BENEFITS TRANSFER APPROACH TO ESTIMATING RECREATION VALUE

September 1996

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BENEFITS TRANSFER APPROACH TO ESTIMATING RECREATION VALUE

by

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Environmental Resources Services
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September 1996

UNITED STATES DEPARTMENT OF THE INTERIOR ★ BUREAU OF RECLAMATION

RECLAMATION'S MISSION

The mission of the Bureau of Reclamation is to manage, develop, and protect water and related resources in an environmentally and economically sound manner in the interest of the American public.

DEPARTMENT OF THE INTERIOR'S MISSION

As the Nation's principal conservation agency, the Department of the Interior has responsibility for most of our nationally-owned public lands and natural resources. This includes fostering wise use of our land and water resources; protecting our fish, wildlife, and biological diversity; preserving the environmental and cultural values of our national parks and historical places; and providing for the enjoyment of life through outdoor recreation. The Department assesses our energy and mineral resources and works to ensure that their development is in the best interests of all our people by encouraging stewardship and citizen participation in their care. The Department also has a major responsibility for American Indian reservation communities and for people who live in island territories under U.S. Administration.

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INTRODUCTION

For project justification, many Bureau of Reclamation (Reclamation) studies have required some form of economic analysis. Planning studies, environmental impact statements, safety of dams evaluations, etc., generally involve economic review.

The recreation component of these studies has become increasingly important over time. As the level of recreation use of Reclamation facilities has increased, so has the need to value that use. Fortunately, over the past twenty to thirty years, the economic community has greatly improved the approaches used to value recreation.

The U.S. Water Resource Council's "Economic and Environmental Principles and Guidelines for Water and Related Land Resources Implementation Studies" (P&Gs) provides a fairly detailed discussion of the various approaches for estimating recreation use values.[1] However, the P&Gs discussion generally assumes the analyst has the time, budget, and technical background necessary to conduct original research.

In many cases, the Government analyst does not have the luxury of gathering data and developing the economic models suggested in the P&Gs. Original recreation research can take several months to several years to complete, depending on the scope and complexity of the study. Typically, the analyst must obtain the necessary information from existing research, a procedure known as benefits transfer.[2] The modeling based benefits transfer approach suggested in this paper represents an improvement over the traditional value transfer approach used by most Government analysts.

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[1] Recreation use values reflect benefits accruing to recreation participants. Use values can be contrasted with "nonuse" values, which are experienced without actually using the resource (e.g., preservation values associated with simply knowing the resource exists even if one never intends to use it).

[2] Many of the transfer applications to date have been oriented toward economic benefits of recreation use. Given its contentiousness, nonuse benefits have generally been developed using original research. However, under the appropriate circumstances, nonuse benefits could conceivably be transferred, although the requirements would likely be very restrictive.

Given that most transfers have been benefit oriented, the term "benefits transfer" has evolved. However, non-benefit applications often arise (e.g., transfer recreation use estimating models). As a result, the more general term "information transfer" is sometimes seen.

PURPOSE AND PAPER FORMAT

The purpose of this paper is to describe the benefits transfer approach of estimating recreation values. Specifically, this paper provides the information necessary to estimate recreation benefits for anadromous fishing using a benefits transfer approach.

After introducing the concept of benefits transfer, including its advantages and disadvantages, benefits transfer procedures are discussed. This is followed by an anadromous fishing benefits transfer application used in a recent Reclamation planning study. The appendix presents information on existing recreational economic anadromous fish studies obtained from literature reviews. The information presented includes type of study (modeling/valuation, theory, literature review, and benefit transfer), and for valuation studies, information useful to the benefit transfer process. The intent of the literature review is to provide a source list from which to obtain models and values for use in future anadromous fish benefit transfer applications.

CONCEPT OF BENEFITS TRANSFER

Benefits transfer involves the reuse of existing original economic research. The transfer concept derives from the fact that the purpose of the application is often quite different from that of the original research. From a recreation perspective, this new purpose may imply a different time period, site, recreation activity, or level of resource quality.

Most recreation oriented benefit transfer studies involve transferring information between sites. For clarity, benefits transfer analysts use the terms study site and policy site. The study site refers to the site where the original research was developed. The policy site reflects the focus of the application, the site where the research is being transferred.

Benefits transfer could involve reuse of either a recreation value or a statistical model. The traditional approach to valuing recreation in most Government studies, assuming original research is not feasible, has been to apply an existing measure of value from either a travel cost, contingent valuation, or unit day value study.[3] Typically, the only adjustment is to account for inflation by converting the value to current dollars using consumer price indices.[4]

Since transferring values involves an extremely limited amount of adjustment, the preferred approach is to transfer recreation models. Information on the model's explanatory variables can be gathered for the policy site to reflect current or proposed conditions. Policy site data are then used in conjunction with the model's explanatory variable coefficients to estimate recreation visitation and value at the policy site. By allowing the analyst the flexibility to account for a series of important explanatory variables, the model transfer technique implies a substantial improvement over the traditional value transfer approach.

Meta analysis is another benefits transfer option, quite different from directly transferring previously developed values or models. This approach involves estimating a statistical model of recreation value based on information derived from previous modeling efforts. No new data is collected. The data used in the statistical analysis reflects valuation results and modeling characteristics found in the previous studies. The dependent variable in the meta analysis model uses the value estimates from the previous studies. The explanatory variables within the model attempt to account for the differences between the studies in the data set (e.g., qualitative or dummy variables for type of activity; type of site; valuation method; inclusion of travel time, site quality, and substitution variables; statistical estimation approach; etc.). Assuming the meta analysis model is defined for recreational activities and site types, the model could conceivably be

[3] The travel cost method (TCM) uses data from observed recreational behavior to estimate a statistical model for predicting trips as a function of travel costs and other variables. The basic premise is that, as travel costs increase, trips tend to decrease. The model can be integrated to obtain measures of recreation value.

The contingent valuation method (CVM) uses survey information. Recreators are directly asked to estimate recreation value for a proposed change in site management or resource quality. Survey data can be directly reported or used within a statistical model.

The unit day value approach is a classic benefits transfer exercise. The original unit day values were determined based on entrance fee studies conducted in the early 1960s. These widely used values incorporate professional judgement related to the quality of various site characteristics.

