Department of Agricultural, Environmental, and Development Economics
The Ohio State University
Working Paper: AEDE-WP-0039-04

The Economic Value of Marine Recreational Fishing: Applying Benefit Transfer to Marine Recreational Fisheries Statistics Survey (MRFSS)

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September 2004

Abstract: Using two data sets from the same source but in different years (1994 and 1997) and regions (Northeast and Southeast), benefit transfer estimates are compared with original estimates to examine the convergent validity of benefit function transfer. Although benefit transfer error could go up to over 400% of original estimates for a particular case, the magnitude of benefit transfer error is less than 100% of original estimates for most cases. Since two data sets used for benefit transfer are from different regions and years, whether regional or temporal variation is more responsible for benefit transfer error can not be determined without intra-regional or intra-temporal data.

Key words: benefit transfer, value transfer, function transfer, marine recreational fishing, access value, harvest rate.

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Ohio State University Extension
Ohio Agricultural Research and Development Center
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Introduction

Benefit transfer generally refers to the practice of applying estimates of economic value obtained from one or more original valuation studies in one context to the evaluation of economic value in another context by *adaptively transferring* available information (value estimates or estimated benefit/demand function) from existing primary studies. Following Desvousges, Naughton, and Parsons (1992), a place for which original research was conducted is called a "*study site*" and a place to which estimates of economic value from original research are transferred is called a "*policy site*." As a less costly and time saving method of obtaining estimates of non-market value for various outdoor recreation activities, the primary goal of benefit transfer practice is to estimate economic benefits of non-market activities with an acceptable degree of accuracy for one context (a policy site) by adaptively transferring benefit estimates or a benefit function from some other context (a study site) when it is too costly or takes too much time to conduct a primary valuation study.

Benefit transfer provides a means by which economic value of an outdoor recreation activity at an unstudied policy site can be estimated using information available from a study site(s). For instance, economic value of marine recreational fishing in a particular state or region could be estimated by transferring estimates of economic value of marine recreational fishing from the original valuation study conducted in another state or region after adjusting to new circumstances (policy site context), especially to different characteristics of angler population and fishing sites. Although this study focuses on transferring economic estimates of non-market value of marine recreational fishing, benefit transfer techniques discussed here could be more broadly applied in a number of other outdoor recreation activities. By providing preliminary measures of economic value estimates in various circumstances, benefit transfer may also be applied in screening agricultural policies, evaluating environmental policies (e.g., U.S. Environmental Protection Agency's (EPA) (1997) assessment of the Clean Air Act), defining the extent of the market affected by a proposed policy, initial screening of natural resource damage assessment, and determining whether original research is warranted (Rosenberger and Loomis 2003).

After a brief overview of the current literature on benefit transfer, benefit transfer technique is applied to the estimation of marine recreational fishing value in the Northeast and Southeast coastal regions of the United States using data from the National Marine Fisheries Service's (NMFS) Marine Recreational Fisheries Statistics Survey (MRFSS) combined with the Add-On MRFSS Economic Survey (AMES) in 1994 and 1997 respectively. The *convergent validity* of benefit transfer is examined by comparing the value estimates obtained from benefit transfer procedures to the value estimates obtained from original non-market valuation research.

An Overview of Benefit Transfer Methodology

Benefit transfer is a practical methodology in evaluating the economic consequences of environmental policies and programs with an underlying assumption that economic benefits and/or costs associated with a particular environmental commodity or change could be extrapolated from existing valuation studies of similar context. In possibly many circumstances, primary research may not be justified or plausible due to budget constraint and/or time limitation necessitating the application of an alternative benefit transfer method. However, this low cost and less time-consuming alternative method for non-market valuation may only be valid and reliable under special circumstances. In addition, there are also several important limitations associated with the application of benefit transfer even when these special circumstances are satisfied. Before a discussion of performing and checking the validity of benefit transfer, we need to discuss the circumstances under which benefit transfer methods can be meaningfully carried out and potential limitations of these methods.

Necessary Conditions for Successful Benefit Transfer

For economically meaningful benefit transfer when primary research for a policy site is not plausible, there are some necessary conditions that should be satisfied (Desvousges, Naughton, and Parsons 1992; Rosenberger and Loomis 2001).

