META ANALYSIS
OF WATER RECREATION

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13. ABSTRACT ***(Maximum 200 words)***

This report presents preliminary results from the estimation of meta analysis models for benefits transfer by recreation activity, site type, and U. S. Bureau of Reclamation region. While the models show promise the value estimates appear questionable given they fell outside the 95% confidence intervals associated with the mean values of the underlying data. More research is needed to finalize the models.

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META ANALYSIS OF WATER RECREATION

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TABLE OF CONTENTS

1.0 INTRODUCTION

Most U. S. Bureau of Reclamation (Reclamation) water management studies require some form of economic analysis to justify proposed actions. Planning studies, environmental impact documents, safety of dams evaluations, etc. all generally involve economic review.

The recreation component of these economic studies has become increasingly important. Early Reclamation projects didn't even include recreation as a project purpose, today recreation impacts constitute a core element of virtually any economic analysis. The need to value changes in recreation activity has increased with the level of recreation use of Reclamation facilities. Fortunately, over the past thirty years, the economic community has conducted a great deal of research in the areas of recreation visitation and valuation.

The U. S. Water Resource Council's "Economic and Environmental Principles and Guidelines (P&Gs) for Water and Related Land Resources Implementation Studies" (WRC, 1983) provides a fairly detailed, although somewhat dated discussion of several approaches available for estimating recreation use values.[1] The P&G discussion assumes the analyst has the time, budget, and technical background necessary to conduct study specific original research.

While original research is undoubtedly the preferred approach, in most cases, given the continued downsizing of government agencies and budgets, analysts typically do not have the luxury of gathering data and developing the economic models suggested in the P&Gs. Study specific recreation research is costly and time consuming, sometimes taking several years to complete depending on the scope and complexity of the study. Typically, the analyst must obtain the necessary valuation information from existing research through procedures known as benefits transfer.[2]

Benefits transfer involves the reuse of existing original economic research. Several forms of benefit transfer have developed over time:

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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 been developed almost exclusively through original research.

Given most transfers have dealt with recreation values or benefits, the term "benefits transfer" has evolved. However, recreation visitation applications often arise which could conceivably be addressed by transferring some form of recreation use estimating model. As a result, the more general term "information transfer" is sometimes seen.

- Value Transfers: Approach involves transferring either a single value estimate or an average across a range of values from the study sites(s) to the policy site(s).

- Model Transfers: Approach involves transferring the statistical model from the study site to the policy site.

- Meta Analysis: Approach involves estimating a statistical valuation function based on the results of previous research.

Due to ease of application, the most common form of benefits transfer involves application of a single study point estimate or an average value across a range of study estimates. In these cases, the only adjustment typically made is to update the estimates to current dollars using some form of inflation based index (e.g., consumer price index, implicit price deflator). Within the P&Gs, value oriented benefit transfers are endorsed, particularly for small scale recreation valuations, through use of unit day values (UDV). Originally, UDV estimates were based from entrance fee studies in the early 1960s. Subsequent UDVs were based on a small sample of valuation studies conducted during the early 1970s. The USFS also applies value transfer approaches through use of its Resource Planning Act values updated approximately every five years.

Many difficulties arise in simply re-applying a previously developed benefit estimate. Despite the extensive amount of available recreation research, chances are generally remote that a benefit estimate has previously been developed for the recreation site of interest (referred to as the "policy" site). Therefore, the first problem involves selecting a representative value estimate from a previously studied similar site (referred to as the "study" site). Such a selection implicitly assumes the analyst has maintained a database of valuation studies from which to draw or has the time and budget to conduct a literature search. Even with a list of studies in hand, difficulty lies in selecting the most appropriate similar site (hence many analysts simply average the values across the available studies). A multitude of factors can cause the results of a simple value transfer to be invalid. Those factors basically boil down to differences between the study site and the policy site (e.g., characteristics of the user populations, physical characteristics of the sites such as available activities, water levels, catch rates) and differences due to time (e.g., changes in value over time, changes in tastes and preferences).

Given the problem associated with value transfers, the theoretically preferred benefit transfer approach has evolved toward model transfers. Model transfers involve applying a statistical model estimated for the study site to the policy site. The primary advantage of this approach is that differences in the explanatory variables between the study site and the policy site can be taken into account with a model transfer. The primary disadvantages of the model transfer approach are 1) it may be difficult to locate an acceptable site and model for transfer and 2) the approach requires detailed knowledge as to how the variables in the model were developed. Even if the variable construction for the study site model are known, the approach requires that similar information be available for the policy site. While these requirements may prove problematic, the approach is generally expected to produce the most reliable benefits transfer estimates and therefore should be attempted when possible.

The final benefits transfer approach, being that of meta analysis, is the overall focus of this paper. As will be described in more detail in the next chapter, the meta analysis approach involves estimating a statistical valuation function using values and characteristics of previous studies. While the approach has strengths and weaknesses, it does provide an alternative valuation option when the value and model transfer approaches prove difficult. Oftentimes, results of the meta analysis approach would be used in conjunction with value transfers in an attempt to validate estimates.

2.0 META ANALYSIS

Meta analyses of recreation involve estimating a statistical model of recreation value based on information derived from previous modeling efforts. Information from existing studies are pooled and analyzed statistically. While extensive literature searches are normally required to develop a dataset of previous studies from which to base the statistical regression analyses, no new data is required. The data used in the regression analysis includes valuation estimates and modeling, site, population, and study/policy characteristics of each study. The dependent variable in the meta model represents the value estimates from the previous studies typically indexed to a constant year. The explanatory variables in the meta model attempt to account for differences between the value estimates included in the data set as a result of modeling characteristics (e.g. inclusion of travel time, site quality, and substitution variables; statistical estimation approach; functional form), site characteristics (e.g., type of activity, type of site, levels of site quality or attractiveness), population characteristics (e.g., population size, socioeconomic or demographic averages), or study/policy question characteristics (e.g., sample size and coverage, data collection approach, valuation method, value elicitation approach, magnitude of the proposed change in site quality). Given the yes/no, included/excluded character of many of the explanatory variables, qualitative or “dummy” variables are used heavily in meta analysis regressions.

Since recreation meta analyses attempt to statistically explain variation in estimated values based on methodological, site, population, and study oriented characteristics, the standard objective is to try and improve recreation modeling by aiding in variable selection. Stated differently, the objective is to understand what variables best explain the variation in recreation values. Another objective for pursuing a meta analysis is to use the models in a benefits transfer application to predict recreation values by activity and region. The meta analysis benefit transfer idea is much different from transferring values or site specific statistical models. Assuming the meta analysis model is defined by geographic region, recreational activity, fish and wildlife species, and site type, the model could be applied to estimate recreation value. The benefits transfer meta analysis concept is the primary focus of this report.

From a statistical estimation perspective, while there is certainly a theoretical justification for including certain explanatory variables within the meta analysis model, other less intuitive variables sometimes prove useful as well. As a result, stepwise regressions are often applied which test all of the available explanatory variables. The final model reflects those explanatory variables which meet or exceed a specified explanatory power threshold. According to Rosenberger and Loomis (2000a), the optimization associated with the stepwise regression is necessary to account for region-specific differences and to prevent the model from becoming cumbersome as a result of too many variables.

A problem to watch for with meta data is the possibility of panel effects. Since many of the value estimates may come from the same group of studies and therefore sets of respondents, it is possible that the value estimates may be correlated. This characteristic, referred to as panel effects, can negate the use of ordinary least squares and related stepwise regression procedures.

Tests for panel effects can be conducted (see Rosenberger and Loomis 2000b), and if present, many statistical packages are available for developing panel data models. Heteroskedasticity, or unequal variance, is likely with meta models since the values estimates are obtained from different models, data sets, and estimation methods (Smith and Kaoru, 1990).

