred alternate fishing site. The pecuniary and physical time prices for a substitute site should have a positive effect on demand. The price to access a follow-on site (P_{md}) is expected to have a negative effect on demand. A follow-on site is a complementary good which is used only in conjunction with a trip to the first site, and if P_{md} is high, the first site has less value. Purchases or time spent during a trip, both on- and off-site, are prices of closely related goods which influence trips to the site (Walsh, Sanders, and McKean, 1990). The weak complementarity principle requires the existence of a particular closely related good, time on-site (Maler, 1974). The omission of closely related goods prices creates underspecification bias (Rosenthal, 1987; McConnell, 1992; McKean, Walsh, and Johnson, 1996; Parsons and Wilson, 1997). Time on-site and time used for other activities during a trip are also subject to the fixed discretionary time budget.

Prices for two closely related goods were specified: (*a*) time spent on-site at Snake River reservoirs (t_{os}), and (*b*) time spent at fishing sites away from the reservoirs by multi-site visitors during reservoir fishing trips (t_{as}). Increased time costs of a trip beyond that required for travel could increase trip demand. In this case, the two goods would be substitutes. Conversely, if increased time costs reduce the number of trips, the two goods would be complements. Therefore, the coefficient sign for discretionary time expenditures per trip is ambiguous.

Taste and Preferences

Expected fishing success (E(*catch*)), fishing intensity (*taste*), and site experience (*FEXP*) (Kaltenborn and Williams, 2002; Williams and Vaske, 2003; Hailu, Boxall, and McFarlane, 2005) are hypothesized to be positively related to trip demand. The expected fishing success rate is proxied by the prior average catch per day at the reservoirs. Two variables, hours fished per day and years that an angler has fished at the reservoirs, are proxies for angler tastes and preferences. A quadratic function for age was included to allow demand to first rise and then decline with age.

Estimation

The dependent variable is a count of fishing trips to the study site taken over a year from surveys of site visitors. Thus, estimators must account for the fact that the dependent variable is a nonnegative integer from a truncated (at one visit per year) endogenously stratified sample with overdispersed data (i.e., the variance of the dependent variable exceeds its mean). Ordinary least squares estimates will be biased toward zero when the dependent variable data are truncated from below (Maddala, 1983). Truncated Poisson and truncated negative binomial regression are appropriate for dependent variables consisting of nonnegative count data (Greene, 1981, 2002; Hellerstein and Mendelsohn, 1993).

The significance of coefficient estimates in a Poisson regression can be overstated when the dependent variable is overdispersed. The negative binomial regression does not suffer from this shortcoming. Two tests for overdispersion developed by Cameron and Trivedi (1990), and shown in Greene (2002), were reported via LIMDEP Version 8.0. These tests did not indicate the presence of overdispersion in the Poisson estimated models; however, the *t*-values appeared inflated. For example, most *t*-values exceeded 10 when Poisson regression was applied, and the *t*-values for the price variables reached about 25. Although the Poisson model assumption that $\mathrm{var}(Q_s)/\mathrm{E}(Q_s) = 1$ was not rejected (Greene, 2002), we chose to use a more conservative truncated negative binomial regression technique rather than truncated Poisson regression. The *t*-values were reduced by about two-thirds when Poisson regression was replaced by negative binomial regression.

Self-selection bias is of concern when site samples are utilized. Although the truncation adjustment accounts for exclusion of zero values, it does not adjust for the possibility that frequent visitors are more likely to be sampled. We therefore applied McKean, Johnson, and Taylor's (2003) technique to obtain full-information maximum-likelihood estimates of truncated negative binomial regression adjusted for endogenous stratification.