[4] While the P&Gs suggest using consumer price indices, other inflationary indices are available (e.g., Gross National Product (GNP) and Gross Domestic Product (GDP)). Since no one index is universally accepted, the selection of the most appropriate index is up to the discretion of the analyst.

applied to estimate value.[5] While meta analysis shows some promise as a possible benefits transfer technique, model estimation can be complicated. Given that the objective of this paper is to describe relatively quick, inexpensive approaches to developing recreation values, meta analysis is not emphasized.

Benefits transfer implies a less than ideal situation. Because of various constraints, the analyst is unable to pursue original research designed specifically to address the problem under consideration. Since the research to be transferred via the benefit transfer process is not specifically designed to address the proposed problem, questions as to validity and reliability may arise.

While value transfers have been conducted for years, very few studies have attempted to test the validity and reliability of the benefit transfer approach. Boyle and Bergstrom (1992) suggest conducting both original research and benefit transfers simultaneously at similar sites. They propose that data be collected and models be estimated at two or more similar sites. Benefits transfer estimates could be derived and compared to the results of the site specific model, where presumably the site specific results would provide an accurate estimate of site values. Loomis et al. (1993) compared model estimates to benefit transfers for reservoirs in Sacramento, Little Rock, and Nashville. Their findings indicate that benefit transfers are most accurate between similar sites within the same region.

Since benefit transfers apply existing models, the accuracy of the transferred values will only be as good as the applied models. Problems associated with the models will be carried forward into the transferred benefit estimates. As a result, benefit transfers require detailed knowledge of the model to be transferred. One must understand the limitations of the model, including methodological and empirical problems, to reasonably apply the transferred values. The benefits transfer process creates its own set of problems in addition to those associated with the original model (e.g., difficulties in finding a comparable site, difficulties in obtaining data for the policy site, etc.). Error stemming from the actual procedures of transferring models compound those associated with the original research.

While some researchers object to the practice of benefits transfer for various reasons, most suggest it is possible to conduct defensible benefits transfers, given proper diligence. Some suggest that a set of universally accepted benefit transfer procedures should be developed to help standardize the practice (Boyle and Bergstrom 1992, Smith 1992).

While benefits transfer has its problems, it does present a reasonably reliable alternative to conducting original research. There are numerous situations where a benefits transfer approach may be warranted: (1) when the analysis is not expected to be controversial, (2) when the analysis does not require a high degree of accuracy, and (3) when time and budget constraints prevent the pursuit of original research (Brookshire and Neill 1992).

Table 1 presents a summary of the primary advantages and disadvantages associated with the benefits transfer approach:

[5] While meta analysis models could be used to calculate benefits, Smith and Kaoru (1990) warn against such practices. They feel the strength of the approach is in evaluating important modeling elements and not in estimating value.

Table 1.—Summary of advantages and disadvantages of benefits transfer

Advantages:

1. Typically less time intensive and costly than original research.
2. A lower level of technical expertise may be required as compared to original research.
3. A reasonably accurate range of estimates can be developed relatively easily by using models from different studies.
4. Transferring models allows the analyst to account for differences between sites and user populations.
5. Fewer data requirements than original research.

Disadvantages:

1. Requires an extensive database of original research.
2. May be difficult to find a similar study for transfer.
3. Transferred model or value may not align with the purpose of the application. As a result, the transfer process may not provide accurate benefit estimates.
4. May be difficult to obtain model explanatory variable data for the policy site. Data inconsistencies may also prove problematic.
5. Problems with the benefits transfer process compound those associated with the original research.

PROCEDURES FOR BENEFITS TRANSFER

Model based benefits transfers generally require five steps: (1) determine the type of model required, (2) conduct a literature review of pertinent studies, (3) select an appropriate model for transfer, (4) gather information on the model's explanatory variables relevant to the application, and (5) calculate the desired information from the model (e.g., benefits and/or recreation use.)

(1) **Type of Model**: The type of economic model(s) to be applied is influenced by the information required. The model(s) selected will depend on whether only values or both values and use estimates are needed. For example, should both value and use information be required, a travel cost model would be preferred, since both use and value are estimated. An alternative approach would involve two models: a use estimating model to estimate recreation visitation and a contingent valuation model to estimate value. Should only values be desired, either the travel cost or the contingent valuation model could be applied.

(2) **Literature Review**: Once the type of model has been defined, a thorough search and review of the literature should be conducted. Literature searches should incorporate not only published research (e.g., journal articles, dissertations), but also the "gray" literature (e.g., Government publications, consulting firm reports, university working papers, etc.).

(3) **Model Selection**: Model selection can be considered after the analyst has compiled a group of potentially relevant studies. Model selection is perhaps the most difficult aspect of the benefits transfer process. Although a consensus has yet to be achieved, model selection criteria have received significant discussion within the economics literature.

Model selection should be based not only on an attempt to match population, site, and recreational activity characteristics, but also on the adequacy of the original data collection and modeling approaches, including the incorporation of important independent variables influenced by the proposed management action. Judgement must be used in choosing between models. A fully specified model at a different regional site may be preferred over a poorly specified model at the same site.

Table 2 provides proposed search criteria for model transfers and a source list for value transfers (Loomis 1993). The model selection criteria and value selection sources are presented in descending order from most to least reasonable.

Criteria 1-5 reflect the preferred model transfer approach. Loomis suggests recreational activity is the most important selection factor, followed by location. Therefore, selection of a model focusing on the same activity at the same or similar regional sites would provide the best benefit transfer results. Once the analyst is forced to consider models from outside the region, the accuracy of the transfer may be reduced significantly.

Items 6-9 reflect the traditional, less preferred approach of transferring values. While value transfers are less preferred, when an appropriate model does not exist, value transfers may be the analyst's only option.

Table 2.—Benefit transfer selection criteria: Loomis

Model Transfer:

1.	Same Activity and Same Site.
2.	Same Activity and Different Site within the Same Region.
3.a.	Specialized Activity: Same Activity in Different Region.
3.b.	General Activity: General Water-Based Value from within the Same Region.
4.	META analysis equations (Walsh, Smith).
5.	Similar Activity from a Different Region.

Value Transfer:

6.	Literature Review Average Values (e.g., Walsh et al. 1988).
7.	USDA Forest Service Resource Planning Act Values.
8.	Existing Values: CVM or TCM study.
9.	Unit Day Values.