Meta analysis has certain advantages over point estimates, average values, and demand function benefit transfer methods (Rosenberger and Loomis, 2000a) including: reliance on a larger dataset of studies thus providing stronger measures of central tendency, capability of controlling for methodological differences, ability to account for differences between study and policy sites by setting explanatory variables at policy site levels, and application of multi-activity and multi-site models allowing value estimation for activities and regions where prior research has not been conducted. On the downside, meta analysis implies certain limitations including: a requirement for sufficient numbers of primary research studies to estimate statistical relationships, the need for high quality and detailed reporting of the underlying studies to ensure accuracy of the meta analysis value estimates, and the need for the underlying studies to be similar enough to allow for statistical analysis.

Meta analysis with an orientation toward recreation valuation benefit transfer is fairly new, having only been conducted over the past decade or so. As a result, there are relatively few recreation oriented studies which have utilized this methodology.

Smith and Kaoru (1990a and b) provide one of the first examples of meta analysis in recreation. They reviewed and analyzed 77 travel cost studies conducted between 1970 and 1986. Their objective was to determine if systematic relationships existed between the benefit estimates and the features of the empirical models (e.g., site characteristics - recreation activities, type of site; modeling characteristics - include substitute price, opportunity cost of time, site specific versus regional model; econometric characteristics - function form, regression approach). While the authors found that meta analysis can help evaluate the sensitivity of value estimates to modeling assumptions, they were less convinced of the applicability of meta analysis to benefits transfer.

Walsh, et al. (1989, 1992) estimated average recreation values per day across twenty different recreational activities for the 1990 USDA Forest Service Resource Planning Act (RPA) valuation effort based on a dataset of recreation economic studies from 1968-1988. In addition to the value estimates, the authors developed meta analysis equations with the objective of evaluating modeling, valuation methodology, and statistical estimation effects on recreation benefit estimates. While the meta models were not directly used to estimate benefits by activity and region, a series of travel cost method value estimate adjustments were described to account for the following potential issues: omission of travel time costs, use of individual or zonal approach, inclusion of only in-state users at sites where out-of-state users are also present, and omission of cross-price substitution terms.

Loomis and White (1996) conducted a meta analysis on the total value of endangered species taking into consideration both use and nonuse values. In addition to some of the standard meta analysis independent variables (e.g., contingent valuation elicitation approach, response rate, data year), they found the following variables to be significant: percentage change in species population, frequency of payment (one time versus annual), and users versus nonusers. While Loomis and White caution against using their estimated meta model to assign values for endangered species, they suggest as more studies are performed and the meta analysis updated, the potential exists for using the model to value certain species.

Rosenberger and Loomis (2000, 2000a, and 2000b) conducted a recent broad based meta analysis study of recreation for the purpose of benefits transfer. The authors combined literature review results from Walsh et al. (1988) and McNair (1993) along with their own search from 1989 to 1998 to develop a database of recreation valuation studies from 1967 to 1998. Statistical models using estimates of consumer surplus per day in 1996 dollars as the dependent variable and a range of travel cost and contingent valuation methodology, data collection, functional form, region, site type, and other explanatory variables were estimated using stepwise ordinary least squares regressions.[3] Six meta models were estimated, a standard full dataset model to evaluate study effects on value estimates and five regional "benefit transfer" models to forecast values by activity and geographic region. The benefit transfer models were used to estimate benefits across 21 recreational activities and five geographic regions.

In summary, while there still appears to be some apprehension against widespread application, the literature seems to be evolving to the point where meta analysis models could be considered for estimating recreation economic benefits by activity and region. Assuming a sufficient level of out-of-region primary research exists, meta analysis would be particularly applicable for estimating benefits in regions where few if any primary research studies have been conducted for a given recreational activity.

[3] Panel data effects were tested but found to be not discernible. Therefore, ordinary least squares procedures were applied along with the Newey-West version of White's consistent covariance estimators (Smith and Kaoru, 1990).

3.0 META DATABASE

3.1 Original Database:

A detailed database describing modeling efforts across 163 recreation economic studies in the United States and Canada from 1967 to 1998 was obtained through a contract with Colorado State University. As described in Rosenberger and Loomis (2000), information was assembled based on four literature search efforts: 1) Sorg and Loomis (1984), 2) Walsh, Johnson, and McKean (1988), 3) MacNair (1993), and 4) Loomis, Rosenberger, and Shrestha (1999).

3.1.1 Database Development:

Sorg and Loomis (1984) collected data on 93 benefit estimates from the mid-1960s to 1982. Walsh, Johnson, and McKean (1988) extended the time frame to 1988 supplementing the Sorg and Loomis database to a total of 120 studies and 287 benefit estimates. MacNair (1993) further extended the coverage to 1993 resulting in a total of 706 benefit estimates. Despite the greater number of benefit estimates, the MacNair effort was actually based on fewer overall studies compared to the Walsh, Johnson, and McKean effort. MacNair broadened the criteria for including benefit estimates, thereby significantly increasing the number of estimates. An advantage of the MacNair study was the expanded coding of study information for each study. Loomis, Rosenberger, and Shrestha (1999) conducted another outdoor recreation literature review focusing on the 1988 to 1998 time period. Again, coding of study information was provided for each benefit estimate - improving the study information coding procedures proved to be a major emphasis of this research.

The Loomis, Rosenberger, and Shrestha effort did not target fishing studies since that is the goal of another ongoing review funded by the U. S. Fish and Wildlife Service (Markowski et al.1997). Since this effort was co-funded by both the U. S. Forest Service and Reclamation, ocean activities were not emphasized. An objective of the Loomis, Rosenberger, and Shrestha review was to target recreational activities which were either under-represented or unrepresented in the previous reviews. The final database used for the modeling conducted for this paper merged the results of the Loomis, Rosenberger, and Shrestha review with the MacNair review. In addition, the authors only included fishing studies from the MacNair review which where also included in the Walsh, Johnson, and McKean review. While the Loomis, Rosenberger, and Shrestha review excluded fishing studies, the authors believe there were a sufficient number of fishing studies within the MacNair review to cover this important recreational activity (although no post 1988 fishing studies were included). The final database includes 163 studies and 701 benefit estimates across twenty different recreation activities.

Table 1 presents mean values from this dataset per recreator per activity day in 1996 dollars by recreation activity and geographic region. The geographic regions are based on the following U.S. Forest Service regions: 1) Northeast region is equal to USFS region 9 (MN, IA, MO, WI, IL, MI, IN, OH, WV, PA, MD, DE, NJ, NY, CT, RI, MA, VT, NH, ME), 2) Southeast region is equal to USFS region 8 (TX, OK, AR, LA, MS, AL, FL, GA, SC, NC, TN, KY, VA), 3) Intermountain region is equal to USFS regions 1-4 (MT, ND, SD, WY, NE, KS, CO, NM, AZ, UT, NV, ID), 4) Pacific Coast region is equal to USFS region 6 and 7 (WA, OR, CA), and 5) Alaska region is equal to USFS region 10 (AK).

While beyond the budgetary capability of this study, extensions of the final database could be made by coding 56 additional studies included in the Walsh, Johnson, and McKean review which were excluded from the MacNair review, appending additional fishing studies from the Markowski et al. review when they become available, and adding ocean fishing studies. While both ocean studies and fishing studies were not emphasized within the database, in some cases BOR activities do influence ocean fishing, making that an activity worthy of consideration in future efforts.