First, the policy site context should be thoroughly defined. The extent, magnitude, and quantification of the expected impacts from the proposed policy action should be identified. The availability of current data at the policy site and further data needs for benefit transfer should be identified, including the type of measurement (unit, average, or marginal value), the kind of value measured (use, nonuse, or total value), and the degree of certainty surrounding the transferred information (i.e., the accuracy and precision of transferred estimates).

Second, the study site should meet certain conditions for successful benefit transfer. It is necessary that original studies transferred should be based on adequate data, sound economic method, and correct empirical technique (Freeman 1984). The statistical relationships between economic benefits (or costs) and both socio-economic characteristics of the affected population and physical/environmental characteristics of the study site should be contained in the original study. In addition, an adequate number of original studies on a particular recreation activity for similar sites would allow us to carry out more reliable statistical inferences.

Finally, the study and policy sites should exhibit an adequate level of similarity in terms of the environmental resource evaluated, the nature of an environmental change, and the characteristics of the affected populations and sites. The conditions and quality of the recreation activity analyzed should be similar, including intensity, duration, and skill requirement. Unless enough information on own and substitute prices is available, the markets for the study and policy sites should be similar. The quality and quantity of the change in the environmental resource at the study site should be similar to those of the expected change in the environmental resource at the policy site, including the measurability and the source of the change. The similarity of socio-economic profiles of the affected populations and the characteristics of the environmental resource of interest between the study site and the policy site is an important requirement for a successful application of benefit transfer. Benefit transfer applications work better when the attributes of the environmental resource, the nature of the environmental change, the characteristics of the affected populations and sites display an adequate level of similarities between the study site and the policy site.

Potential Limitations of Benefit Transfer

Several studies (Boyle and Bergstrom 1992; Desvousges, Naughton, and Parsons 1992; Navrud and Pruckner 1997; Desvousges, Johnson, and Banzhaf 1998; Bergstrom and De Civita 1999; Azqueta and Touza 2000; Brouwer 2000; Rosenberger and Loomis 2001) collectively provide a comprehensive overview on potential problems associated with the application of benefit transfer methods.

First, the most fundamental limitation of benefit transfer methods stems from the quality of the original valuation study. Brookshire and Neill (1992) point out that benefit transfer estimates cannot be more reliable than the original study estimates upon which they are based, and the problems associated with the original non-market valuation study will only be magnified in the benefit transfer process. Although there are no clear guidelines for evaluating the quality of original studies, both Desvousges, Naughton, and Parsons (1992) and Boyle and Bergstrom (1992) suggest some criteria. Their criteria include adequate data, sound economic method, and correct empirical technique; similarities between the study site and the policy site in terms of non-market activity, environmental change, and relevant markets and populations affected; description of non-market value as a function of socio-economic variables and site characteristics; and proper assignment of property rights leading to the same theoretically appropriate welfare measures at both study and policy sites.

Second, an important limitation can also arise from the availability of relevant original valuation studies. Finding appropriate valuation studies that correspond to the policy site context could be difficult. For some recreation activities, only a small number of original valuation studies may exist although this issue can be improved as more original non-market valuation studies are implemented by providing a greater pool of non-market value estimates upon which benefit transfer could be based. As more original valuation studies are conducted, these studies could be made more easily accessible to the researchers conducting benefit transfer studies by establishing a nationwide or worldwide database system of both published and unpublished non-market valuation studies containing data sets, estimation techniques, and actual welfare estimates.

Third, the degree of correspondence between the study site and the policy site affects the efficiency and effectiveness of benefit transfer methods. Benefit transfer could produce inaccurate estimates due to the lack of similarities between the study site and the policy site in terms of site and population-specific characteristics. Some original studies may estimate different non-market values of particular recreation activities at unique recreation sites under unique circumstances, leading to quite different estimated values. Different temporal and spatial dimensions of the study and policy sites, let alone among original studies, could affect the stability of data and value estimates over time and across locations. Since existing valuation studies usually occur at different points in time and/or locations, the extent of the affected populations and resources may not be directly comparable.