Source: Loomis (undated)

Boyle and Bergstrom (1992) suggest the following criteria for selection of a model: (1) the nonmarket commodity must be identical, (2) affected populations must have identical characteristics, and (3) assignment of property rights must suggest the same welfare measure [i.e., willingness-to-pay (WTP) versus willingness-to-accept (WTA)].[6]

Desvousges et al. (1992) also present criteria for selecting studies for potential transfer. They suggest the following: (1) original studies should apply appropriate data, economic methods, and statistical estimation techniques, (2) the change in resource quality must be similar between the study and policy site, (3) original model measures willingness to pay as a function of socioeconomic and site characteristics, (4) study and policy sites should have similar site characteristics or the model should include site quality variables, and (5) market areas of the sites should be similar, implying similar distances to substitute sites.

In an attempt to minimize problems with the original modeling approach, analysts may prefer to use more recent studies employing state-of-the-art data collection and model estimation procedures (Boyle and Bergstrom 1992). Alternatively, the benefits transfer analyst could first decide on the preferred types of modeling approaches required to address the policy issue. The analyst could then screen the available studies, selecting those which meet the modeling requirements.

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[6] Willingness-to-pay is an appropriate welfare measure when the affected public does not maintain property rights for the resource. Conversely, when the public perceives they do maintain the property right, willingness-to-accept payment becomes the more appropriate welfare measure. WTP is often associated with increases in resource quality, whereas WTA is associated with decreases. In practice, WTP measures are frequently used, even for decreases in resource quality (e.g., WTP to avoid resource reduction).

Defining the market area for the policy site can be an especially difficult problem. Market definition generally requires information on historic recreation use. Unfortunately, this information is often unavailable. It has been suggested that more original research using multi-site models should be initiated to address problems associated with defining market size and site substitution (Desvousges et al. 1992).

Professional judgement has played a significant role in the benefit transfer process (McConnell 1992). This can lead to inconsistency between benefit transfer applications, fueling the fire for skeptics to criticize the practice. While professional judgement generally plays an important role in any economic analysis, many researchers have called for a set of universally accepted benefits transfer protocols or guidelines to help standardize the procedure. Unfortunately, there will never be a simple, acceptable method to mechanically transfer a model. Professional judgement will always be the most important factor in benefits transfer, just as it is with model construction (McConnell 1992).

The closest attempt at developing a set of benefit transfer guidelines for Government analysts has come from the National Oceanic and Atmospheric Administration (NOAA 1994). In general, the NOAA guidelines suggest development of a range of valuation estimates using alternative methods.

As illustrated in table 3, the NOAA guidelines specifically encourage the benefit transfer analyst to review three areas of comparability between the study and policy sites: (1) comparability of users, (2) comparability of the change in quality or quantity of the resource, and (3) quality of the studies being transferred. The NOAA guidelines present a series of questions under each of these comparison areas to aid the analyst in evaluation.

To allow review of potential studies for transfer, detailed discussions of the data collection procedures, statistical modeling procedures, variable definitions, population characteristics, etc. must have been adequately reported within the original research effort. In many cases, especially in journal articles, such details are neglected, making the benefits transfer applications difficult. To aid benefit transfer applications, original research reporting improvements will be required.

(4) **Data Collection**: Gathering data to calculate modeling results at the policy site requires a thorough understanding and acceptance of a model's data collection approach, statistical estimation approach, and explanatory variables. Should the data collection and model estimation approaches prove unacceptable, that model should be eliminated from consideration. Once a model's variable definitions are fully understood, data can be gathered for the policy site. The model's quality variable can be adjusted to reflect both the policy site's baseline characteristics and the with project conditions for development of with and without benefit estimates.

(5) **Calculation of Results**: Once the model has been selected and policy site data gathered, calculation of benefits or visitation estimates becomes a fairly straight-forward process of applying the data to the model's previously estimated coefficients.

Table 3.—Benefit transfer guidelines

Comparability of the Users:

1. Are markets similar in terms of user population size and availability of substitutes?
2. Are the demographic and socioeconomic characteristics of the market areas similar?
3. Are baseline environmental conditions similar?
4. Was the existing study unique?
5. Have any important general attitudes changed since the development of the original study?
6. Are the resources that are being valued in the two studies similar?

Comparability of the Change in Quality or Quantity of the Resource:

1. Did the original study attempt to value an entire range of resources or only a particular subset?
2. Was the type of analysis that was pursued in the original study reflective of the policy application?
3. Was the range of resource change that was evaluated in the original study inclusive of the range being evaluated for the policy application?

Quality of the Studies being Transferred:

1. Did the original study apply proper survey design and sampling procedures, sound economic analysis, and appropriate statistical techniques?
2. Was the original study peer reviewed?
3. If state-of-the-art estimation approaches were not used, can the estimates be adjusted?

Source: NOAA (1994)

BENEFITS TRANSFER APPLICATION

The Sacramento River Fish Habitat Improvement Study, recently completed by Reclamation, included an economic analysis of Sacramento River chinook salmon recreational benefits using a benefits transfer approach. Both model transfer and value transfer approaches were used in this study.

Values for both ocean and river salmon fishing trips for each project alternative were estimated by benefits transfer. These values were used in conjunction with estimates of ocean and river fishing trips to calculate recreational fishing benefits by alternative. The fishing trip estimates were developed using a separate, unrelated procedure.[7]

For ocean salmon fishing, a study of San Francisco area saltwater salmon fishing was used (Huppert 1989). This study was very relevant to the analysis, since it was conducted across essentially the same geographic region. For river salmon fishing, a study of salmon fishing on the Rogue River of Oregon was chosen (Olsen and Richards 1992). Since the Rogue River lies within 50 miles of the northern California border, the geographic area was considered representative of Sacramento River fishing.

The reported values per trip estimated in each study were not applied, since they would reflect the situation at the time the study was conducted. Because the Sacramento River study's alternatives imply different underlying conditions as compared to the studies to be transferred, the values from these studies required adjustment.

Value per Ocean Trip: In the Huppert study, the following truncated travel cost model was developed to estimate annual anadromous fishing trips per angler:

ln (Trips per Angler) = .468 -.0185 TCOST +.0199 INCOME +.3082 CATCH -.00669 TIMCST

where: TCOST = Out-of-pocket expenses per trip plus \$ 0.20 per mile
INCOME = Household Income
CATCH = Catch per trip
TIMCST = TIME * reported wage rate for employed individuals, where TIME reflects fishing plus travel time

Because the market areas were essentially the same for the original study and the Sacramento River Study, and the duration between the studies was not substantial, no adjustment was made to the model's explanatory variable data, other than CATCH. This is admittedly an unusual circumstance. Normally, the transfer process is between different sites, implying the market area between the sites will not align as closely as it did in this application. In the typical situation, the analyst will need to apply updated data for most model variables.