Table 1: Recreation Values (1996 $) per activity day by Recreation Activity and USFS Region (Rosenberger and Loomis, 2001)

Recreation Activity	North East			South East			Intermountain West			Pacific Coast			Alaska			U. S. & Canada Totals		
	n	*Mean*	*95% CI*	*n*	*Mean*	*95% CI*	*n*	*Mean*	*95% CI*	*n*	*Mean*	*95% CI*	*n*	*Mean*	*95% CI*	*n*	*Mean*	*95% CI*
Camping	7	24.34	12.10-36.58	10	21.90	7.33-36.47	18	25.87	15.30-36.44	3	53.58	4.33-102.83				40	30.36	19.58-41.14
Picnicking	2	47.04	0-124.63	2	30.52	17.36-43.68	4	22.95	14.46-31.45	2	20.80	4.84-36.77				12	35.26	16.33-54.19
Swimming	3	16.37	0-41.33	3	22.87	5.34-40.41	1	24.62	n/a	4	22.74	4.21-41.27				12	21.08	12.34-29.82
Sightseeing	1	27.56	n/a	4	52.58	25.38-79.78	10	13.22	6.17-20.27	1	50.64	n/a	1	13.20	n/a	20	35.88	17.44-54.32
Motor Boating	1	66.75	n/a	2	8.40	3.23-13.56	5	23.58	7.20-39.96	4	21.69	.96-42.41				14	34.75	11.92-57.58
Float Boating	4	52.99	9.85-96.14	2	20.98	9.33-32.64	9	57.01	34.06-79.97				1	15.13	n/a	19	61.57	34.60-88.54
Hiking	3	62.65	41.70-83.61	4	22.25	0-45.25	5	31.85	13.87-49.83	14	26.71	13.67-39.75	1	12.93	n/a	29	36.63	21.21-52.06
Big Game Hunting	53	42.37	36.65-48.09	29	33.89	28.49-39.30	69	40.12	34.56-45.68	12	40.76	23.39-58.13	5	52.40	41.85-62.96	177	43.17	38.84-47.50
Small Game Hunting	3	36.73	0-78.37				13	25.75	17.20-34.30	1	27.37	n/a				19	35.70	16.96-54.44
Waterfowl Hunting	22	27.06	17.10-37.02	11	17.70	14.80-20.60	16	23.58	13.19-33.97	5	33.19	13.53-52.86	1	60.08	n/a	59	31.61	23.65-39.57
Fishing	41	23.04	17.03-29.05	13	27.74	15.62-39.86	39	31.42	23.79-39.06	15	36.97	22.80-51.15	1	39.22	n/a	122	35.89	29.19-42.59
Wildlife Viewing	56	27.03	23.57-30.48	39	29.13	25.18-33.08	38	32.80	28.56-37.04	15	29.74	23.48-36.00	6	37.42	19.46-55.39	157	30.67	27.97-33.37
Biking	1	34.11	n/a	1	56.27	n/a	2	58.89	51.06-66.71							5	45.15	28.69-61.61

3.1.2 Database Content:

A coding sheet containing 126 different fields was used to record information for each study into the database. A wide range of information was included in the dataset, including the following:

Value Estimates:	Consumer surplus per person estimates were converted to a per day basis and indexed to 1996 dollars
Valuation Method:	Stated preference (contingent valuation/behavior) versus revealed preference (travel cost, hedonics)
Contingent Valuation Elicitation Approach:	Dichotomous choice, open-ended, iterative bid, payment card, conjoint
Revealed Preference Approach:	Zonal TCM, Individual TCM, Random Utility Model, Hedonic
Variable Inclusion:	Travel time, substitute sites
Sample Frame:	Onsite versus off-site
Data Collection Method:	Mail, phone, in person, existing data
Functional Form:	Linear, log-linear, linear-log, log-log
Study Quality:	Year of the data as a proxy
Site Quality:	Site was recorded as high quality if indicated by the author or if a National Park, National Recreation Area, or Wilderness Area
Region:	US Forest Service and Census regions.
Site Type:	Lake, river, forest, ocean
Site Management:	US Forest Service managed, and public versus private
Facilities:	Developed or undeveloped
Recreation Activities:	Camping, Picnicking, Swimming, Sightseeing, Off-Road Vehicle Driving, Motor Boating, Float Boating, Hiking, Biking, Downhill Skiing, Cross-Country Skiing, Snowmobiling, Snowplay,

Hunting, Fishing, Wildlife Viewing, Horseback Riding, Staying at Resorts, Rock Climbing, General Water Based Recreation, Other

3.2 Benefits Transfer Database:

While the original database allows for both standard methodological Meta analysis and benefits transfer Meta analysis, the focus of this paper is on benefits transfer modeling. To prepare for benefits transfer Meta analysis from a Reclamation perspective, the following additional variables were coded into the database:

BOR Regions: Based on site location, studies were assigned to each BOR Region as well as the rest of the U. S. Qualitative or dummy variables were developed for each of the five BOR regions (Great Plains (GP), Lower Colorado (LC), Mid-Pacific (MP), Pacific Northwest (PN), and Upper Colorado (UC)). The necessary excluded option for use of dummy variables reflects studies located outside Reclamation's western 17 states.

Site Type: Qualitative or dummy variables were developed for the following site types of interest to Reclamation: lakes and reservoirs (LAKE), oceans and estuaries (OCEAN1), and rivers (RIVER). The necessary excluded option for use of dummy variables involves land-based recreational activities.

Recreational Activities: The following recreational activities, often impacted by Reclamation activities, were also coded as dummy variables: camping, picnicking, swimming, sightseeing, motorboating, floatboating, hiking, hunting, fishing, and wildlife viewing.

In addition to the individual activities, the following activity groups were also converted into dummy variables:

Water based activities including swimming, motorboating, floatboating, fishing, and general water based recreation were coded into a water based variable (WATRBASE). Water based values are relevant to studies where recreation visitation cannot be separated by activity.

Hunting and fishing were grouped into a consumptive use activity variable (CONSUMP).

Swimming, floatboating, hiking, biking, and hunting were grouped into an active as opposed to passive use activity variable (ACTIVE).

4.0 META STATISTICAL ANALYSIS AND RESULTS

The basic objective of this Meta analysis effort is to develop recreation economic benefit transfer models for estimation of economic values per day by recreation activity, site type, and Reclamation region. As a result, the benefits transfer models only include explanatory variables for recreation activities, site types, and Reclamation regions.

Rosenberger and Loomis estimated a benefits transfer model using the entire dataset as well as a series of models separated by geographic region (USFS regions). We follow a similar approach except that we focus in on Reclamation regions. We also focus heavily upon the site type variables and when possible, estimate values by activity and site type. The following section briefly presents both the full dataset and region specific models.

4.1 Benefit Transfer Models:

Full Dataset Model: The full dataset model includes all the information in the dataset. It includes observations from all geographic areas found in the data.

Value per Day$_{aj}$ = f (GP, LC, MP, PN, UC; LAKE, OCEAN1, RIVER; WATRBASE, CAMP,...)
|-----BOR Regions----| |----------Site Types---------| |--Recreation Activities--|

where:

Activity: a = 1,...,20
Site: j = 1,..., n

Dependent Variable: Economic Value (consumer surplus) per day in 1996 dollars by activity and site

Explanatory Variables:

BOR Regions: Qualitative dummy (0,1) variables for each of the five BOR regions (GP, LC, MP, PN, UC). The objective is to test whether or not average values for the same activity vary by geographic region.

Site Types: Qualitative dummy (0,1) variables for each site type of interest to Reclamation (lakes/reservoirs, ocean, rivers). The objective is to test whether or not average values for the same activity vary by site type (e.g., lake fishing versus river fishing).

Recreation Activities: Qualitative dummy (0,1) variables for each recreation activity of interest to Reclamation.

Individual activities include camping, picnicking, swimming, sightseeing, motorboating, floatboating, hiking, hunting, fishing, and wildlife viewing. Grouped activities include water based (WATRBASE), consumptive (CONSUMP) and active (ACTIVE). The objective is to test whether or not average values vary across recreation activities.