Survey and Site Description

A mail survey was conducted on anglers who were first contacted in person during a creel census (Normandeau Associates, University of Idaho, and Agricultural Enterprises, Inc., 1998) at Snake River reservoirs. The mail survey enumerated money and physical time costs of travel, the distance to a follow-on site (if any), fishing activities, other activities both on and off the reservoirs, and detailed socioeconomic information. The creel census included aerial angler counts and ground interviewers who contacted boat and shore anglers. Interviewers lived on-site from May through October. Based on comparisons of aerial counts which were taken for a period of 12 months, it was estimated that ground interviews accounted for

Table 2. TCM I Aggregate Demand Model Not Accounting for Location Value ($N = 567$)

Variable	Coefficient	t-Ratio
Constant	−9.890	—
P_s	−0.032	−14.58
L(t_s)	−0.214	−5.18
L(t_{os})	−0.144	−3.79
L(t_{as})	0.098	2.46
L(P_a)	0.009	4.46
L(E^*)	−0.200	−2.74
L(T^*)	0.213	7.19
L(*taste*)	0.238	3.30
L(*E*(*catch*))	0.170	4.94
FEXP	0.017	4.04
A	0.056	2.52
AS	−0.0006	−2.68

Note: The mean of the dependent variable (Q_s) = 19.22.

more than 90% of total angler hours. Virtually all persons contacted on-site agreed to receive a mail questionnaire and provided their name and mailing address. A total of 910 surveys were mailed. The mail survey resulted in a sample of 567 usable responses out of 576 surveys returned, yielding a usable response rate of 62%.

The Snake River reservoirs provide anglers with many fish species, excellent catch rates, a vast reservoir acreage, and easy access. The four reservoirs, which are connected by locks, have more than 34,000 acres of surface area stretching for nearly 140 miles. Public boat launching facilities are available at 29 locations. Anglers can choose from more than a dozen fish species, with the most sought after being smallmouth bass, steelhead trout, channel catfish, and rainbow trout (Normandeau Associates, University of Idaho, and Agricultural Enterprises, Inc., 1998). Catch rates averaged 7.2 fish per day in our sample. To facilitate barge and tour ship traffic, all reservoirs are managed to maintain minimal variations in water level.

Results

The multi-site problem was important for this data set because more than one-half (52%) of the visitors said they would continue on to a second site if the Snake River site was unsatisfactory, and more than one-third (36%) actually continued on to a second site. Three empirical approaches to the multi-site problem were used to compare the effects of different methodologies on own-price, location value, and total site value. The preferred pooled location pricing model (TCM II, table 3) is compared to a model that ignores location (TCM I, table 2) and a model which omits anglers with a follow-on site (TCM III, table 4). Models TCM I and TCM III are included to show the effects of prior approaches to multi-site recreation demand modeling. TCM I includes the entire sample and does not distinguish anglers who had follow-on sites. TCM III estimates the trip demand model after discarding

Table 3. TCM II Pooled Demand Model with Separate Pecuniary and Time Prices for Anglers Who Did or Did Not Have a Follow-on Site (N = 567)

Variable	Coefficient	t-Ratio
Constant	−13.970	—
P_{ss}	−0.054	−11.72
P_{ms}	−0.023	−6.69
$L(t_{ss})$	−0.152	−2.73
$L(t_{ms})$	−0.256	−4.66
$L(t_{os})$	−0.118	−3.01
$L(t_{as})$	0.088	2.19
$L(P_a)$	0.008	3.65
P_{md}	−0.018	−1.58
$L(E^*)$	−0.160	−2.14
$L(T^*)$	0.214	7.15
L(*taste*)	0.265	3.64
L(*E*(*catch*))	0.161	4.60
FEXP	0.017	4.01
A	0.049	2.17
AS	−0.0006	−2.26

Note: The mean of the dependent variable (Q_s) = 19.22.

Table 4. TCM III Demand Model Excluding Anglers Who Had a Follow-on Site (N = 271)

Variable	Coefficient	t-Ratio
Constant	−9.230	—
P_{ss}	−0.051	−7.97
$L(t_{ss})$	−0.170	−2.39
$L(t_{os})$	−0.262	−3.54
$L(P_a)$	0.014	2.77
$L(E^*)$	−0.207	−1.67
$L(T^*)$	0.207	4.27
L(*taste*)	0.428	3.86
L(*E*(*catch*))	0.259	4.69
FEXP	0.017	2.78
A	0.052	1.28
AS	−0.0005	−1.15

Note: The mean of the dependent variable (Q_s) = 20.39.

anglers who had a follow-on site. Thus, model TCM III omits the location value of a Snake River reservoir site for anglers who have a follow-on site. Following the discussion of the own-price and location value results, variables common to all three models (i.e., two-step decision model variables, closely related goods variables, and taste variables) will be discussed.

