A Benefit Transfer Toolkit for Fish, Wildlife, Wetlands, and Open Space

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Introduction

The application of existing non market valuation studies to quantify the economic benefits provided by unstudied areas or policies has been evolving for decades as more studies accumulate and advances have been made in benefit transfer methodologies. Entire valuation databases exist either on line for a variety of recreation activities (Loomis, 2005) or have been published (e.g., recreational fishing (Boyle, et al.)). The Environmental Valuation Reference Inventory (EVRI) is an international database of recreation valuation studies as well as values of air quality and water quality (www.EVRI.ca).

In addition to these databases of studies, there have been applications of meta analyses to summarize these recreation values (Smith and Karou, 1990; Walsh, et al., 1992; Rosenberger and Loomis, 2000). Meta analyses have also been performed for wetland values (Woodward and Wui (2001); Randall et al., 2007), and threatened and endangered species values (Loomis and White, 1996), to name a few non recreation examples.

Numerous journal articles test the accuracy of different approaches to benefit transfer (see the special issue of Ecological Economics by Wilson and Hoehn, (2006) for a summary). However, according to Moeltner and Woodward (2007) there have been only a few published accounts of economists using either databases or meta analyses in actual policy evaluation.

Public land management agencies, such as the U.S. Forest Service (USFS) and Bureau of Land Management (BLM), have been faulted for not incorporating values of fishing, hunting, wildlife viewing and natural environments into their economic analysis (Haefele, 2006). Even BLM recognizes that changing demographics around public land have "…increased the BLM's need for well-focused and credible socio-economic data and analysis" (BLM, 2008).

Even when public land management agencies do incorporate non market economic values into their analysis, their approaches do not reflect improvements made in benefit transfer methodology in the last two decades. USFS and BLM typically rely upon administratively approved standardized average value transfers (e.g., USFS Resource Planning Act average values calculated from the literature) or published averages others have calculated from the existing literature (e.g., Bergstrom and Cordell, 1991). There are several reasons agencies often have for reliance on these older methods Often public land management agencies lack access to the proprietary economic databases (e.g., EconLit) to locate more recent studies.

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They may also lack the time or expertise to assemble and synthesize the existing valuation studies in the form of meta analyses. Finally, even those agencies aware of meta analyses are sometimes confounded by how to apply existing meta analysis equations to calculate benefits that fit their particular situation due to the myriad of methodological variables contained in these meta models. The benefit transfer toolkit is intended to facilitate the application of benefit transfer for wildlife recreation and habitat as well as improve the consistency of such benefit transfers.

Calculating a value per day for, say, wildlife viewing, is only half the job. Agencies need to estimate the number of wildlife viewing days in the current situation, and more importantly how those days would change with increases or decreases in wildlife habitat. These estimates of visitor use are not only needed for economic valuation but also for regional economic impact analysis. As such, the toolkit provides statistical models for visitor use estimation as well.

The purpose of this article is to summarize a new benefit transfer toolkit that contains databases, average value tables, meta analysis-based pre-programmed spreadsheets and visitor use estimation models for wildlife recreation and wildlife habitat. The format and interface can also serve as a template for other economists who might wish to develop similar spreadsheet models for valuing non-wildlife recreation such as hiking, camping, and reservoir recreation as well as natural environments such as wilderness.

Benefit Transfer and Use Estimation Toolkit for Wildlife Recreation and Habitat

Desvousges, Johnson and Banzhaf (1998:1) noted that "Transfer studies are the bedrock of practical policy analysis. Thus databases, average value tables and meta analyses for fishing, hunting, wildlife viewing, endangered species, open space, water quality and wetlands have been developed to improve the practice of benefit transfer by public agencies and consultants. Also contained in the toolkit are standardized spreadsheet templates that estimate values per unit (e.g., visitor day, acres, per household). The spreadsheet templates simplify the estimation of changes in visitor days resulting from changes in habitat acreage. Of course, the models are far from perfect and limited by the available data. Yet, these standardized tabular values and meta analysis equations should minimize errors in benefit transfers by economists, wildlife biologists and public land planners who do not have extensive experience with non market valuation and benefit transfer. These tools provide an opportunity for public land management agencies, county planners and others to incorporate non-market values into their planning and decision making.