BOR Region Specific Models: The region specific models use datasets which have removed all observations outside the region of interest. As a result, we have five region specific datasets. Since the dataset is already region specific, the explanatory variables used in the full dataset model related to each region are unnecessary in this model.

Value per Day_{ajr} = f (LAKE, OCEAN1, RIVER; WATRBASE, CAMP, ...)
|---------Site Types---------| |--Recreation Activities--|
where:

Activity: a = 1,...,20
Site: j = 1,..., n
Region: r = 1,...,5 (GP, LC, MP, PN, UC)

Dependent Variable: Economic Value (consumer surplus) per day in 1996 dollars by activity and site only for observations within the specific Reclamation region of interest.

Explanatory Variables:

Site Types: Qualitative dummy (0,1) variables for each site type of interest to Reclamation (lakes/reservoirs, ocean, rivers). The objective is to test whether or not average values by region for the same activity vary by site type (e.g., lake fishing versus river fishing).

Recreation Activities: Qualitative dummy (0,1) variables for each recreation activity of interest to Reclamation. Individual activities include camping, picnicking, swimming, sightseeing, motorboating, floatboating, hiking, hunting, fishing, and wildlife viewing. Grouped activities include water based (WATRBASE), consumptive (CONSUMP) and active (ACTIVE). The objective is to test whether or not average values by region vary across recreation activities.

Given that economic values per day can vary by activity, site type, and geographic region, and their exists little or no expectations as to the magnitude of the values across the different activities, site types, and geographic areas, the signs on the various explanatory variables would generally be unknown.

4.2 Statistical Estimation:

For sake of efficiency, we follow the statistical analysis lead of Rosenberger and Loomis (2000a) who also made use of the same dataset to estimate benefits transfer Meta analysis models from a broader perspective. Given that panel effects associated with the database were deemed by Rosenberger and Loomis not to be a concern, they employed ordinary least squares with a Newey-West version of White's consistent covariance estimator to estimate the models.[4] According to Smith and Kaoru (1990), use of the Newey-West covariance estimator corrects for heteroskedasticity and autocorrelation problems potentially associated with meta analysis datasets. This statistical procedure was available within the LIMDEP statistical package employed in our modeling.

In addition to the econometric issues, Rosenberger and Loomis (2000a) note that there is no precedent for choice of functional forms with meta analyses. As a result, we tested both linear and semi-log functional forms.

4.3 Modeling Results:

The following section presents the most promising statistical results of the Reclamation oriented benefits transfer regressions for both the full dataset and regionally sorted partial dataset models. A series of models were tested starting with the fully specified models which include all the explanatory variables mentioned above, and ending with partially specified models based on a subset of the range of potential explanatory variables.

Promising results were determined mainly through consideration of the number of statistically significant explanatory variables as indicated by asterisks (*). Variable significance was assumed based on the achievement of 90 percent confidence levels which implies we are 90

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[4] Panel data refers to instances where greater than one observation stems from the same study. Within this dataset, multiple observations are common, with one study contributing over 100 benefit estimates. Use of ordinary least squares estimation becomes problematic if there is correlation among the multiple observations obtained from the same study. Fortunately, Rosenberger and Loomis tested for panel effects and found them to be nonexistent. For more on this topic see Smith and Kaoru (1990).

percent certain that the variable coefficient does not equal zero. Models were estimated which resulted in several significant explanatory variables. Given there were no expectations as to the positive or negative direction of the signs of the explanatory variables, no sign evaluations could be made. The explanatory power or goodness of fit of the model to the underlying data was also considered by reviewing the adjusted R^2. However, this measure was given less weight than variable significance given it can be influenced simply by adding or removing variables. It should be noted that with cross sectional data, very low R^2 can result despite the estimation of a useful model. Given the meta dataset has both cross sectional (across sites) and time series (across time) characteristics, models with low R^2 would not be unexpected. In most cases, the explanatory power of even the best models wasn't particularly high (around the .6 range) implying the geographic region, site type, and recreational activity explanatory variables do not explain a whole lot of the variation across the value estimates. Generally speaking the partial dataset, region specific models resulted in higher R^2 than the full dataset models. While variable significance should be able to identify differences in value between activities, the low R^2 suggests the overall value predictions may be questionable.

Finally, values are calculated for each of the significant recreation activities in each of the models. Note that in cases where site types or regions proved significant, values were calculated by activity and site type or activity and region. To calculate the values by activity for the linear models, since all the variables are qualitative (0 or 1 values), simply add up the coefficients of the appropriate significant variables. For example, in the first model presented below, to estimate the value per day for picnicking, add the coefficients for the constant term, the river variable, and the picnic variable (24.62+33.07+18.95) to obtain the $76.65 value. For the non-river picnicking value, the river coefficient is dropped to obtain $43.58. For the semi-log models, the same procedure is followed with the additional step of taking the antilog of the total. The models would estimate the same value for all of the insignificant activities since the coefficients of those variables are statistically equivalent to zero. The values would basically be equal to the constant term plus any significant regional or site type variables. Given the values reflect 1996 dollars, they would have to be indexed to current dollars using some form of inflation based index.

The benefit transfer model estimates are compared to average values and 95 percent confidence intervals by USFS region and recreation activity presented in Table 1 as obtained from Rosenberger and Loomis (2000). The average values represent the straight average across the number of value estimates available for each activity and region. The confidence intervals take into account the standard deviation and error associated with each average value and reflects the range within which one would expect an estimated value to fall. Given the errors are large in some cases, the confidence interval ranges can be fairly wide. While the meta model estimates are not directly comparable to the results from Rosenberger and Loomis, due to different geographic region definitions and the fact that Rosenberger and Loomis did not calculate separate values by site type, the values in Table 1 do provide a general benchmark for comparison. Meta model estimated values with a asterisk indicate they fall outside the 95 percent confidence interval. Reviewing the range of comparable estimates from the full dataset models resulted in only 30% of the meta model's estimated values falling within the 95%

confidence interval of the actual dataset values. Reviewing the region specific meta models, the results were somewhat better with 50% of the estimated values falling within the 95% confidence intervals. Bottomline, the models appear to show some promise for benefits transfer, but are not appropriate for application at this point.

4.3.1 Full Dataset Models:

Fully Specified Models by Region, Site Type, and Activity:

Linear Models:

```
--> REGRESS;lhs=CURDOL;rhs=INDVAR7;pds=11$
+-----------------------------------------------------------------------+
| Ordinary    least squares regression    Weighting variable = none     |
| Dep. var. = CURDOL   Mean=   35.67691869    , S.D.=   32.45027923     |
| Model size: Observations =     701, Parameters =  20, Deg.Fr.=    681 |
| Residuals:  Sum of squares= 676286.7693    , Std.Dev.=       31.51316 |
| Fit:        R-squared=  .082521, Adjusted R-squared =          .05692 |
| Model test: F[ 19,    681] =    3.22,    Prob value =          .00000 |
| Diagnostic: Log-L =  -3403.2645, Restricted(b=0) Log-L =   -3433.4516 |
|             LogAmemiyaPrCrt.=    6.929, Akaike Info. Crt.=      9.767 |
| Autocorrel: Durbin-Watson Statistic =   1.42127,   Rho =       .28937 |
| Autocorrelation consistent covariance matrix for lags of 11 periods   |
+-----------------------------------------------------------------------+
+---------+--------------+----------------+--------+---------+----------+
|Variable | Coefficient  | Standard Error |b/St.Er.|P[|Z|>z] | Mean of X|
+---------+--------------+----------------+--------+---------+----------+
 Constant  24.62690118      5.4954541        4.481   .0000 *
 GP        4.008639925      3.9376545        1.018   .3087    .15406562
 LC        3.146303590      8.1797839         .385   .7005    .48502140E-01
 MP        3.779673294      5.4970302         .688   .4917    .72753210E-01
 PN       -5.422602153      4.0078588       -1.353   .1761    .11697575
 UC        2.980776178      5.4772190         .544   .5863    .79885877E-01
 LAKE     -13.70083298      9.2899848       -1.475   .1403    .48502140E-01
 OCEAN1    15.94124290      10.706149        1.489   .1365    .24251070E-01
 RIVER     33.06620686      9.1130123        3.628   .0003 *  .41369472E-01
 CAMP      5.623668304      14.716077         .382   .7024    .35663338E-01
 PICNIC    18.95363494      11.339253        1.672   .0946 *  .11412268E-01
 SWIM     -12.91529032      7.8271461       -1.650   .0989 *  .99857347E-02
 SIGHTSEE  13.49920690      15.569403         .867   .3859    .25677603E-01
 MTRBOAT   14.42944816      17.618070         .819   .4128    .14265335E-01
 FLTBOAT   26.93860845      15.456842        1.743   .0814 *  .14265335E-01
 HIKE      8.909784914      11.507762         .774   .4388    .32810271E-01
 BIKE      19.33478835      8.3718897        2.309   .0209 *  .71326676E-02
 HUNT      14.67862458      6.0089218        2.443   .0146 *  .36376605
 FISH      6.853700829      6.3592345        1.078   .2811    .17403709
 WLVIEW    5.017508257      5.7756956         .869   .3850    .22396576
```