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[7] Trip Estimation Procedure: Changes in salmon spawners were estimated by Reclamation biologists for each alternative. Recreational ocean and river catch to escapement ratios obtained from the U.S. Fish and Wildlife Service were used to convert spawners to catch. Finally, catch rate elasticities (percent change in recreation trips divided by percent change in catch) derived from literature reviews were used to estimate ocean and river recreational visitation for each alternative.

Integrating the above model provides the following formula for measuring the change in value per angler as a function of annual trips per angler (Huppert 1989). Trips per angler for each alternative were estimated directly from the travel cost model by varying the catch rate per trip to the Sacramento River Study's with and without conditions.

Value per Angler = $1/B_1 \; (T_O - T_1) \; [1 + (t_{B1})^2]$

where: B_1 = coefficient on TCOST

T_O = original annual trips per angler reported in study

T_1 = alternative specific annual trips per angler

t_{B1} = t statistic on B_1

The change in value per angler associated with each project alternative was converted to a change in value per trip by dividing by the estimated trips per angler for each alternative. The change in value per trip was then added to the original value per trip estimate provided in the study ($61). Finally, this new value per trip was updated to the base year (1992 dollars) using the ratio of Consumer Price Indices. The new values per trip were developed for each alternative, including the baseline. These values were combined with the separately developed changes in total visitation by alternative to develop total ocean recreation benefits by alternative.

Value per River Trip: The Olsen and Richards study used a contingent valuation survey to estimate value per trip. Their values were based on both actual 1992 harvest conditions and a doubling of those conditions. The catch rates per trip estimated for each of the Sacramento River Study's alternatives proved to be less than the average catch per trip measured in the Olsen and Richards study. To adjust the original $25.80 reported benefit value downward, a ratio of alternative catch per trip to original catch per trip was applied to the original value. Given that catch rates are not the only source of value for a fishing trip, the decision was made to adjust the catch ratio. The catch ratio was multiplied by .48, reflecting the ratio of change in value per trip to change in catch per trip resulting from the Huppert study.

CONCLUSION

Under certain conditions, benefit transfer applications can provide a timely, cost-effective, and reasonably accurate alternative to conducting original research. Given that the benefits transfer approach involves a new application of previous research, the approach will never replace the on-going need for original research.

As is apparent from the application presented in the paper, the model transfer approach was considerably more involved and took into account many more factors than the value transfer approach. Given the limited amount of adjustment associated with the direct value transfer approach, model based transfers are highly recommended.

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APPENDIX

LITERATURE REVIEW OF ANADROMOUS FISH RECREATION ECONOMIC STUDIES

This appendix is divided into two subsections - one on the literature review and another on the study evaluation.

A. Literature Review

The literature review involved a two step procedure: (1) review of currently held studies and (2) keyword searches of various economic and biological databases.

Recreational economic studies in the possession of Reclamation economists (both in Denver and in the regional offices) were gathered and their reference lists searched for relevant studies. As studies were gathered, more and more reference lists were scanned. In this way, the number of studies for consideration grew exponentially.

Keyword searches were conducted with the help of Reclamation library personnel. Eighteen biologic, environmental, and social science databases were searched for keywords in the title and study description.

List of Studies

The following section presents a list of anadromous fish studies in alphabetical order by author. In addition, the studies are categorized, based on type of study: valuation, modeling, benefits transfer, literature review, and theory. Studies without designation were not reviewed at the time of this paper.

Summary Table 1.—Anadromous Fish Studies

	Values	Models	Benefits transfer	Literature review	Theory paper
Adams, R.M.; Klingeman, P.C.; Li, H.W.; Berrens, R.; Cerda, A. "Bioeconomic Analysis of Water Allocations and Fish Habitats Enhancements, John Day Basin, Oregon." Oregon State University, Corvallis, Report No.: USGS/G-1479, 1990.	X				
Andrews, Elizabeth J. and J.E. Wilen. "Angler Response to Success in the California Salmon Sport Fishery: Evidence and Management Implications." *Marine Resource Economics*, Volume 5, pp. 125-138, 1988.					X
Bergland O. and W. G. Brown. Draft: "Multiple Site Travel-Cost Models and Consumer Surplus: Valuation of Oregon Sport-Caught Salmon." In: *Marine and Sport Fisheries: Economic Valuation and Management*, Association of Environmental and Resource Economists, Washington, DC, Report No: EPA/230/08-88/034, 1988.	X	X			
Boyle Engineering Corporation. "Economic Values for an Escaped Anadromous Fish." Prepared under contract to U.S. Bureau of Reclamation, Mid-Pacific Region, contract no. 5-CS-20-03270, August 1986.				X	
Brown, G.M. Jr., Mendelsohn, R. "The Hedonic Travel Cost Method." *Review of Economics and Statistics*, Vol. 66 No. 3, pages 427-433, 1984.					