Fourth, many subjective judgments, sometimes inevitably, involved in the process of benefit transfer may affect the validity and/or reliability of value estimates obtained from benefit transfer. Usually, benefit transfer practitioners should make a number of assumptions and professional judgments in applying benefit transfer methods: "*There is no simple, acceptable way mechanically to transfer a model. Just as the chief ingredient in model construction is judgment, it is also the most important ingredient in transferring benefits*" (McConnell 1992). For instance, researchers may often need to make assumptions about how to measure environmental quality and how the proposed changes in measured environmental quality affect behavior. In addition, the crucial assumption for empirically testing the validity of benefit transfer estimates is that the original study estimates available at the policy site are the "true value" of the environmental resource being evaluated, and benefit transfer estimates can be validated by comparing them with the assumed true value (convergent validity test). These assumptions and professional judgments regarding many aspects of benefit transfer methods may introduce greater subjectivity and uncertainty into the analysis. An important question to be addressed is whether the added subjectivity and uncertainty surrounding benefit transfer methods are acceptable, and resulting benefit transfer estimates still provide informative results.

Finally, several methodological issues should be addressed as possible limitations of benefit transfer. Different research and statistical methods used across existing valuation studies could lead to significant differences in estimated values. In estimating non-market value of various recreation activities, original studies may apply revealed (stated) preference techniques which indirectly (directly) estimate consumer surplus (willingness to pay). Revealed preference techniques rely on the *weak complementarity* (no non-use value) assumption between a recreation activity and market goods necessary to participate in the activity, implying that environmental amenity has no effect on the individual's welfare unless market goods required for recreation experience are purchased. Stated preference techniques rely on the constructed *hypothetical markets* through which people's willingness to pay for environmental resources or recreation opportunities are derived. Original studies may estimate different types of non-market value using different methodologies with different definitions of a relevant market, making the comparison of various existing studies more difficult and problematic.

The potential limitations illustrated above could lead to biased benefit transfer estimates and decrease the robustness of benefit transfer procedure. Although original study estimates are approximations themselves and therefore subject to many sources of errors, potential limitations of benefit transfer process itself should be minimized by attempting to identify and control most relevant limitations for each benefit transfer application.

Benefit Transfer Application: Marine Recreational Fishing

The importance of and need for efficient and effective management programs for recreational fisheries as a renewable resource have been recognized to accomplish an economically and biologically sustainable level of harvest (catch and keep). With 15 to 17 million marine recreational anglers taking over 86 million fishing trips and harvesting over 189 million fish weighing almost 266 million pounds (over 254 million fish were caught and released) in 2001, marine recreational fishing could have significant economic impacts on coastal regions and the areas where market goods related to marine recreational fishing are produced, let alone a large impact on available fish stocks (the MRFSS). To develop fishery management policies and evaluate the impacts of resulting regulations on marine recreational anglers and fisheries, the NMFS collects data on the number and socio-economic characteristics of marine recreational anglers; total number of fishing trips by them; and the number, size composition, and weight of recreational harvest through the MRFSS combined with the AMES.

The method of function transfer is applied to evaluate how well benefit transfer performs in the estimation of non-market recreational value associated with marine recreational fishing in the coastal areas of the U.S. using two original valuation studies with a high level of correspondence in many aspects (Table 1). Using a two-stage nested random utility model (NRUM) for single day marine recreational fishing trips, both Hicks et al. (1999) and Haab, Whitehead, and McConnell (2001) estimate the economic value associated with access to county-level zone fishing sites (willingness to pay (WTP) for the opportunity of marine recreational fishing in a particular area) and a one unit increase in five-year historic harvest rate (willingness to pay for the better opportunity of catching fish) using the Northeast (NE) 1994 and Southeast (SE) 1997 MRFSS-AMES data respectively. Both NE and SE coastal regions in the U.S. are considered as potential candidates for both the study site and the policy site in carrying out function transfer. The results of original estimations (NE 1994 and SE 1997) are compared with the results of benefit transfer estimations to empirically assess the convergent validity (the percentage difference between the assumed true value and transferred value) of benefit function transfer estimates in a marine recreational fishing environment with MRFSS data.

Original Estimation Model

A marine recreational angler is assumed to jointly choose target species and fishing mode at the first stage, and then choose among mutually exclusive fishing sites based on their attributes at the second stage (two-stage mode/species-site choice model). If we denote alternative sites and mode-species combinations with j (1,…,63 (NE 1994) or 70 (SE 1997)) and sm (1,…,15) respectively, an indirect utility function of an arbitrary angler can be written as (following Haab, Whitehead, and McConnell 2001)

(1) $$n_{jsm} = b_1 c_j + b_2 tt_j + g_1 logM_j + \sum_{s=1}^{5} g_{2s} d_s \sqrt{q_{jsm}} + e_{jsm}$$

where ν_{jsm} is the deterministic utility for site j and mode/species combination sm, c_j is the travel cost to site j, tt_j is the travel time for those who cannot value the travel-time at the wage rate, M_j is the number of intercept sites in the aggregated county level zone, q_{jsm} is five-year historic harvest rate for species s through mode m at site j, d_s is a species dummy variable, and ε_{jsm} is a generalized extreme value random error term.