While five of the eleven recreation activity variables proved significant, but only one of the three site type variables and none of the region variables proved significant. The model resulted in a low R^2 (.056).

Values per day (1996 $): Values from the full dataset models are compared in most cases to the national average values by activity given the region variables generally proved insignificant. While river versus non-river values were not estimated based on the actual data, the river values fall outside the 95% confidence intervals for four of the five significant activities.

River Non-River

	Values	Values
Picnicking	76.65 * (high)	43.58
Swimming	44.78 * (high)	11.71 * (low)
Float Boating	84.63	51.57
Biking	77.03 * (high)	43.96
Hunting	72.37 * (high)	39.31

* denotes estimates outside the U. S. and Canada 95% confidence interval of actual dataset values

Semi-Log Models:

```
--> REGRESS;lhs=LCURDOL;rhs=INDVAR7;pds=11$
+-----------------------------------------------------------------------+
| Ordinary    least squares regression    Weighting variable = none     |
| Dep. var. = LCURDOL  Mean=   3.235879067    , S.D.=   .8736866346     |
| Model size: Observations =     701, Parameters =  18, Deg.Fr.=    683 |
| Residuals:  Sum of squares= 470.4980024    , Std.Dev.=         .82998 |
| Fit:        R-squared=  .119461, Adjusted R-squared =          .09754 |
| Model test: F[ 17,    683] =    5.45,    Prob value =          .00000 |
| Diagnostic: Log-L =   -854.9259, Restricted(b=0) Log-L =    -899.5171 |
|             LogAmemiyaPrCrt.=    -.347, Akaike Info. Crt.=      2.491 |
| Autocorrel: Durbin-Watson Statistic =   1.25691,   Rho =       .37155 |
| Autocorrelation consistent covariance matrix for lags of 11 periods   |
+-----------------------------------------------------------------------+
+---------+--------------+----------------+--------+---------+----------+
|Variable | Coefficient  | Standard Error |b/St.Er.|P[|Z|>z] | Mean of X|
+---------+--------------+----------------+--------+---------+----------+
 Constant  2.870350240      .15357790       18.690   .0000 *
 GP        .4855692445E-01  .10946890         .444   .6574    .15406562
 LC       -.3237897473E-02  .21059849        -.015   .9877    .48502140E-01
 MP        .1357568970      .12678248        1.071   .2843    .72753210E-01
 PN       -.1057536856      .13386438        -.790   .4295    .11697575
 UC        .2109619746      .12625719        1.671   .0947 *  .79885877E-01
 LAKE     -.6564606500      .35829444       -1.832   .0669 *  .48502140E-01
 OCEAN1    .1565418157      .20217589         .774   .4388    .24251070E-01
 RIVER     .5476002125      .24128921        2.269   .0232 *  .41369472E-01
 CAMP     -.8627654340E-01  .48420478        -.178   .8586    .35663338E-01
 PICNIC    .5734914275      .35692690        1.607   .1081    .11412268E-01
 SWIM     -.5792613206      .31526924       -1.837   .0662 *  .99857347E-02
 SIGHTSEE -.1649459490E-01  .61333538        -.027   .9785    .25677603E-01
 MTRBOAT   .2614160805      .41747749         .626   .5312    .14265335E-01
 FLTBOAT   .8862469686      .29946858        2.959   .0031 *  .14265335E-01
 HUNT      .5362891398      .17031740        3.149   .0016 *  .36376605
 FISH      .3088625840      .18513393        1.668   .0953 *  .17403709
 WLVIEW    .3874085386      .15621092        2.480   .0131 *  .22396576
```

While five of the nine recreation activity variables and two of the three site type variables proved significant, only one of the region variables proved significant. The model displays a low R^2 (.097).

Values per day (1996 $): Given the Upper Colorado (UC) region came in significant, values are calculated for lake and river setting both within and outside the

UC region. As a result, the UC estimates are compared to the Intermountain values whereas the non-UC estimates are compared to the U. S. and Canada values. Where only one value was obtained, confidence intervals could not be estimated, so a (?) is placed beside the estimate. Based on this model, the lake value estimates appear low and the river value estimates high.

	UC Lake Values	UC River Values	Non-UC Lake Values	Non-UC River Values
Swimming	6.33 (?)	21.11 (?)	5.13 * (low)	17.09
Float Boating	27.42 * (low)	91.39 * (high)	22.20 * (low)	74.01
Hunting	19.32	64.41 * (high)	15.65 * (low)	52.16
Fishing	15.39 * (low)	51.30 * (high)	12.46 * (low)	41.55
Wildlife Viewing	16.65 * (low)	55.50 * (high)	13.48 * (low)	44.94 * (high)

Partially Specified Models by Site Type and Activity:

Semi-Log Models:

```
--> REGRESS;lhs=LCURDOL;rhs=INDVAR6;pds=11$
+-----------------------------------------------------------------------+
| Ordinary    least squares regression    Weighting variable = none     |
| Dep. var. = LCURDOL  Mean=   3.235879067    , S.D.=   .8736866346     |
| Model size: Observations =     701, Parameters =   7, Deg.Fr.=    694 |
| Residuals:  Sum of squares= 487.0757890    , Std.Dev.=         .83776 |
| Fit:        R-squared=  .088436, Adjusted R-squared =          .08056 |
| Model test: F[  6,    694] =   11.22,    Prob value =          .00000 |
| Diagnostic: Log-L =   -867.0630, Restricted(b=0) Log-L =    -899.5171 |
|             LogAmemiyaPrCrt.=    -.344, Akaike Info. Crt.=      2.494 |
| Autocorrel: Durbin-Watson Statistic =   1.25269,   Rho =        .37366 |
| Autocorrelation consistent covariance matrix for lags of 11 periods   |
+-----------------------------------------------------------------------+
+---------+--------------+----------------+--------+---------+----------+
|Variable | Coefficient  | Standard Error |b/St.Er.|P[|Z|>z] | Mean of X|
+---------+--------------+----------------+--------+---------+----------+
 Constant  3.191929331      .76581218E-01   41.680   .0000 *
 LAKE     -.6307597249      .31233232       -2.020   .0434    .48502140E-01
 OCEAN1    .1298110406      .22731689         .571   .5680    .24251070E-01
 RIVER     .5993698032      .23271822        2.576   .0100 *  .41369472E-01
 WATRBASE -.3675430211      .21157500       -1.737   .0824 *  .25392297
 CONSUMP   .3201835310      .18097911        1.769   .0769 *  .53780314
 ACTIVE   -.7113349035E-01  .17410657        -.409   .6829    .45363766
```

This model used the entire dataset, but dropped the region variables. In addition, the model focused on the combined waterbased, consumptive, and active activities. The objective was to estimate a value for general waterbased activities applicable when waterbased recreation cannot be separated by activity. Again, the model's R^2 was low (.081).