Summary Table 1.—Anadromous Fish Studies - continued

	Values	Models	Benefits transfer	Literature review	Theory paper
Brown, W.G., A. Singh, and E. Castle. "An Economic Evaluation of the Oregon Salmon and Steelhead Sport Fishery." Agricultural Experiment Station, Oregon State University, Corvallis, 1964.					X
__________, D.M. Larson, R.S. Johnston, and R.J. Wahle. "Improved Economic Evaluation of Commercially and Sport-Caught Salmon and Steelhead of the Columbia River." Oregon Agricultural Experiment Station, Corvallis, Oregon, 1976.	X	X			
Brown, W.G., C. Sorhus, B. Chou-Yang, and J. Richards."Using Individual Observations to Estimate Recreation Demand Functions: A Caution." *American Journal of Agricultural Economics*, February 1983, pps. 154-157.	X	X			
__________, F. Shalloof. "Recommended Values for Columbia River Salmon and Steelhead for Current Fishery Management Decisions." Oregon State University, Corvallis, Oregon, March 1986.	X	X			
__________, "Estimation of Net Economic Values for Oregon Sport-Caught Salmon and Steelhead." Report to Oregon Department of Fish and Wildlife (R/PPA-30), Portland, Oregon, 1990.					
Bryant, M. and S. Mathews. "The Lake Washington Sockeye Salmon Sport Fishery: Catch, Fishing Effort, and Economic Evaluation." Fisheries Research Institute, College of Fisheries, University of Washington, 1977.					
Cameron, Trudy A. and Michelle D. James. "Efficient Estimation Methods for "Closed-Ended" Contingent Valuation Surveys." *The Review of Economics and Statistics*, 1987.	X	X			
Carson, R., W. Wade, and T. Graham-Tomasi. *Rebuttal to: Philip Meyer: "Value Associated with King Salmon of the Sacramento/San Joaquin/San Francisco Bay System.* Bay Institute Exhibit No. 40, July 1987.					X
Charbonneau, J. and M. Hay. "Determinants and Economic Values of Hunting and Fishing." *Transactions of the North American Wildlife and Natural Resources Conference*, 43: 391-403, 1978.	X	X			
Chou-Yang, Bih-lain. "Estimated Net Economic Benefits from Steelhead Sport Fishing of Selected Washington Rivers." M.S. Thesis, Oregon State University, 1981.					
Crutchfield, J.A., and K. Schelle. "An Economic Analysis of Washington Ocean Recreational Salmon Fishing with Particular Emphasis on the Role Played by the Charter Vessel Industry." Department of Economics, University of Washington, Seattle, Washington, 1978. NOAA/NMFS Grant 04-7-158-44024.	X				

Summary Table 1.—Anadromous Fish Studies - continued

	Values	Models	Benefits transfer	Literature review	Theory paper
Donnelly, D.M., Loomis, J.B., Sorg, C.F., Nelson, L.J. "Net Economic Value of Recreational Steelhead Fishing in Idaho." U.S. Forest Service, Rocky Mountain Forest and Range Experiment station, Fort Collins, Colorado, 1985.					
Gordon, Douglas. "An Economic Analysis of Project Number F18R15, Idaho Sport Fisheries." Idaho Cooperative Fishery Unit, Idaho Department of Fish and Game, Boise, 1970.					
Hanemann, W.M. "Economic Valuation of Changes in the Catch of Sacramento River Chinook Salmon." Dept of Agricultural and Resource Economics, University of CA Berkeley. Prepared for EA Engineering, Science, and Technology, October 1986.			X	X	
Hanemann, M., J. Loomis, and B. Kanninen. "Statistical Efficiency of Double-Bounded Dichotomous Choice Contingent Valuation." *American Journal of Agricultural Economics,* November 1991, pps. 1255-63. Duplicate Study: Jones & Stokes Associates, Inc. "Final *Benefits Study of San Joaquin Valley's* Fish and Wildlife Resources." prepared for: The Federal-State San Joaquin Valley Drainage Program under U.S. Bureau of Reclamation Cooperative Agreement No. 9-FC-20-07420, September 1990. Duplicate Study: Loomis, John, Thomas Wegge, M. Hanneman, and B. Kanninen. "The Economic Value of Water to Wildlife and Fisheries in the San Joaquin Valley: Results of a Simulated Voter Referendum." *Transcript of the 55th N.A. Wildlife and Natural Resources Conference.* pp. 259-268. 1990.	X	X			
Hastie, J.D. "Economic Evaluation of Projects and Polices Affecting Anadromous Fish: A Simulation Approach." Ph.D Thesis, Oregon State University, 1986.					X
Hsiao, Ching-Kai. "An Evaluation of Alternative Estimates of Demand For and Benefits From Oregon Salmon Sport Fishing." Ph.D Thesis, Oregon State University, 1985.	X	X			
Huppert, Daniel D. "Measuring the Value of Fish to Anglers: Application to Central California Anadromous Species." *Marine Resource Economics*, Vol. 6, pp. 89-107, 1989.	X	X			
Huppert, D. and R. Fight. "Economic Considerations in Managing Salmonid Habitats", School of Marine Affairs HF-05, University of Washington, Seattle, American Fisheries Society Special Publication, 19., American Fisheries Society, Bethesda, Maryland, 1991.				X	

Summary Table 1.—Anadromous Fish Studies - continued

	Values	Models	Benefits transfer	Literature review	Theory paper
Hydrosphere Resource Consultants. "Evaluation of Economic Impacts of Alternatives for Designation of Winter-Run Chinook Salmon Critical Habitat in the Sacramento River." Prepared under contract to National Marine Fisheries Service, Terminal Island, California, July 1991.			X		
Johnson, Neal S. and Richard M. Adams. "On the Marginal Value of a Fish: Some Evidence From a Steelhead Fishery." Marine *Resource Economics*, Vol. 6, No. 1, 1989, pps. 43-55. Duplicate Study: Johnson, Neal S. and Richard M. Adams. "Benefits of Increased Streamflow: The Case of the John Day River Steelhead Fishery." *Water Resources Research*, Vol. 24, No. 11, pp. 1839-1846, November 1988.	X	X			
Jones & Stokes Associates, Inc. "Southcentral Alaska Sport Fishing Economic Study." Report prepared for Alaska Department of Fish and Game, November 1987.	X	X			
Loomis, John. "The Evolution of a More Rigorous Approach to Benefit Transfer - Benefit Function Transfer." *Water Resources Research*, Vol. 28, No. 3 (March), 1992.			X		
Loomis, John. "Estimation of and Variation in Site Specific Marginal Values for Recreational Fisheries." *J. Environmental Management*, Vol. 29, No. 2, Division of Environmental Studies, University of California, Davis, 1989.	X	X			
Loomis, John. "A Bioeconomic Approach to Estimating the Economic Effects of Watershed Disturbance on Recreational and Commercial Fisheries." *Journal of Soil and Water Conservation* JSWCA3, Vol. 44, No. 1, University of California, Davis, 1989. Duplicate Study: Loomis, John. "The Bio-economic Effects of Timber Harvesting on Recreational and Commercial Salmon and Steelhead Fishing: A Case Study of the Siuslaw National Forest." *Marine Resource Economics*, Vol. 5, pp. 43- 60, 1988.		X			
Loomis, John. "An Examination of the Variation in Empirical Estimates of Site Specific Marginal Values for Recreational Fisheries." Working paper, University of CA - Davis, 1986.	X	X			
____________, and W. G. Brown. "The Use of Regional Travel Cost Models to Estimate the Net Economic Value of Recreational Fishing at New and Existing Sites." From Making Economic Information More Useful for Salmon and Steelhead Production Decisions, NOAA Technical Memorandum NMFS F/NMR-8, 1984.			X		