The probability of choosing site j conditional on mode/species choice sm, mode/species-specific inclusive value, and probability of choosing mode/species combination sm are

(2) $$\text{Prob}(j|sm) = \exp[(b_1 c_j + b_2 tt_j + g_1 logM_j + \sum_{s=1}^{5} g_{2s} d_s \sqrt{q_{jsm}})/qs]$$

$$/ \textstyle\sum_h \exp[(b_1 c_h + b_2 tt_h + g_1 logM_h + \sum_{s=1}^{5} g_{2s} d_s \sqrt{q_{hsm}})/qs]$$

(3) $$I_{sm} = \ln(\textstyle\sum_h \exp[(b_1 c_h + b_2 tt_h + g_1 logM_h + \sum_{s=1}^{5} g_{2s} d_s \sqrt{q_{hsm}})/qs])$$

(4) $$\text{Prob}(sm) = \exp(qs\, I_{sm}) / \textstyle\sum_n \exp(qs\, I_n)$$

where θs is a species-specific inclusive value parameter and I_{sm} is the mode/species-specific inclusive value. The estimation of the second stage site choice decision (equation (2)) yields the estimates of (b , g)/θs, and then the inclusive values (equation (3)) can be calculated using these parameter estimates for the estimation of the first stage mode-species choice decision (equation (4)). In both NE 1994 and SE 1997 data, the inclusive value parameters for the four targeted species groups are assumed to be the same (θ_T), and the inclusive value parameter for the non-targeted species is assumed to be different (θ_{NT}) since the pattern of substitution between sites is expected to differ for those who do not target a particular species. Hicks et al. (1999), however, don't allow the inclusive value parameter for the anglers with no target species to differ.

The standard welfare measure from a nested logit random utility recreational fishing model that is linear in travel cost compares the expected maximum utility after policy change (V^1) with a baseline level of the expected maximum utility (V^0), and then converts the difference into a money metric by normalizing with the marginal utility of income (β_1). Given the indirect utility function in equation (1), the expected maximum utility under policy situation z (V^z) is

$$\text{(5)} \qquad V^z = \ln\left[\sum\nolimits_{tm}\left(\sum\nolimits_{j}\frac{\nu^z_{jtm}}{\theta_T}\right)^{\theta_T} + \sum\nolimits_{nm}\left(\sum\nolimits_{j}\frac{\nu^z_{jnm}}{\theta_{NT}}\right)^{\theta_{NT}}\right]$$

where the first summation is over the 12 mode/species combinations that contain targeted species groups, the third summation is over the 3 mode/species combinations with no target, and ν^z_{jsm} (ν^z_{jtm} or ν^z_{jnm}) is the estimated indirect utility function evaluated at independent variable values under situation z.

It is possible to introduce a policy regime that changes the value of independent variables included in the indirect utility function. Two policy situations considered in the analysis are a closure of all fishing sites in a state during a particular wave and an increase in the historic harvest rate at all fishing sites in a state for each species group to measure the access value of fishing in the state for all anglers and the marginal willingness to pay for a one fish increase in the harvest rate at all sites respectively. In these cases, the expected maximum utility is adjusted by either eliminating the affected sites (j) or increasing harvest rates (q_{jsm}) from the corresponding summations in equation (5). The willingness to pay for a policy change or the welfare change from policy situation z = 0 to z = 1 (assuming welfare enhancing change) can be measured as

$$(6) \qquad WTP = (V^0 - V^1)/b_1$$

where V^0 is a baseline level of the expected maximum utility under situation 0, V^1 is the expected maximum utility after a policy change to situation 1, and b_1 is the estimate of travel cost coefficient obtained from the estimation of the second stage site choice decision (equation (2)).