Values per day (1996 $): The average values for the overall dataset were not separated by waterbased and consumptive activities, therefore no comparisons can be made.

	Lake Values	River Values
Water Based Activities	8.97	30.68
Consumptive Activities	17.84	61.04

```
--> REGRESS;lhs=LCURDOL;rhs=INDVAR7;pds=11$
+-----------------------------------------------------------------------+
| Ordinary    least squares regression    Weighting variable = none     |
| Dep. var. = LCURDOL  Mean=   3.235879067    , S.D.=   .8736866346     |
| Model size: Observations =     701, Parameters =  15, Deg.Fr.=    686 |
| Residuals:  Sum of squares= 469.7396533    , Std.Dev.=         .82750 |
| Fit:        R-squared=  .120881, Adjusted R-squared =          .10294 |
| Model test: F[ 14,    686] =    6.74,    Prob value =          .00000 |
| Diagnostic: Log-L =   -854.3605, Restricted(b=0) Log-L =    -899.5171 |
|             LogAmemiyaPrCrt.=    -.358, Akaike Info. Crt.=      2.480 |
| Autocorrel: Durbin-Watson Statistic =   1.27066,   Rho =       .36467 |
| Autocorrelation consistent covariance matrix for lags of 11 periods   |
+-----------------------------------------------------------------------+
+---------+--------------+----------------+--------+---------+----------+
|Variable | Coefficient  | Standard Error |b/St.Er.|P[|Z|>z] | Mean of X|
+---------+--------------+----------------+--------+---------+----------+
 Constant  2.797392792      .18169601       15.396   .0000 *
 LAKE     -.6478752567      .35490861       -1.825   .0679 *  .48502140E-01
 OCEAN1    .1390825445      .20360441         .683   .4945    .24251070E-01
 RIVER     .5909584732      .23835767        2.479   .0132 *  .41369472E-01
 CAMP     -.1475296560E-01  .49877752        -.030   .9764    .35663338E-01
 PICNIC    .6562688925      .37514355        1.749   .0802 *  .11412268E-01
 SWIM     -.4982558211      .32905143       -1.514   .1300    .99857347E-02
 SIGHTSEE  .5586260395E-01  .62898429         .089   .9292    .25677603E-01
 MTRBOAT   .3730825311      .46670869         .799   .4241    .14265335E-01
 FLTBOAT   .9564868046      .33698871        2.838   .0045 *  .14265335E-01
 HIKE      .3085711340      .26926238        1.146   .2518    .32810271E-01
 BIKE      .9175993174      .27929747        3.285   .0010 *  .71326676E-02
 HUNT      .6275112159      .19609461        3.200   .0014 *  .36376605
 FISH      .3833579680      .20554982        1.865   .0622 *  .17403709
 WLVIEW    .4824173040      .18910010        2.551   .0107 *  .22396576
```

This model used the entire dataset, but dropped the region variables. Unlike the previous model, the individual activities were included. Six of the eleven activity variables and two of the three site type variable proved significant. Again, the model's R^2 was low (.102).

Values per day (1996 $): The value estimates presented below were compared to the U. S. and Canada totals. Most of these estimates feel outside the 95% confidence intervals for each activity. As above, the lake values appear low while the river values appear high. Values for land based activities at other than lake and river sites were also calculated for comparison. In each case, the values fell between those of the lake and river sites for the same land based activity.

	Lake Values	River Values	Land Values
Picnicking	16.54	57.09 * (high)	31.60

Float Boating	22.33 * (low)	77.08	-
Biking	21.48 * (low)	74.14 * (high)	41.04
Hunting	16.07 * (low)	55.47 * (high)	30.71
Fishing	12.59 * (low)	43.45 * (high)	-
Wildlife Viewing	13.90 * (low)	47.98 * (high)	26.56 * (low)

4.3.2 Partial Dataset Models:

Great Plains Region:

Fully Specified Model by Site Type and Activity:

Semi-Log Models:

```
--> REGRESS;lhs=LCURDOL;rhs=INDVAR7;pds=11$
+-----------------------------------------------------------------------+
| Ordinary    least squares regression    Weighting variable = none     |
| Dep. var. = LCURDOL  Mean=   3.285089033    , S.D.=   .9427830552     |
| Model size: Observations =     108, Parameters =  11, Deg.Fr.=     97 |
| Residuals:  Sum of squares= 66.54005543    , Std.Dev.=         .82824 |
| Fit:        R-squared=  .300358, Adjusted R-squared =          .22823 |
| Model test: F[ 10,     97] =    4.16,    Prob value =          .00008 |
| Diagnostic: Log-L =   -127.0917, Restricted(b=0) Log-L =    -146.3798 |
|             LogAmemiyaPrCrt.=    -.280, Akaike Info. Crt.=      2.557 |
| Autocorrel: Durbin-Watson Statistic =   2.01829,   Rho =      -.00914 |
| Autocorrelation consistent covariance matrix for lags of 11 periods   |
+-----------------------------------------------------------------------+
+---------+--------------+----------------+--------+---------+----------+
|Variable | Coefficient  | Standard Error |t-ratio |P[|T|>t] | Mean of X|
+---------+--------------+----------------+--------+---------+----------+
 Constant  3.072875384      .32898917       9.340   .0000 *
 LAKE     -.8502002974      .39891642      -2.131   .0356 * .83333333E-01
 RIVER     1.037223356      .59682999       1.738   .0854 * .46296296E-01
 CAMP     -.7765193632      .45480465      -1.707   .0910 * .46296296E-01
 PICNIC    .4021918457      .32898917       1.223   .2245   .92592593E-02
 MTRBOAT   .3149545591      .82583093        .381   .7038   .27777778E-01
 FLTBOAT   1.543234742      .32898917       4.691   .0000 * .92592593E-02
 HIKE     -.3528342790     1.0293616        -.343   .7325   .18518519E-01
 HUNT      .4144018370      .33264758       1.246   .2159   .45370370
 FISH      .2753080149      .34495007        .798   .4268   .14814815
 WLVIEW    .9488467330E-01  .40292704        .235   .8143   .23148148
```

Both site type variables (note that the only ocean shoreline within this region occurs in Texas, therefore that variable was excluded) and two of the eight recreation activity variables proved significant. The model's R^2 was somewhat higher than the full dataset models (.228).

Values per day (1996 $): The value estimates for the region specific partial dataset models are compared to the actual values from the dataset for the particular region of interest. While Texas and Oklahoma are found in the USFS Southeast region, most of the Reclamation's Great Plains region falls within the intermountain region of Table 1.