Summary Table 1.—Anadromous Fish Studies - continued

	Values	Models	Benefits transfer	Literature review	Theory paper
Mathews, S. and G. Brown. "Economic Evaluation of the 1967 Sport Salmon Fisheries in Washington." Technical Report No. 2, Washington Department of Fisheries, Seattle, 1970.	X				
Meyer, Philip. *The Value of King Salmon, Harbor Seals, and Wetlands of San Francisco Bay.* Bay Institute Exhibit No. 41, July 1987. Prepared for: Metropolitan Water District of Southern California, The Bay Institute of San Francisco, 1987.	X	X			
Meyer, Philip. Net Economic Values for Salmon and Steelhead from the Columbia River System. NOAA Technical Memorandum, NMFS F/NWR - 3, June 1982.			X		
Meyer, Philip. A Summary of Existing Information Regarding Procedures to Include Social or Non-Market Values that are Useful for Salmon and Steelhead Management Decisions. Prepared for National Marine Fisheries Service workshop, Seattle, Washington, July 1984.				X	
Michalson, E.L. "Scenic Rivers Study Report No. 11, Report of Aesthetics of Wild and Scenic Rivers: A Methodological Approach." Idaho University, Moscow, Water Resources Research Institute, 1974.					
Morey, E. R., W. D. Shaw, R. D. Rowe. "A Discrete-Choice Model of Recreational Participation, Site Choice, and Activity Valuation When Complete Trip Data Are Not Available." *Journal of Environmental Economics and Management*, Vol. 20, 1991, pps. 181-201. Duplicate Study: Rowe, Robert D., E.R. Morey, A.D. Ross, and D.W. Shaw. "Valuing Marine Recreational Fishing on the Pacific Coast." 1985.					X
Olsen, Darryll, Jack Richards, and R. Douglas Scott. "Existence and Sport Values for Doubling the Size of Columbia River Basin Salmon and Steelhead Runs." *Rivers*, Vol. 2, No. 1, pgs. 44-56, 1991.	X				
Olsen, Darryll, Jack Richards. "Summary Report: Rogue River Summer Steelhead and Fall Chinook Sport Fisheries - Economic Valuation Study." The Pacific Northwest Project, Lake Oswego, Washington, 1992.	X				
Raja Abdullah, N. M. "Estimation of Average and Incremental Net Values of Oregon Sport-Caught Salmon: An Aggregated Travel Cost Approach." Doctoral Dissertation, Corvallis: Oregon State University, Department of Agricultural and Resource Economics, 1989.	X	X			
Richards, J. and S. Peterson. "Economic Benefits from Recreational Steelhead Fishing." Draft working paper, 1978.	X	X			

Summary Table 1.—Anadromous Fish Studies - continued

	Values	Models	Benefits transfer	Literature review	Theory paper
Scott, M. J., R. J. Moe, M. R. LeBlanc, and J. W. Currie. "Columbia River Salmon: Benefit-Cost Analysis and Mitigation." *Northwest Environment Journal*, Vol. 3, pp. 121-151, 1987.			X		
Sorg, C.F.; Loomis, F.B. "Economic Value of Idaho USA Sport Fisheries With An Update On Valuation Techniques." U.S. Forest Service, Rocky Mountain Forest Range Experiment Station, Fort Collins, North American Journal of Fish Management 6 (4), 1986.					
Sorhus C.N. "Estimating Expenditures by Sport Anglers and Net Economic Values of Salmon and Steelhead for Specified Fisheries in the Pacific Northwest." Ph.D. Thesis, Oregon State University, Corvallis, 1980.	X	X			
Strong, Elizabeth J. "Measuring Benefits of Outdoor Recreation Services: An Application of the Household Production Function Approach to the Oregon Steelhead Sport Fishery." M.S. Thesis, Oregon State University, 1984.					X
Strong, Elizabeth J. "A Note on Functional Form of Travel Cost Models with Zones of Unequal Populations." *Land Economics*, 59(3):342-349, 1983.	X	X			
Theurer, F.D.; Lines, I.; Nelson, T. "Interaction Between Riparian Vegetation, Water Temperature, and Salmonid Habitat in the Tucannon River." Water Resources Bulletin, Vol. 21, No. 1, Agricultural Research Service, Fort Collins, Colorado, Hydro-Ecosystem Research Unit, 1985.					
Thomson, Cynthia and D. Huppert. "Results of the Bay Area Sportfish Economic Study (Bases)." NOAA Technical Memorandum, NOAA-TM-NMFS-SWFC-78, 1987.	X				
Tuttle, M.E., J.A. Richards, and R.J. Wahle. "Partial Net Economic Values for Salmon and Steelhead for the Columbia River System." U.S. Department of Commerce, NOAA, National Marine Fisheries Service, 1975.					X
U.S. Fish and Wildlife Service. "Evaluation Report of the Potential Impacts of the Proposed Lake Red Bluff Water Power Project on the Fishery Resources of the Sacramento River." USFWS Report to the Bureau of Reclamation, 1984.			X		
Walsh, Richard G., Donn M. Johnson, John R. McKean. "Review of Outdoor Recreation Economic Demand Studies with Nonmarket Benefit Estimates: 1978-1988." Technical Report No. 54, Colorado Water Resources Institute, December 1988.				X	

B. Study Evaluation

A checklist for study evaluation was developed, based on a series of relevant factors to the model selection decision. The checklist was broken down into the following subsections and topics:

1. General Information:

   - author, title, publishing date, published via a peer reviewed source.

2. Type of Study:

   - water source, location, mode of fishing, fish species.

3. Data Collection Information:

   - date, sample size, approach, population.

4. Modeling Information:

   - Travel Cost and/or Contingent Valuation methodology, explanatory variables, functional form.

5. Econometric Approach:

   - ordinary least squares, censored/truncated, maximum likelihood (logit/probit).

6. Value Estimates:

   - average, incremental, marginal; unit of measure; use or total value; results.

7. Descriptive statistics:

   - expenditures, catch, visitation.

8. Abstract.

Reviewing the above information for each study of interest would aid in the selection. The analyst must decide which factors to focus on and how much weight to place on them. It could be that a study for the same activity and site could suffer from a fatal flaw necessitating the use of a less preferred approach from the standpoint of the benefits transfer criteria.