Original Welfare Estimation

Tables 2 and 3 present welfare estimates of the *mean value of access per trip* by state and two-month wave and *willingness to pay for a one fish increase in historic harvest rate per trip* by state and species group from NE 1994 and SE 1997 models respectively. At the first stage estimation (conditional site choice decision given mode-species combination) of a two-stage nested RUM, all parameter estimates are normalized by inclusive value parameter. Since we assume different inclusive value parameters for four targeted species groups ($?_T$) and other non-targeted species group ($?_{NT}$), a weighted inclusive value parameter is used to recover β_1 in equation (6). The proportions of anglers with any of four targeted species groups and non-targeted species group in the sample are used as corresponding weights.

In NE 1994 model (Table 2), Virginia (22% of total fishing trips) has the largest access value followed by New York, New Jersey, Maryland, Massachusetts, and Maine while New Hampshire (4.6% of total fishing trips) has the lowest access value among the Northeastern coastal states for all waves. There is no particular wave that generally has larger access value among all Northeastern states although the largest proportion (34.2%) of fishing trips occurs in wave 4 (July-August). Big game species group provides the largest gain per trip from a one fish increase in 5-year historic harvest rate followed by flat fish and small game species groups while bottom fish species group provides the lowest gain per trip in all Northeastern states. For all targeted species groups, Maine and Maryland show relatively larger gains per trip from a one fish increase in harvest rate although variations are not very considerable.

In SE 1997 model (Table 3), Florida (60.26% of total fishing trips) has the largest access value followed by North Carolina and Louisiana while Alabama (3.2% of total fishing trips) has the lowest access value among the Southeastern coastal states for all waves. Again, there is no particular wave that has larger access value among all Southeastern states, and most fishing trips (23.83%) occur during the wave 3 (May-June) unlike the Northeastern coastal states with most fishing trips occurring during the wave 4 (July-August). In the Southeastern coastal states, flat fish species group provides the largest gain per trip from a one fish increase in historic harvest rate followed by big game and small game species groups while bottom fish species group provides the lowest gain per trip in all Southeastern coastal states. There is not any noticeable variation across states in gains per trip from a one fish increase in historic harvest rate of all targeted species groups.

In evaluating the mean values of access per trip by state, we should not add these values together across states to calculate the access value of multiple states since these values are calculated under the assumption that all of other alternative sites in other states are available to the angler. Simply adding these values together provides incorrect measures of access value of multiple or all states in the region. For the access value of multiple states in the region, all fishing sites in the considered states should be assumed simultaneously closed to calculate the access value of these closed states using equation (6). Table 3 actually shows the access value of some multi-state areas: Gulf of Mexico and South Atlantic areas. To accurately calculate the access value of whole region, survey data from another region should be combined to create multi-region data.

Benefit Transfer Welfare Estimation: Function Transfer

Since we have original welfare estimation results of marine recreational fishing value from the Northeast 1994 (Table 2) and Southeast 1997 data (Table 3) using the same benefit function (equation (6)), both regions could be a candidate for either the study site or the policy site for benefit transfer exercise. Function transfer procedure begins with inserting the policy site values into the independent variables of the study site benefit function. Using the study site benefit function and its parameter estimates with the policy site independent variable values, benefit transfer estimates of the economic value of marine recreational fishing for the policy site can be described as

(7) $WPT_{Study|Policy} = WTP_{BT} = (V^0_{Study|Policy} - V^1_{Study|Policy})/b_{1,Study}$

where $WPT_{Study|Policy}$ is benefit function transfer welfare estimates for the policy site, $V^0_{Study|Policy}$ ($V^1_{Study|Policy}$) is the study site expected maximum utility function under a current (changed) policy regime adapted to the policy site context by inserting the policy site values into this study site benefit function's independent variables, and $b_{1,Study}$ is the study site parameter estimate of travel cost variable.

One way of empirically testing the validity of benefit transfer procedure is to compare benefit transfer welfare estimates for the policy site with the original welfare estimates available at the policy site (convergent validity test). The measure of convergent validity used in the analysis is

(8) $d_{BT} = (WTP_{BT} - WTP_{Policy}) / WTP_{Policy}$

where d_{BT} is the benefit transfer error measured as the percentage difference between benefit transfer estimates and the policy site's original estimates, WTP_{BT} is the benefit transfer welfare estimates for the policy site, and WTP_{Policy} is the original welfare estimates available at the policy site.