	Lake <u>Values</u>	River <u>Values</u>
Camping	4.25 * (low)	28.04
Float Boating	43.20	285.24 * (high)

Lower Colorado Region:

Fully Specified Model by Site Type and Activity:

Linear Models:

```
--> REGRESS;lhs=CURDOL;rhs=INDVAR6;pds=11$
+-----------------------------------------------------------------------+
| Ordinary    least squares regression    Weighting variable = none     |
| Dep. var. = CURDOL   Mean=   41.19147059    , S.D.=   47.14948524     |
| Model size: Observations =      34, Parameters =   6, Deg.Fr.=     28 |
| Residuals:  Sum of squares= 24796.09120    , Std.Dev.=       29.75861 |
| Fit:        R-squared=  .662001, Adjusted R-squared =          .60164 |
| Model test: F[  5,     28] =   10.97,    Prob value =          .00001 |
| Diagnostic: Log-L =   -160.3093, Restricted(b=0) Log-L =    -178.7494 |
|             LogAmemiyaPrCrt.=    6.949, Akaike Info. Crt.=      9.783 |
| Autocorrel: Durbin-Watson Statistic =   1.76010,   Rho =       .11995 |
| Autocorrelation consistent covariance matrix for lags of 11 periods   |
+-----------------------------------------------------------------------+
+---------+--------------+----------------+--------+---------+----------+
|Variable | Coefficient  | Standard Error |t-ratio |P[|T|>t] | Mean of X|
+---------+--------------+----------------+--------+---------+----------+
 Constant  31.16167435      8.1292731       3.833   .0007 *
 LAKE      14.30077152      8.1341099       1.758   .0897 *  .14705882
 RIVER     105.1097840      17.148924       6.129   .0000 *  .17647059
 WATRBASE -26.37790148      9.9733307      -2.645   .0132 *  .41176471
 CONSUMP   21.42545560      9.2725602       2.311   .0284 *  .52941176
 ACTIVE   -25.16780463      12.109261      -2.078   .0470 *  .44117647
```

All the variables in this model proved significant. An ocean site type variable was not tested since only a relatively small portion of southern California shoreline is included in the region. Again, the combined activity variables were used in this model. The model's R^2 was considerably higher than the full dataset models (.602).

Values per day (1996 $): The average values for the overall dataset were not separated by waterbased, consumptive, and active activities, therefore no comparisons can be made.

	Lake Values	River Values
Water Based Activities	19.08	109.89
Consumptive Activities	66.89	157.70
Active Activities	20.29	111.10

```
--> REGRESS;lhs=CURDOL;rhs=INDVAR7;pds=11$
+--------------------------------------------------------------------------+
| Ordinary    least squares regression    Weighting variable = none       |
| Dep. var. = CURDOL   Mean=   41.19147059    , S.D.=   47.14948524       |
| Model size: Observations =      34, Parameters =   9, Deg.Fr.=     25 |
| Residuals:  Sum of squares= 22593.08101    , Std.Dev.=        30.06199 |
| Fit:        R-squared=  .692031, Adjusted R-squared =          .59348 |
| Model test: F[  8,     25] =    7.02,    Prob value =          .00007 |
| Diagnostic: Log-L =   -158.7276, Restricted(b=0) Log-L =    -178.7494 |
|             LogAmemiyaPrCrt.=    7.041, Akaike Info. Crt.=      9.866 |
| Autocorrel: Durbin-Watson Statistic =   1.62223,   Rho =        .18888 |
| Autocorrelation consistent covariance matrix for lags of 11 periods   |
+--------------------------------------------------------------------------+
+---------+-------------+---------------+--------+---------+----------+
|Variable | Coefficient  | Standard Error |t-ratio |P[|T|>t] | Mean of X|
+---------+-------------+---------------+--------+---------+----------+
 Constant  9.420000000    ........(Fixed Parameter)........
 LAKE      12.31555556      10.636708        1.158   .2579    .14705882
 RIVER     107.5177778      20.958620        5.130   .0000 *  .17647059
 CAMP      3.725000000      2.9018768        1.284   .2110    .17647059
 SIGHTSEE  2.103333333      .38645482        5.443   .0000 *  .88235294E-01
 FLTBOAT  -44.09777778      23.889592       -1.846   .0768 *  .58823529E-01
 HUNT      15.26571429      10.641603        1.435   .1638    .20588235
 FISH      18.77444444      11.027720        1.702   .1011 *  .32352941
 WLVIEW    29.92555556      2.9652654       10.092   .0000 *  .11764706
```

One of the two site type variables and four of the six activity variable proved significant. The model's R^2 was considerably higher than the full dataset models (.593).

Values per day (1996 $): As with the Great Plains region, Reclamation's Lower Colorado Region also crosses the boundaries of the USFS regions. Comparisons are made with the intermountain region values in Table 1.

	River Values	Non-River Values
Sightseeing	119.04 * (high)	11.52
Float Boating	72.84	(34.68) * (low)
Fishing	135.71 * (high)	28.19
Wildlife Viewing	146.86 * (high)	39.35 * (high)

Partially Specified Model by Activity:

Semi-Log Models:

```
--> REGRESS;lhs=LCURDOL;rhs=INDVAR3;pds=11$
+-----------------------------------------------------------------------+
| Ordinary    least squares regression    Weighting variable = none     |
| Dep. var. = LCURDOL  Mean=   3.158576916    , S.D.=   1.126623883     |
| Model size: Observations =      34, Parameters =   7, Deg.Fr.=     27 |
| Residuals:  Sum of squares= 22.82461843    , Std.Dev.=         .91943 |
| Fit:        R-squared=  .455081, Adjusted R-squared =          .33399 |
| Model test: F[  6,     27] =    3.76,    Prob value =          .00756 |
| Diagnostic: Log-L =    -41.4691, Restricted(b=0) Log-L =     -51.7901 |
|             LogAmemiyaPrCrt.=     .019, Akaike Info. Crt.=      2.851 |
| Autocorrel: Durbin-Watson Statistic =   1.83232,   Rho =       .08384 |
| Autocorrelation consistent covariance matrix for lags of 11 periods   |
+-----------------------------------------------------------------------+
+---------+--------------+----------------+--------+---------+----------+
|Variable | Coefficient  | Standard Error |t-ratio |P[|T|>t] | Mean of X|
+---------+--------------+----------------+--------+---------+----------+
 Constant  2.242835089    ........(Fixed Parameter)........
 CAMP     -.9775987257E-02  .36928555        -.026   .9791    .17647059
 SIGHTSEE  .1954540048      .34043938E-01    5.741   .0000 *  .88235294E-01
 FLTBOAT   1.901589130      .19420905        9.791   .0000 *  .58823529E-01
 HUNT      .3602498998      .48144355         .748   .4608    .20588235
 FISH      1.604772164      .99362560E-01   16.151   .0000 *  .32352941
 WLVIEW    1.657523667      .40376646        4.105   .0003 *  .11764706
```

This model tested the influence of the activity variables exclusively. Four of the six activities proved significant. The model's R^2 was somewhat higher than most of the full dataset models (.334).

Values per day (1996 $): Estimated values are compared to the actual values from the intermountain region in Table 1.

	Values
Camping	9.33 * (low)
Sightseeing	11.45
Float Boating	63.08
Fishing	46.88 * (high)
Wildlife Viewing	49.42 * (high)

Mid-Pacific Region:

No useful models were estimated.

Pacific Northwest Region:

Fully Specified Models by Site Type and Activity:

Linear Models:

```
--> REGRESS;lhs=CURDOL;rhs=INDVAR5;pds=11$
+-----------------------------------------------------------------------+
| Ordinary    least squares regression    Weighting variable = none     |
| Dep. var. = CURDOL   Mean=   31.79548780    , S.D.=   23.50371687     |
| Model size: Observations =      82, Parameters =   5, Deg.Fr.=     77 |
| Residuals:  Sum of squares= 41968.27446    , Std.Dev.=       23.34615 |
| Fit:        R-squared=  .062086, Adjusted R-squared =          .01336 |
| Model test: F[  4,     77] =    1.27,    Prob value =          .28742 |
| Diagnostic: Log-L =   -372.1089, Restricted(b=0) Log-L =    -374.7369 |
|             LogAmemiyaPrCrt.=    6.360, Akaike Info. Crt.=      9.198 |
| Autocorrel: Durbin-Watson Statistic =   1.67293,   Rho =       .16354 |
| Autocorrelation consistent covariance matrix for lags of 11 periods   |
+-----------------------------------------------------------------------+
+---------+--------------+----------------+--------+---------+----------+
|Variable | Coefficient  | Standard Error |t-ratio |P[|T|>t] | Mean of X|
+---------+--------------+----------------+--------+---------+----------+
 Constant  33.23650000      4.0479571        8.211   .0000 *
 LAKE      12.58863636      4.1345215        3.045   .0032 * .24390244E-01
 OCEAN1    24.73613636      15.152399        1.632   .1067   .48780488E-01
 RIVER     18.15963636      10.394699        1.747   .0846 * .60975610E-01
 WATRBASE -15.14013636      4.4524637       -3.400   .0011 * .26829268
```

The model tests the effects of the site type and waterbased activity variables. The model includes the ocean site type for this region. Using the 90% confidence interval for variable significance, the ocean variable just missed coming in significant, but an ocean value was estimated anyway. All the other variables proved significant. The model's R^2 wasn't particularly high, although somewhat higher than the full dataset models (.287).