Description of Types of Values Included in the Toolkit

The funding to develop the toolkit focused on fishing, hunting, wildlife viewing, endangered species, and wildlife habitat such as wetlands and aquatic species as well as open space. Table 1 presents the types of values analyzed in the toolkit. This table indicates whether there is a meta valuation model, average per unit tabular value, and standardized database of the original studies included in the toolkit.

Table 1: Values quantified, value models, tables and databases contained in the Toolkit

Value analyzed	*Value expressed as*	*Meta Valuation model*	*Average value table*	*Database table*
Open space property value premiums	% of property value total $ for all properties near site	✓	NA	✓
Terrestrial Habitat		✓	NA	NA
Aquatic improvements		✓	NA	NA
Ecosystem Services of Wetlands		✓	✓	✓
Wildlife-associated recreation benefits and visitor use estimator:	$/visitor day and change in # visitor days at site			
• Fishing		✓	✓	✓
• Hunting		✓	✓	✓
• Wildlife viewing		NA	✓	✓
T/E/Rare species values	$/household for species population change;	✓	NA	✓
Salmon	total $ for species population change	✓	✓	✓

Table 1 shows that the toolkit contains average values for species, habitat types, and recreation activities along with databases of individual study values. Users preferring to construct their own average values from the underlying database can exercise this option with the toolkit. All the value tables, meta analyses, hunting, angling and wildlife viewing estimation models, user manuals and technical documentation are available at: http://dare.colostate.edu/tools/benefittransfer.aspx or http://www.defenders.org/programs_and_policy/science_and_economics/conservation_economics/index.php.

Since the average value tables are fairly typical of past benefit transfer efforts (e.g., Rosenberger and Loomis, 2000; 2001) and the underlying database of original valuation studies are similar to what is available in Loomis (2005) they will not be discussed in detail. Rather, this article will concentrate on illustrating the user friendly pre-programmed spreadsheet programs that employ the meta analysis approach to benefit transfer and the visitor use estimating models.

Sources of Meta Analyses

This section describes the basic approach followed in developing the meta analyses used in the spreadsheet templates contained in the toolkit. The specific procedures for each meta analysis are described in more detail in the technical documentation (Loomis and Richardson (2008)) that is available at either website. First, we relied upon published meta analyses whenever available (e.g., Woodward and Wui (2001) wetlands). If more recent meta analyses were available they were used or included along with the published ones. Johnston, et al.'s (2005) article provided aquatic resource values. There was also a very thorough meta analysis of recreation fishing performed by Boyle, et al. and one of their meta regressions was selected for the toolkit. Original meta analyses for hunting benefits, and total economic value of salmon were estimated for the toolkit. The Threatened and Endangered species meta analysis by Loomis and White (1996) was updated for the toolkit. The open space property premium model also represents an original meta analysis of the available hedonic property analyses. While each spreadsheet itself contains some documentation, as part of the overall toolkit, there are several PDF files that provide more complete documentation of data and statistical analysis than can be found in the spreadsheets themselves.