Tables 4 and 5 demonstrate the results of *convergent validity tests* of the benefit transfer welfare estimates for NE and SE regions respectively as described in equation (8). In the application of benefit function transfer procedure in a marine recreational fishing environment, the magnitude of benefit transfer error falls within 100% of the policy site's original welfare estimates in general except for the benefit transfer estimates of marginal willingness to pay for a one bottom fish increase in historic harvest rate for SE 1997 (above 400%). Benefit function transfer seems to perform better in estimating the mean access value of fishing sites than in estimating marginal willingness to pay for fishing quality in both regions with an exception of benefit transfer estimation of marginal willingness to pay for a one flat fish increase in historic harvest rate for SE 1997 (less than 8% of benefit transfer error). Another noticeable pattern is that benefit transfer estimates in both regions are generally underestimated compared to the policy site's original estimates except for the marginal willingness to pay estimates for a one fish increase in big game, small game, and bottom fish species groups for SE 1997.

Conclusions

With two highly similar original valuation studies, the technique of *benefit function transfer* is applied to the valuation of marine recreation fishing in the coastal states of the Northeastern and Southeastern regions of the United States. Two welfare measures are estimated by transferring a two-stage nested random utility model of marine recreational fishing behavior: the *mean access value* per trip by state and wave and *willingness to pay for a one fish increase in five-year historic harvest rate* per trip by state and species group. The *convergent validity* of benefit function transfer procedure in a marine recreational fishing environment is empirically evaluated by examining the percentage difference between original and benefit transfer welfare estimates for the Northeast (1994) and Southeast (1997) coastal regions. Percentage differences between original and benefit transfer estimates for most benefit function transfer results are less than 100%. Benefit transfer estimation of site access value generally involves with smaller benefit transfer error than benefit transfer estimation of marginal willingness to pay for historic harvest rate of species groups. Benefit transfer estimates of marine recreational fishing value (site access value and marginal willingness to pay for historic harvest rate) for the Northeast and Southeast coastal regions seem to underestimate in general compared to original welfare estimates available at the same region.

One critical limitation of testing benefit transfer procedure with the NE 1994 and SE 1997 data is that the source of benefit transfer error cannot be clearly distinguished between regional and temporal variations. For function transfer, a behavioral relationship between marine recreational fishing and socio-economic and site characteristics variables is assumed to be identical at the policy and study sites. If this assumption doesn't hold because of regional (NE and SE) and/or temporal (1994 and 1997) variations, current data don't allow us to identify which variation is more responsible for benefit transfer error. Even when benefit transfer procedure adapts reasonably well to the differences in population and site characteristics, we still have two undistinguishable sources of benefit transfer error: regional and temporal variations that may lead to different behavioral relationships across different regions and points in time. To identify which variation is more responsible for benefit transfer error, intra-regional (different years in the same region) and intra-temporal (different regions in the same year) data could be used for testing the convergent validity of benefit function transfer procedure.

A comprehensive survey of benefit transfer's historical background, methodologies, and procedures could help us answer a question of when, why, and how to use this highly empirical technique of obtaining economic benefits (or costs) in a number of circumstances where the results of past research in a similar context are available. As is the case with most estimation techniques, benefit transfer has potential advantages and limitations with some necessary conditions for successful application that generates economically meaningful results. For valid and reliable benefit transfer results, benefit transfer practitioners should carefully consider the strength and weakness of the technique, and apply it only in feasible circumstances with appropriate professional judgments.

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Table1. Summary of Two Original Valuation Studies

	Hicks et al. (1999)	***Haab, Whitehead, and McConnell (2001)***
Recreation activity	Saltwater sport fishing: one day trip	Saltwater sport fishing: one day trip
Data	MRFSS-AMES: 1994 Northeast	MRFSS-AMES: 1997 Southeast
States included	VA, MD, DE, NJ, NY, CT, RI, MA, NH, & ME	NC, SC, GA, FL, AL, MS, & LA
Estimation technique	two-stage nested random utility model (NRUM)	two-stage nested random utility model (NRUM)
Welfare measures	WTP for site access to a state across waves[1] (3~6) & for one unit ? in historic harvest rate by state and 4 species groups	WTP for site access to a state across waves (2~6) & for one unit ? in historic harvest rate by state and 4 species groups
Choice set	3 fishing modes-5 target species & 63 county-level zone sites	3 fishing modes-5 target species & 70 county-level zone sites
Explanatory variables of indirect utility function	Trip cost & time, # interview sites in a county zone, & site-specific historic harvest per trip for species group	Trip cost & time, # interview sites in a county zone, & site-specific historic harvest per trip for species group