Location Prices and Willingness to Pay

The reciprocal of the coefficient on P_{ms} measures the value of a Snake River site to an angler who has a follow-on site. The reciprocal of the coefficient on P_{ss} is the value of a Snake River site to anglers who did not have a follow-on site. The reciprocal of the coefficient on P_{md} measures the value of a follow-on site to anglers who traveled from the first site to a follow-on site. Each of these demands is conditional on the other; i.e., the demand for the first site is measured given the price of the follow-on site and vice versa. The value of the first site to anglers with follow-on sites (in TCM II) is unbiased because: (*a*) WTP is based only on the travel cost to the first site (P_{ms}), and (*b*) the effect on demand for the first site of travel costs to access the complementary follow-on site is corrected by inclusion of the variable P_{md}, which is the price of accessing the follow-on site from the first site.

The pooled location pricing model (TCM II, table 3) was specified with three prices: (*a*) the own-price coefficient for anglers who had no follow-on site (P_{ss}) was −0.054 with a consumer surplus of $1/-\beta_{ss}$ = \$18.52, (*b*) the own-price coefficient for anglers who had a follow-on site (P_{ms}) was −0.023 with a consumer surplus of $1/-\beta_{ms}$ = \$43.48, and (*c*) the coefficient on P_{md}, which measures the pecuniary cost of travel from the Snake River site to a follow-on site, was −0.018, or \$55.56 per angler per visit for the second leg of a trip. (The *t*-value on P_{md} was only −1.58, probably because data for P_{md} were not available for anglers who had a site available but did not use it at the time of the survey.) Travel to a follow-on site is the result of a sequential decision made after reaching the first site where it was found to have poor fishing conditions. The second-leg value (\$55.56) is realized only when poor fishing conditions occur at the first site. (Recreationists without a follow-on site returned home or may have engaged in other activities besides fishing.) The estimate of \$43.48 for the first leg of the trip for anglers who had a follow-on site is based only on the cost of the first leg of the trip, but it is conditional on the cost of the second leg of the trip.

One estimate of location value is revealed by the own-price coefficients for anglers with or without a follow-on site, as shown in equation (6). Benefits for Snake River anglers who had no follow-on site were \$18.52, while benefits for anglers with a follow-on site were \$43.48. The added benefits for having the option to visit a follow-on site is \$43.48 − \$18.52 = \$24.96 (table 5).

The total travel cost for anglers who utilized a follow-on site would be P_{ss} plus P_{md}, but these two components of pecuniary travel cost are entered separately in the regression. The demand for each leg of a trip is conditional on the price of the other trip leg. Of course, the value of the second leg of the trip ($1/-\beta_{md}$ = \$55.56) does not apply to the first site. However, based on equations (2)–(5), an estimate of location value is the average expected fishing use value of the second leg of the trip. Thus, location value is the product of the fraction of anglers who visited a follow-on site and the estimated consumer surplus for the follow-on site, or (0.36)(\$55.56) = \$20.00. Therefore, two estimates (\$24.96 and \$20.00) of the location or option value accruing to anglers at the Snake River site are obtained (see table 5). Anglers with a follow-on site are willing to spend more than other anglers to access a Snake River site and to spend again, if necessary, to access a follow-on site. Their willingness to spend more

Table 5. Location Values: Summary of Results

Description	Consumer Surplus per Angler per Trip
Pooled Model TCM II: Snake River anglers who have a follow-on site	$43.48
Pooled Model TCM II: Snake River anglers who do not have a follow-on site	$18.52
Added WTP to visit the Snake River reservoirs for anglers who have a follow-on site (location value)	$43.48 − $18.52 = $24.96
Pooled Model TCM II: Expected value of the second leg of the trip for 36% of the anglers who rejected the first site and traveled to the second site (second estimate of location value)	(0.36) ($55.56) = $20.00
Aggregate Model TCM I: Full sample, ignoring the follow-on site dichotomy	$32.25
Partial Sample Model TCM III: Excludes data for anglers with a follow-on site	$19.61

than other anglers to access a Snake River site is explained by its location on a feasible path to a follow-on site and/or tastes and preferences.