Summary of Valuation Studies

The following section presents a summary of studies resulting in value estimates. This summary is presented in alphabetical order by author, with separate tables by species (salmon versus steelhead). Each study's value estimates are presented as reported and updated to July 1996 dollars, based on Consumer Price Index ratios. Also shown is information on study location, State, data date, valuation method, valuation measure, and the inclusion of nonuse values.

Summary Table 2.—Salmon Valuation Studies

Author	Site	Area	Data Date	Value Method	CVM Welfare Measure	Nonuse Value?	Description	Reported Value per... (in dollars)					Updated Values in 1996 $:				
								Trip	Day	Fish	Year	House-hold	Trip	Day	Fish	Year	HH
Abdullah, 1988	Ocean	OR	1987	TCM	N/A	N/A		63, 89, 125					87, 123, 173				
Bergland & Brown, 1988	Ocean	OR	1987-88	TCM	N/A	N/A					280					372	
Brown et al. 1976	Ocean	OR	1962	TCM	N/A	N/A			13.70					71.23			
Brown & Shalloof, 1986	Ocean & River	WA, OR	1977	TCM	N/A	N/A	WA/OR River........ WA/OR Ocean........	22 58					57 150				
Cameron & James, 1987	Ocean	Canada	1984	CVM	WTP	No		48.83		14.47			73.79		21.86		
Charbonneau & Hay, 1978	River	U.S.	1975	CVM	WTP	No			51.00					148.83			
Crutchfield & Schulle, ?	Ocean	WA	1978	CVM	WTP & WTA	No	WTP........ WTA........	18.19 40.43					43.80 97.36				
Hanemann et al. 1991	River	CA	1989	CVM	WTP (6% increase in catch)	Yes	All CA..... SJ Valley..					181-336 202					229-426 256

Summary Table 2.—Salmon Valuation Studies - continued

Author	Site	Area	Data Date	Value Method	CVM Welfare Measure	Nonuse Value?	Description	Reported Value per... (in dollars): Trip	Day	Fish	Year	House-hold	Updated Values in 1996 $: Trip	Day	Fish	Year	HH
Hsaio, 1985	Ocean & River	OR	1977	Zonal TCM	N/A	N/A	River......	20.50					53.11				
							Ocean......	57.00					147.67				
				Ind. TCM													
							River......	91					235.76				
				Adj. Ind. TCM			Ocean......	293					759.09				
				Zonal TCM,			River......	48					124.36				
							Ocean......	85					220.21				
				Ind. TCM													
				Multi- Site TCM			Ocean......	14.50					37.56				
							Ocean......	12.35					32.00				
							River......	23.80					61.66				
Huppert, 1989	Ocean	CA	1985-86	TCM	N/A	N/A		228-296, 128-134, 60-61					413-424, 183-192, 86-87				
				CVM	WTP (100% increase in catch)	No		38-41					54-59				
Jones & Stokes, 1987	River	AK	1986	CVM & TCM	WTP	No		300					429.75				
Mathews & Brown, 1970	Ocean & River	WA	1968	CVM	WTP	No	Ocean......	40.87					184.38				
							River......	31.89					143.87				

Summary Table 2.—Salmon Valuation Studies - continued

Author	Site	Area	Data Date	Value Method	CVM Welfare Measure	Nonuse Value?	Description	Reported Value per... (in dollars)					Updated Values in 1996 $:				
								Trip	Day	Fish	Year	House -hold	Trip	Day	Fish	Year	HH
Meyer, 1987	River& Ocean	CA	1986	CVM	WTP (10K increase in catch)	Yes						15-66					22-95
Olsen & Richards, 1992	River	OR	1992	CVM	WTP	Yes		62.00	25.80	75.60			68.59	28.55	83.65		
					WTP (2x Catch)	Yes		16.50					18.26				
Olsen et al. 1991	Ocean & River	WA, OR, ID, MT	1989	CVM	WTP (2x Run Size)	Yes	Nonusers...			16.97		26.52			21.48		33.58
							Possible Nonusers...			7.14		58.56			9.04		74.14
							Users......			44.38		74.16			56.19		93.90
					WTP-Current	Yes	Puget Sound......	75.88	46.66	51.27			96.07	59.08	64.91		
					" "		WA/OR Coast......	89.47	51.19	41.61			113.28	64.81	52.69		
					" "		Coastal Rivers.....	58.39	32.68	36.72			73.93	41.37	46.49		
					" "		Columbia River Basin	111.46	49.33	45.68			141.13	62.46	57.84		
Sorhus, 1981	Ocean& River	OR, WA	1977	TCM	N/A	N/A	OR Ocean...	51.82					134.26				
							OR River...	16.80					43.53				
							WA Ocean...	49.95					129.41				
Thomson & Huppert, 1987	Ocean	CA	1985-86	CVM	WTP (100% increase in catch)	No		6.57			40.76		9.41			58.39	

Summary Table 3.—Steelhead Valuation Studies

Author	Site	Area	Data Date	Value Method	CVM Welfare Measure	Nonuse Value?	Description	Reported Value per... (in dollars)					Updated Values in 1996 $:				
								Trip	Day	Fish	Year	Household	Trip	Day	Fish	Year	HH
Adams et al. 1978	River	OR	1988-89	Ind. TCM	N/A	N/A	25, 50, 75, 100% increase in catch			29-35					37.02-44.64		
Brown & Shaloof, 1986	River	OR, WA	1977	TCM	N/A	N/A		30					77.73				
Brown et al. 1983	River	OR	1977	Ind. TCM	N/A	N/A		82.00					212.44				
				Zonal TCM				29.00					75.14				
Charbonneau & Hay, 1978	River	U.S.	1975	CVM	WTP	No			51.00					148.83			
Hsiao, 1985	River	OR	1977	Zonal TCM	N/A	N/A		20.50					53.11				
				Ind. TCM				91.00					235.76				
				Adj. Ind. TCM				48.00					124.36				
				Multi-Site TCM				23.80					61.66				
Johnson & Adams, 1989	River	OR	1986-87	CVM	WTP(One additional fish per year)	No				6.65					9.19		
Loomis, 1992	River	OR	1977	TCM	N/A	N/A		48-89					124-231				
Loomis, 1986	River	OR	1977	Zonal TCM	N/A	N/A				18-333					47-862		
Olsen & Richards, 1992	River	OR	1992	CVM	WTP	Yes		90.00	33.30	82-105			99.58	36.84	90-117		