1. A wave is a two-month period: Jan/Feb (wave1) ~ Nov/Dec (wave6).

Table 2. Welfare Estimates from Northeast 1994 MRFSS-AMES Data

The Mean Value of Access Per Trip

State	All Waves	Wave 3	Wave 4	Wave 5	Wave 6
Connecticut	$5.31	$5.56	$5.70	$4.97	$4.58
Delaware	$2.42	$3.42	$2.78	$0.93	$2.50
Maine	$18.76	$20.29	$23.51	$21.83	$0.00
Maryland	$29.66	$32.86	$27.99	$35.94	$17.24
Massachusetts	$21.08	$22.31	$20.38	$25.50	$12.94
New Hampshire	$1.31	$1.91	$1.52	$1.21	$0.00
New Jersey	$34.90	$40.91	$33.19	$34.83	$28.89
New York	$58.93	$58.39	$56.12	$57.85	$68.19
Rhode Island	$9.91	$9.10	$10.35	$11.12	$8.18
Virginia	$117.46	$79.89	$95.29	$113.04	$238.64
Obs.	4897	1220	1675	1271	731

Willingness to Pay for a One Fish Increase in Historic Harvest Rate Per Trip

State	Obs.	Big Game	Small Game	Bottom Fish	Flat Fish
Connecticut	281	$21.85	$8.10	$5.92	$16.12
Delaware	190	$20.07	$7.38	$5.28	$15.19
Maine	273	$25.12	$9.55	$6.91	$21.59
Maryland	501	$25.67	$9.35	$6.52	$20.50
Massachusetts	529	$22.29	$7.74	$5.55	$16.03
New Hampshire	225	$22.83	$8.07	$5.77	$17.30
New Jersey	793	$18.15	$6.54	$4.71	$12.96
New York	678	$17.67	$5.81	$4.50	$12.00
Rhode Island	349	$20.70	$7.50	$5.41	$15.73
Virginia	1078	$16.27	$5.72	$4.76	$12.05
All States	4897	$19.96	$7.10	$5.28	$14.88

Table 3. Welfare Estimates from Southeast 1997 MRFSS-AMES Data

The Mean Value of Access Per Trip

State	All Waves	Wave 2	Wave 3	Wave 4	Wave 5	Wave 6
Florida (All)	$300.12	$351.54	$287.54	$299.89	$270.55	$306.23
Florida West (Gulf)	$60.66	$74.53	$58.09	$56.23	$58.15	$59.10
Florida East (SA)	$16.33	$17.01	$13.81	$16.84	$15.51	$19.23
Georgia	$3.41	$1.17	$5.10	$4.45	$3.35	$2.40
N. Carolina	$37.19	$21.74	$39.61	$38.02	$49.58	$32.44
S. Carolina	$9.93	$10.02	$8.07	$9.37	$12.12	$10.12
Louisiana	$16.58	$12.23	$16.81	$19.34	$16.41	$17.61
Mississippi	$4.87	$4.61	$4.64	$4.64	$5.41	$4.96
Alabama	$2.09	$2.37	$2.53	$1.85	$1.61	$2.07
Gulf Coast	$113.42	$118.61	$109.15	$113.93	$114.82	$112.28
S. Atlantic	$162.37	$112.10	$168.07	$161.58	$201.10	$154.29
Obs.	6379	1039	1520	1115	1417	1288

Willingness to Pay for a One Fish Increase in Historic Harvest Rate Per Trip

State	Obs.	Big Game	Small Game	Bottom Fish	Flat Fish
Alabama	206	$20.17	$9.79	$3.32	$27.78
Florida East (SA)	1398	$20.36	$9.83	$3.38	$28.09
Florida West (Gulf)	2446	$20.78	$10.10	$3.47	$28.87
Georgia	207	$20.23	$9.66	$3.40	$27.91
Louisiana	776	$20.67	$9.90	$3.38	$28.92
Mississippi	220	$20.85	$10.11	$3.48	$29.03
N. Carolina	603	$20.47	$10.00	$3.46	$28.62
S. Carolina	523	$20.89	$10.35	$3.60	$29.18
All States	6379	$20.62	$10.00	$3.44	$28.64