Example of Per Visitor Day Meta Analysis

Table 2 presents an example of a meta analysis-based pre-programmed spreadsheet for valuing a hunter day. The structure of the other wildlife recreation activities such as fishing and wildlife viewing are similar. The first layer (shown in Table 2) is the user interface that contains the key variables needed by the user to customize the meta analysis regression's estimate of value per day to their specific geographic area and specific type of wildlife activity. The second layer of the spreadsheet (not shown) is a more complete definition of each of the variables to provide guidance to the user. The last layer is the underlying estimated regression equation (coefficients, standard errors, and means) used in the meta analysis. In the case of hunting the regression is:

Value per Hunter Day=βo-β_1(DataYear)- β_2(InterMtnDum)- β_3(NoEastDum)- β_4 (PacificDum)

- β_5(SoEastDum)- β_6(LandOwnership)- β_7(Unit Conversion Dum)- β_8(ValueMethod)

- β_9(Waterfowl)+ε

where

Data Year is the year the data of the original study was collected;
InterMtnDum, NoEastDum, PacificDum and SoEastDum are regional dummy variables;
LandOwnership is a dummy variable for 1 if land is public and zero for private;
Unit Conversion Dummy is 1 if benefit units were converted to a per person per day from the original study units;
Value Method is 1 if contingent valuation and zero otherwise; and
Waterfowl is 1 if species hunted is waterfowl, zero otherwise.

For Table 2, the user changes only the regional dummies, land ownership type and species hunted to tailor the value estimate to their study area and activity. The methodological variables are set at the means of the original study database and do not require any user input. Following this protocol should improve consistency in benefit transfers across users.

Table 2. Example of Recreation Use Meta Analysis Pre-Programmed Spreadsheet

Value of Hunting per Hunter Day			
Instructions:	Fill in relevant cells marked "ENTER >" associated with the region the hunting value is for,		
	the land ownership type, and if the type of species being valued is waterfowl.		
	See accompanying user manual for detailed instructions and documentation.		
STEP 1:	**Enter a 1 next to the site location; 0 otherwise**		
	ENTER >	1	Intermountain region (AZ, CO, ID, KS, MT, ND, NE, NM, NV, SD, UT, WY)
	ENTER >	0	Northeast region (CT, DE, IA, IL, IN, MA, MD, ME, MI, MN, MO, NH, NJ, NY, OH, PA, RI, VT, WI, WV)
	ENTER >	0	Pacific region (CA, HI, OR, WA)
	ENTER >	0	Southeast region (AL, AR, FL, GA, KY, LA, MS, NC, OK, SC, TN, TX, VA)
STEP 2:	**Enter a 1 if land ownership is public; 0 if private or mixed public private)**		
	ENTER >	1	
STEP 3:			
	ENTER >		**Enter "BIG" if the site supports BIG GAME hunting**
	ENTER >	SMALL	**Enter "SMALL" if the site supports SMALL GAME hunting**
	ENTER >		**Enter"WATER" if the site supports WATERFOWL hunting**
OUTPUT: Big Game		$0.00	**$/ Hunter Day (2006 base year)**
OUTPUT: Small Game:		$62.95	**$/ Hunter Day (2006 base year)**
OUTPUT: Waterfowl:		$0.00	**$/ Hunter Day (2006 base year)**

Estimating Hunting, Fishing and Wildlife Viewing Use

As noted above, a complete benefit transfer not only involves per-unit values but an estimate of total use (e.g., visitor days for recreation, acres for habitat preservation, etc.). For hunting, fishing and wildlife viewing two sets of seven recreation use regressions were developed as follows: (a) one set applicable to lands designated as USFWS National Wildlife Refuges--NWR/State Wildlife Management Areas--WMA (based on data from the USFWS Banking on Nature, 2004); (b) one set applicable to all types of lands in each state (based on USFWS National Survey of Fishing, Hunting and Wildlife Associated Recreation (2002) and the USDA National Resource Inventory (NRI)). The specific recreation activities for NWR/WMA and the state level include the following:

(1) big game hunting; (2) small game hunting; (3) migratory bird hunting; (4) total hunting (sum of 1, 2 and 3); (5) freshwater fishing; (6) saltwater fishing and (7) nonconsumptive/viewing visitor use.