The own-price coefficient estimate of −0.032 for the TCM I model provides an estimated consumer surplus per angler per trip of $1/-\beta_S$ = $32.25 (table 2). As expected, consumer surplus in model TCM I falls between that for anglers who did not have a follow-on site ($18.52) and those who did have a follow-on site ($43.48) in the TCM II model (table 5).

The TCM III regression model estimates trip demand for anglers who did not have a follow-on site. After the omission of these anglers, the sample size declined from 567 to 271. The own-price coefficient was −0.051 (table 4), which resulted in a consumer surplus estimate of $19.61 per person per trip. This result is very close to that of the pooled model ($18.52), which reported separate prices for anglers who did and did not have follow-on sites (see TCM II, table 3).

Ideally, all independent variables in the pooled regression (TCM II, table 3) would be entered separately with dummy interaction variables for the presence or absence of a follow-on site. However, collinearity and difficulty in finding a solution to the iterative truncated negative binomial model precludes expanding the already large variable list. Six interaction variables were tested individually to determine if expanding the right-hand-side variables altered consumer surplus estimates. In each case, consumer surplus fell (slightly) for anglers without a follow-on site and increased for anglers with a follow-on site. Reductions in the consumer surplus estimate for anglers without a follow-on site were all less than 5%. However, anglers with a follow-on site experienced a large increase in consumer surplus in certain cases. The greatest increase was for the substitute site price interaction variable for anglers with a follow-on site, where consumer surplus increased by 15%. Including an interaction term for expected catch rate increased consumer surplus for anglers with a follow-on site by 9%. The remaining interaction variables increased consumer surplus by less than 5%. Other unobserved socioeconomic variables, such as family size or tastes for other water-based recreation activities, might also account for differences in consumer surplus and deserve further study.

Time and Income Variables

The two-step decision model separated income (E^*) and time (T^*) constraint variables. In all three models, the discretionary time constraint (T^*) was positive and highly significant—i.e., as available time increases, people take more trips. When included separately, the effect of discretionary time has been positive in prior studies (Bockstael, Strand, and Hanemann, 1987; Loomis, Yorizane, and Larson, 2000; Loomis, 2003; McKean, Johnson, and Walsh, 1995; McKean, Walsh, and Johnson, 1996; McKean, Johnson, and Taylor, 2003; McKean et al., 2005). The income constraint was negative and significant, showing higher income reduces the number of trips. A negative income effect has been found in many recreation demand studies (Englin and Shonkwiler, 1995; Brox and Kumar, 1997; Larson, Shaikh, and Loomis, 1997; Loomis, Yorizane, and Larson, 2000; Ralston and Park, 1990; Weiler, 2006). The use of full income would require the effect of monetized free time and pecuniary income to be identical. In our research, as in many other studies, these variables have opposing signs. Our results support the use of a modified Barnett two-step decision model over the neoclassical model (Becker, 1965) which specifies full income.

Closely Related Goods Variables

Two closely related goods prices, time on-site at the reservoirs (t_{os}) and time at a second fishing site (t_{as}), were significant in all of the demand functions. The regression coefficient for time on-site at the reservoirs was negative. Hence, time on-site at the reservoirs was a complement for trips taken to the Snake River reservoirs, and a higher physical time on-site price at the reservoirs will decrease trip demand. The coefficient for time spent at a second site was positive, indicating time spent at a second (follow-on) site is a substitute for trips to the Snake River site. Therefore, an increase in the second site physical time on-site price increases trips to the Snake River site.

The demand model also requires specification of the round-trip physical travel time from home to a substitute fishing site. Travel time to a substitute site was not significant, but was highly correlated with the pecuniary cost of travel to the alternate site and was deleted from all models. The pecuniary substitute site price variable (P_a) was highly significant and had the theoretically expected positive sign of a substitute good.

Taste Variables

The taste and preference variables—the fishing success rate variable (E(*Catch*)), hours fished per day (*taste*), experience (*FEXP*), and the quadratic age functions (*A* and *AS*)—were all highly significant (with the exception of angler age in TCM III) and all had the expected signs. Trip demand increased as the success rate, time spent fishing per day, and prior site experience increased. Demand increased and then declined with angler age.