Table 4. Convergent Validity (Percentage Difference) Test of Benefit Transfer Estimates for Northeast 1994

The Mean Value of Access Per Trip

State	All Waves	Wave 3	Wave 4	Wave 5	Wave 6
Connecticut	11.03%	18.11%	7.96%	11.74%	4.12%
Delaware	40.64%	13.20%	19.69%	230.29%	33.61%
Maine	-57.31%	-53.08%	-59.50%	-58.86%	NA
Maryland	-61.80%	-62.51%	-61.07%	-66.34%	-45.80%
Massachusetts	-42.21%	-44.77%	-31.96%	-48.77%	-49.37%
New Hampshire	13.72%	-10.54%	25.66%	19.69%	NA
New Jersey	-56.33%	-57.02%	-54.15%	-58.96%	-54.92%
New York	-59.21%	-59.01%	-58.04%	-59.31%	-61.54%
Rhode Island	-16.38%	-12.26%	-10.88%	-20.52%	-30.17%
Virginia	-65.81%	-66.74%	-66.45%	-64.11%	-66.10%

Willingness to Pay for a One Fish Increase in Historic Harvest Rate Per Trip

State	Big Game	Small Game	Bottom Fish	Flat Fish
Connecticut	-91.96%	-89.97%	-97.03%	-79.90%
Delaware	-89.58%	-87.42%	-96.65%	-74.60%
Maine	-91.23%	-88.98%	-96.43%	-77.76%
Maryland	-91.06%	-89.53%	-96.66%	-78.52%
Massachusetts	-92.16%	-90.09%	-97.29%	-79.65%
New Hampshire	-91.35%	-89.18%	-96.94%	-77.63%
New Jersey	-90.15%	-87.76%	-97.13%	-76.27%
New York	-91.52%	-88.60%	-97.25%	-78.56%
Rhode Island	-91.93%	-89.79%	-97.03%	-79.37%
Virginia	-86.90%	-82.84%	-96.41%	-68.31%
All States	-90.46%	-87.94%	-96.87%	-76.40%

Table 5. Convergent Validity (Percentage Difference) Test of Benefit Transfer Estimates for Southeast 1997

The Mean Value of Access Per Trip

State	All Waves	Wave 2	Wave 3	Wave 4	Wave 5	Wave 6
Florida (All)	-31.46%	-31.53%	-31.50%	-31.31%	-31.49%	-31.46%
Florida West (Gulf)	-36.71%	-36.62%	-36.86%	-36.55%	-36.58%	-36.92%
Florida East (SA)	-35.80%	-35.86%	-36.12%	-35.89%	-35.15%	-36.00%
Georgia	-35.86%	-36.20%	-35.72%	-35.75%	-35.63%	-36.62%
N. Carolina	-31.60%	-31.02%	-32.33%	-31.50%	-31.24%	-31.57%
S. Carolina	-35.86%	-36.01%	-36.02%	-36.06%	-35.82%	-35.49%
Louisiana	-34.38%	-35.55%	-33.80%	-34.07%	-35.09%	-33.94%
Mississippi	-37.64%	-37.88%	-37.84%	-37.47%	-37.37%	-37.71%
Alabama	-35.98%	-35.91%	-35.70%	-35.75%	-36.34%	-36.31%
Gulf Coast	-34.69%	-35.28%	-34.65%	-34.35%	-34.61%	-34.64%
S. Atlantic	-30.23%	-30.70%	-30.31%	-30.34%	-29.96%	-30.12%

Willingness to Pay for a One Fish Increase in Historic Harvest Rate Per Trip

State	Big Game	Small Game	Bottom Fish	Flat Fish
Alabama	90.30%	72.17%	413.15%	-6.36%
Florida East (SA)	89.95%	70.63%	421.61%	-5.67%
Florida West (Gulf)	86.06%	66.68%	409.95%	-7.58%
Georgia	96.89%	74.63%	450.53%	-3.36%
Louisiana	95.44%	74.88%	429.90%	-3.15%
Mississippi	93.40%	74.30%	435.66%	-4.18%
N. Carolina	98.03%	78.99%	457.40%	-2.05%
S. Carolina	94.04%	76.45%	457.18%	-4.05%
All States	90.57%	71.20%	425.71%	-5.52%