Summary Table 3.—Steelhead Valuation Studies - continued

								Reported Value per... (in dollars)					Updated Values in 1996 $:				
Author	Site	Area	Data Date	Value Method	CVM Welfare Measure	Nonuse Value?	Description	Trip	Day	Fish	Year	House-hold	Trip	Day	Fish	Year	HH
Olsen et al. 1991	River	OR, WA	1989	CVM	WTP	Yes	Coastal Rivers..	59.58					75.44				
							Columbia River Basin	90.08					114.05				
Richards & Peterson, 1978	River	WA	1975-76	TCM	N/A	N/A			50.67					139.81			
Sorhus, 1981	River	OR	1977	TCM	N/A	N/A		23.86					61.82				
Strong, 1983	River	OR	1977	TCM	N/A	N/A		22.95 25.54					59.46 66.16				

Given that the value estimates are reported using various recreational measurement approaches (trip, day, fish, year, and household (HH)), the following presents a brief discussion of definitions and conversion methods.

Types of Value Measures

A. *Recreational Fishing Use Values.*—Travel Cost or Contingent Valuation use value estimates.

(1) Per Angler:

Value per angler or user is estimated for a given period of time (e.g., year). Value is a function of the amount of use by the average angler over the time period.

(2) Per Fish:

Some economists feel the value of a fishing trip can be separated into component parts (catching fish, experiencing nature, relaxation, visiting friends, etc.). They believe that when valuing a change in fish population and catch, only the fish value component should be addressed. Other economists dispute the logic of valuing the fish caught (or kept) as only a portion of the overall value of the fishing trip. They claim that the individual would not go on the trip without the possibility of catching fish. A trip's fish and non-fish value components are seen as joint products, simultaneously obtained when taking the trip. They believe one cannot separate non-fish and fish trip components, therefore the entire value of the trip is assigned to the fish. Given the difficulty involved in separating fish value from non-fish value components, economists typically assign the entire value of the trip to the fish.

(3) Per unit of time:

Recreation Day/Activity Day: Recreation by one individual at a site for any portion of a 24-hour period. The approach is satisfactory for measuring the quantity of recreation in a single (or similar) activity, where the length of stay (hours per day) does not vary significantly between participants.

Problems:

- Approach can result in double-counting when measuring individual use for more than one activity during a single day.
- Cannot compare estimates if length of stay (hours) varies significantly across users.
- May not be a useful measure when applying the travel cost method because travel costs reflect a full trip and not a single day (unless the trip can be assumed to last only 1 day).

Recreation Visitor Day (USDA Forest Service): A recreation visitor day (RVD) represents 12 person hours of recreation. This activity could be 12 hours by one person, or 12 persons for one hour, or anywhere in between. The recreation can take place continuously or intermittently within the same 24-hour day or across time. This approach provides a good measure of recreational activity when individuals participate in more than one activity per day for varying periods of time.

Problems:

- Recreators perceive recreation as an occasion rather than a set period of time. From an economic perspective, the amount of recreation use generally reflects the frequency of use as opposed to the duration of use. If 12 people visit a site for 1 hour, this would be counted as 12 recreation occasions and not one 12-hour RVD. Because recreation activities generally do not last 12 hours, 12-hour RVDs may dramatically underestimate the number of recreation occasions. RVDs provide a good measure of facilities use for maintenance purposes, but do not provide a good measure of the number of choice occasions.

- Same point applies to RVDs as to recreation days with regard to the application of the travel cost model; travel costs reflect the entire trip and not a single day or hour of use.

(4) Per Recreation Occasion:

Recreation Visit (National Park Service): Recreation by a single individual for any length of time. This measure is the same as a recreation trip when the individual visits only 1 recreation site during the visit. When the visits or trips are of similar duration (single day or overnight/weekend), this measure provides the best use estimate for application of travel cost models.

Problems:

- Measure becomes less effective when trips are of significantly different lengths of stay because value per visit or trip is a function of length of stay. When comparing across activities, this measure must be adjusted for length of stay.

- Problems also arise when individuals use more than 1 site on the same visit or trip because travel costs must be apportioned between sites.[8]

[8] Various apportionment options exist, including allocating costs based on length of stay at each site. (See Mendelson et al., 1992.)

- Another problem arises when trips are taken for multiple purposes. For example, if an individual visits relatives and subsequently travels to a Reclamation reservoir to go fishing, the travel costs associated with only the recreation purpose need to be identified. This identification is often a difficult task.

B. *Recreation Use and Nonuse Values.*—Contingent Valuation use and nonuse value estimates. Recreation use values reflect benefits accruing to recreation participants. Use values can be contrasted with "nonuse" values, which are obtained without actually using the resource (e.g., preservation values associated with simply knowing the resource exists even if one never intends to use it).

(1) Per Household or Per Capita:

Measures the value of the recreation activity or resource to the general public for a given period of time. Includes both "user" and "nonuser" households to incorporate both use and nonuse components of value.

C. *Methods of Converting Between Value Measures.*—The following simple formulas are used to convert between the various recreation use and valuation measures.

(1) RVDs to Recreation Days:

(RVDs × 12) ÷ average hours per day

(2) Recreation Days to RVDs:

(Recreation Days × average hours per day) ÷ 12

(3) Recreation Visits (Trips) to Recreation Days:

Visits × average days per trip

(4) Recreation Days to Recreation Visits (Trips):

Recreation Days ÷ average days per visit

(5) Recreation Visits (Trips) to RVDs:

(Visits × average days per visit × average hours per day) ÷ 12

(6) RVDs to Recreation Visits (Trips):

[(RVDs × 12) ÷ average hours per day] ÷ average days per visit

(7) Visitation Value to Value per Participant, User, Angler:

To convert from values per unit of recreation visitation (recreation/activity days, RVDs, visits/trips) to values per user, the analyst must know the average number of days, RVDs, visits, etc. per user per length of time (e.g., year). Multiplying the average number of trips per user per year by the value per trip provides an estimate of the average value per user.

(8) Visitation Value to Value per Fish:

To convert from values per unit of recreation visitation (recreation/activity days, RVDs, visits/trips) to values per fish, the analyst must know the average number of fish caught (or kept) per day, RVD, or visit. Dividing the value per trip by the average catch per trip provides an estimate of the average value per fish.