Values per day (1996 $): The average values for the overall dataset were not separated by waterbased activities, therefore no comparisons can be made.

	Lake Values	Ocean Values	River Values
Water Based Activities	30.69	42.83	36.26

Upper Colorado Region:

Partially Specified Models by Activity:

Linear Models:

```
--> REGRESS;lhs=CURDOL;rhs=INDVAR3;pds=11$
+-----------------------------------------------------------------------+
| Ordinary    least squares regression    Weighting variable = none     |
| Dep. var. = CURDOL   Mean=   41.19147059    , S.D.=   47.14948524     |
| Model size: Observations =      34, Parameters =   7, Deg.Fr.=     27 |
| Residuals:  Sum of squares= 53287.47116    , Std.Dev.=       44.42533 |
| Fit:        R-squared=  .273631, Adjusted R-squared =          .11222 |
| Model test: F[  6,     27] =    1.70,    Prob value =          .16055 |
| Diagnostic: Log-L =   -173.3145, Restricted(b=0) Log-L =    -178.7494 |
|             LogAmemiyaPrCrt.=    7.775, Akaike Info. Crt.=     10.607 |
| Autocorrel: Durbin-Watson Statistic =   1.77354,   Rho =       .11323 |
| Autocorrelation consistent covariance matrix for lags of 11 periods   |
+-----------------------------------------------------------------------+
+---------+-------------+---------------+--------+---------+----------+
|Variable | Coefficient  | Standard Error |t-ratio |P[|T|>t] | Mean of X|
+---------+-------------+---------------+--------+---------+----------+
 Constant  9.420000000    ........(Fixed Parameter)........
 CAMP      3.725000000      2.9018768        1.284   .2102    .17647059
 SIGHTSEE  2.103333333      .38645482        5.443   .0000 *  .88235294E-01
 FLTBOAT   63.42000000      12.876414        4.925   .0000 *  .58823529E-01
 HUNT      15.26571429      10.641603        1.435   .1629    .20588235
 FISH      53.69545455      9.2706122        5.792   .0000 *  .32352941
 WLVIEW    56.80500000      32.353959        1.756   .0905 *  .11764706
```

This model tested the influence of the activity variables exclusively. Four of the six activities proved significant. The model's R^2 was low (.112).

Values per day (1996 $): Value estimates for Reclamation's Upper Colorado region are compared to the actual values for the intermountain region in Table 1. All three of these values fall within the 95% confidence interval of the intermountain region.

	Values
Hiking	24.56
Biking	58.89
Fishing	20.95

5.0 SUMMARY AND CONCLUSIONS

This report presents the results of several comprehensive literature reviews (see Table 1) as well as statistical benefits transfer oriented meta analysis models. Both sets of results are designed to measure recreation value per person per day by recreation activity and geographic region. The meta analysis models extend the analysis to present values by site type (river, lake, ocean) and Reclamation region. Such information could be used in a wide range of recreation economic benefit transfer applications, an analytical approach heavily used by government analysts given the infrequent ability to conduct original research due to time and budget constraints.

Despite presenting the average values from the literature searches as a point of reference, the primary focus of the effort was on the benefits transfer meta analysis models. A series of models were attempted using both a comprehensive national dataset, comprised of studies across the entire U. S., and a set of sorted regional datasets, comprised of studies specific to each Reclamation region. In most of the full dataset national models, the region variables proved insignificant, generally indicating little difference in values per day between regions for the same recreation activity (to further test this result, the analysis could be extended to include models by activity where the dataset was sorted by activity prior to statistical analysis). While the insignificance of the region variables in the national models might imply that the regional models may be unnecessary, it was interesting to note that the explanatory power of the regional models were generally higher than the national models.

In several national and regional models, the site type variables proved significant. An interesting result of this was that generally speaking, the value of activities at river locations exceeded the value for those same activities at lake locations. Assuming this result holds in future research, this could have implications for valuing recreation substitution between lake and river settings. In many cases, lake residents claim that dam removal would adversely affect regional recreation value, but if in river values exceed lake values, and levels of lake visitation simply transfer to river visitation, it is possible that recreation value might actually increase with dam removal.

While the most promising models provided a range of statistically significant explanatory variables, not all the variables proved significant. Therefore, distinct value estimates for every region, site type, and recreation activity could not be estimated. This means that the models would estimate the same value for all regions, site types, and activities which proved insignificant. Of course, for regions, site types, and activities which did prove significant, distinct values can be estimated. Unfortunately, the value estimates generated for the statistically significant and therefore distinct regions, site types, and activities frequently fell outside the 95 percent confidence intervals calculated from the average values of the underlying data. Overall, the models seem promising, but the value estimates generated from the models appear questionable, implying the results are not fully applicable at this point.

Given the ongoing need for recreation economic values for benefits transfer, and the promising statistical modeling results achieved in this preliminary effort, further research seems warranted. The following options could be considered in subsequent research:

1) Expansion of the dataset: Because it was the intent of another meta analysis project (Markowski, et al. 1997) at the time, the underlying data obtained from Rosenberger and Loomis (2000) did not emphasize fishing. One could try to obtain the Markowski data to supplement the Rosenberger and Loomis data. In addition, since the primary purpose of gathering the data was for use in constructing U. S. Forest Service Resource Planning Act values, the data also did not emphasize ocean based activities. With four of the five Reclamation regions having some and often extensive amounts of ocean coastlines, and given it is possible that ocean recreation could be impacted by Reclamation activities, it may be useful to expand the dataset to include potentially impacted ocean activities. Basically, this would involve adding ocean fishing since that would be the primary recreation activity affected by Reclamation actions.

2) Additional Study Coding: Rosenberger and Loomis (2000) did an excellent job in coding the studies included in the dataset, but some additional effort could go into further coding of the studies from a Reclamation perspective (e.g., to verify the coding by Reclamation region and site type). Obviously, particular emphasis would go into including benefit transfer variables relevant to Reclamation.

3) Additional Modeling: Once a broader range of fishing studies is brought into the dataset, attempts could be made to include fish species as an explanatory variable to attempt to value this critical activity by species or species groups (e.g., cold water, warm water, anadromous). Similar efforts could also be attempted for other species oriented recreation activities such as hunting and wildlife viewing.

While Rosenberger and Loomis (2000) determined that the current dataset did not suffer from excessive panel data effects and its associated problems, that situation might not hold should additional studies be added to the dataset in the future. Therefore, additional effort may need to go into understanding and adjusting for panel data effects.

As recreation economic research evolves over time, it would be useful to update the dataset and the models to reflect new studies and research methods. As a result, it is important to not look at this project as a one-time event. The dataset should be periodically supplemented with new studies every five years or so, to keep current and minimize the literature search and dataset coding effort. Given the U. S. Forest Service updates their Resource Planning Act values every five years, it may be possible to coordinate both efforts.

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RECLAMATION'S MISSION

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