Conclusions

Recreation sites with risky recreation conditions have a trip value revealed by the site's distance from the recreationist's residence and a location value from being situated en route to other feasible recreation sites. Anglers have fixed amounts of time available for a fishing trip, which limits the number of sites and precludes some from traveling to a second site. More than one-half of the sample of anglers were able to continue on to a second site if fishing conditions at the Snake River site were unacceptable, and 36% did travel to a follow-on site. Consequently, ignoring the effect of follow-on sites on demand for the Snake River site could result in biased estimates of benefits. Proximity of the first site to follow-on sites is a valued attribute which has been neglected in prior studies. Inclusion of appropriate prices for closely related goods, such as follow-on sites, correctly adjusts for their effect on consumer surplus estimates. Comparison of consumer surplus for Snake River anglers with a follow-on site to those without resulted in a $24.96 differential, which is a location value for the Snake River site.

A second estimate of location value is provided by the option value of a follow-on site. Option values exist when delay in making a risky decision allows a better decision to be made because of improved information. In the case where a follow-on site is available, the ability to continue on to a second site requires the purchase (via the travel cost) of a trip to the first site. Thus, the value of the option to purchase a trip to a follow-on site is included in the angler's willingness to pay for the first (Snake River) site. The exogenous location attribute of the first site with respect to proximity to a follow-on site determines whether or not an option to use the second site exists. Equation (5) shows option value as the product of the probability of accessing the follow-on site and the estimated consumer surplus from fishing at a second site. Based on the consumer surplus for the second site and the sample share visiting a follow-on site, this second estimate of location value was $20.00.

In addition to option value, an indirect option value is created for the risk-averse angler. Such anglers can reduce the probability of future regret by choosing a first site which allows them to visit a follow-on site. The indirect option value is a type of risk-reducing insurance (Walsh, Loomis, and McKean, 1985; Walsh and McKean, 1999).

Models TCM I and TCM II both include the full sample and implicitly include location value. However, model TCM I fails to identify location value. Annual consumer surplus was $1.95 million for the Snake River site, but only $1.32 million per year if consumer surplus per trip was based solely on anglers who did not have a follow-on site (TCM III). Thus, excluding the possibility of multiple site trips when estimating consumer surplus per trip resulted in an underestimate of annual site value of ($1.95 − $1.32 = $0.63 million). The two estimates of location value per person per trip of $20.00 and $24.96 result in estimates of total location value of $0.62 million and $0.78 million, respectively. Therefore, location value accounts for all of the reduction in benefits when visitors with follow-on sites are excluded.

Regardless of estimation method, location value can account for as much as 40% of total site value. In summary, the location pricing trip demand results show that a large portion (52%) of anglers who visited the Snake River reservoirs are willing to pay more than twice (2.35) as much when that purchase includes an option to visit a follow-on site if the fishing conditions at the first site (Snake River reservoirs) are found unacceptable.

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Appendix:
The Modified Barnett Two-Step Consumer Decision Model

For the purpose of recreation demand analysis, Q_s is defined as annual trips to a particular recreation site. Work hours (H) are separated into fixed work hours (H_f) and variable work hours (H_v), and the corresponding wages are w_f and w_v. L is leisure time which has no pecuniary price. The consumer's time constraint is $T = H_f + H_v + \Sigma t_i Q_i + L$. The budget constraint is $w_f H_f + w_v H_v + E = \Sigma P_i Q_i$, where E is non-wage income and $\Sigma P_i Q_i$ is total consumer spending. The value of E is determined outside this model. Variable work hours $H_v > 0$, so that an interior solution can hold in step 1.

Utility is maximized subject to time and income constraints as follows:

(A1) $$Z_1 = u(Q, L) + \theta_1(T - H_f - H_v - \mathbf{tQ} - L) + \theta_2(w_f H_f + w_v H_v + E - \mathbf{PQ}),$$

where **tQ** and **PQ** are the aggregate use of time and money on consumer goods. The first-step consumer choice variables are restricted by the consumer to aggregate consumption (Q), leisure time (L), and discretionary work time (H_v). First-order optimization with respect to Q, L, H_v, and θ_1 results in:

$$\delta Z_1 / \delta Q = 0 = \delta u / \delta Q - \theta_1 t - \theta_2 P \text{ (for aggregate goods, } Q\text{)},$$
$$\delta Z_1 / \delta L = 0 = \delta u / \delta L - \theta_1,$$
$$\delta Z_1 / \delta H_v = 0 = -\theta_1 + \theta_2 w_v,$$
$$\delta Z_1 / \delta \theta_1 = 0 = T - H_f - H_v - \mathbf{tQ} - L.$$

Combining the first three optimization conditions results in the equimarginal rule to select the optimal amount of leisure versus all goods by an individual consumer, $\delta u / \delta L / \delta u / \delta Q = w_v / (P + t w_v)$, where P and t are indices of money prices and physical time costs across all goods in the consumer's market basket. (Note that the values of P and t depend on the composition of the market basket of goods which are determined in step 2. Thus, these indices must be consumer estimates in step 1.) The optimal value for H_v is determined in ($\delta Z_1 / \delta\theta_1 = 0$) using the optimal values of L and Q where H_f is fixed and T is total available time.

The second-step Lagrangian expression is denoted as:

(A2) $$Z_2 = u(Q_i, L^*) + \phi_1\left(T - H_f - H_v^* - \Sigma t_i Q_i - L^*\right) + \phi_2\left(w_f H_f + w_v H_v^* + E - \Sigma P_i Q_i\right).$$

Discretionary work time is preallocated at the level H_v^*, and leisure time is preallocated at L^* (both L and H_v were determined in the first step). The consumer choice variables in the second step are the consumer goods, $Q_1, ..., Q_n$. Assume time is consumed in fixed proportion to the amount of each time-consuming good, i.e., $t_i Q_i$. The Lagrangian expression for step 2 reduces to $Z_2 = u(Q_i, L^*) + \phi_1(T^* - \Sigma t_i Q_i) + \phi_2(E^* - \Sigma P_i Q_i)$.

The variable T^* includes all the time components $T^* = T - H_f - H_v^* - L^*$, and the variable E^* includes all the income components $E^* = w_f H_f + w_v H_v^* + E$. Note that all of the time and income components in T^* and E^* are either exogenous or were predetermined in step 1. Thus, the two-step model ensures variables T^* (available time) and E^* (available income), which are right-hand-side variables in the recreation demand function, are truly fixed or exogenous in step 2. Single-step demand models may ignore this requirement and suffer from simultaneity bias (Shaw and Feather, 1999). First-order optimization conditions for step 2 are:

$$\delta Z_2 / \delta Q_i = 0 = \delta u / \delta Q_i - \phi_1 t_i - \phi_2 P_i \text{ or } \delta u / \delta Q_i = \phi_1 t_i + \phi_2 P_i \text{ for goods } Q_1, ..., Q_n.$$

The marginal rate of substitution for any two goods is $\delta u / \delta Q_1 / \delta u / \delta Q_2 = (\phi_1 t_1 + \phi_2 P_1) / (\phi_1 t_2 + \phi_2 P_2)$.

A solution for the marginal rate of substitution in terms of the prices is not possible in step 2. The wage rate is no longer a relevant measure of the opportunity cost of time because work time and leisure time are intentionally preallocated by the consumer in step 1, and hence there can be no substitution of time from consumption to work in step 2. The important effect is that the "full price"of all time-consuming goods which was derived in step 1 ($P + tw_v$) is inoperable in step 2 for individual goods. Thus, physical time prices and money prices are separate entities in the demand function. There can be substitution of time among different goods but not between goods and work or leisure time. The conditional (on step 1) demand function will contain T^*, E^*, **P,** and **t** with no derived (full price) relationship between *w*, **t**, and **P**. The wage rate is excluded entirely from step 2 demand. Full income also is not defined in a short-run demand function for two reasons. First, as discussed above, wage rates are excluded as a value for free time. Second, and most important, free time and income are exogenous in the short run because they are predetermined by the consumer so that any rate of exchange between them is impossible.

The resulting conditional recreation demand is given by:

$$Q_s = f(\mathbf{P}, \mathbf{t}, T^*, E^*, \mathbf{O}), \tag{A3}$$

where vectors **P** and **t** include own out-of-pocket and physical time prices and prices for closely related goods, T^* and E^* are the time and money income available for consuming, and vector **O** includes all other demand shift variables.