Like the meta analysis-based pre-programmed spreadsheets, these visitor use regressions are pre-programmed and allow users to predict use conditional on the regressions statistically significant site attributes. For the Refuge models, acres of the Refuge is often a statistically significant attribute. In the state level models, acres of particular types of lands that were statistically significant in the state visitor use regressions are included. Based on the NRI data, the candidate land types that were tested in the state models include private forestland, state public forestland, wetlands, cropland, pasture land, federal land, and rangeland.

Table 3. Example of Estimating the Reduction in State Level Wildlife Viewing Days due to Development of Private Forest Land

STEP 1: Enter the current acres of each type of land within the state of interest (use the 'State Variable Input Values' Tab)		
ENTER >	186,000	State Forest Land
ENTER >	21,559,800	Private Forest Land
STEP 2: Enter household median income for the state of interest (use the 'State Variable Input Values' Tab)		
ENTER >	$46,840	
STEP 3: Enter the state population (use the 'State Variable Input Values' Tab)		
ENTER >	8,186,453	
	8,267,286	**Wildlife Viewing Days / year in Georgia**

STATE VALUES WITH MANAGEMENT/POLICY ACTION

STEP 1a: Enter the acres of each type of land within the site of interest		
ENTER >	186,000	State Forest Land
ENTER >	20,059,800	Private Forest Land
	8,155,585	**Wildlife Viewing Days / year in Georgia with policy action**

CHANGE

	-111,701	**Change in Wildlife Viewing Days / year**

Table 3 presents an example of the pre-programmed wildlife viewing estimation model at the state level. This table illustrates the "with versus without" computation of the change in wildlife viewing for a hypothetical loss of one million acres of private forest land that is currently being used as de-facto wildlife habitat. As can be seen in Step 1a the number of acres of State Forest

Land does not change from the current situation, but the private forest land acres is now 20,059,800; one million acres less than the current situation.

As may be evident from the cells in this spreadsheet, the model estimates wildlife viewing days as a function of the two habitat types that were statistically significant in this model (State Forest Land and Private Forest Land) as well as state median income and state population. The second layer of the spreadsheet (not shown) provides values for state median income and population. The third layer of the visitor use estimation spreadsheets is an example spreadsheet, the fourth layer provides variable definitions and the last layer presents the regression coefficients, standard errors and means of the variables.

Property Values Premiums Related to Open Space

Another feature of the toolkit is the ability to calculate the open space-related residential property value premiums for homes located near open space. The meta analysis equation underlying the regression model was estimated using 55 observations of open space premiums obtained from peer-reviewed studies across the U.S. that focused on county and large urban natural area parks, state parks and forests, national forests, parks and wildlife refuges, and private forest lands, or mixed forest and pasture lands. The model allows the user to tailor the estimate of the open space-related percent increase in property values to the variables identified as significant in the meta analysis, namely, the size of the open space (expressed as the corresponding percentage the open space accounts for within the area of analysis) and open space characteristics like land cover type, ownership and protection. Once the property value premium has been calculated by the spreadsheet, the user can enter information on the number and average price of single family homes in the analysis area. The spreadsheet will then calculate the estimated aggregate value of all homes in the user-defined analysis area that is attributable to the open space in question. Table 4 presents the user interface for the Property Value Premium Estimator Model. Users also can consult the provided database of open space property value studies in order to check for studies close to their area of interest that might serve as suitable sources for point or average value transfers.

Table 4. Example of Property Value Premium Estimator Model

Property value premium estimator model

Instructions: Fill in all cells marked "ENTER >". (See accompanying user manual for detailed instructions and documentation.)

STEP 1:	**Select shape of area of analysis in which property value premiums are analyzed**		
	ENTER >	C	Enter "C" for circular and "R" for rectangular shape of area
STEP 2:	**Enter the radius (circular area) or length and width (rectangular area) of the area of analysis**		
	ENTER >	2640	Radius of area in feet
	OUTPUT:	503	Size of study area (acres)
STEP 3:	**Enter the size of the open space**		
	ENTER >	50	Size in acres of the open space whose property value impact is to be estimated
	OUTPUT:	9.9	**%OSChange.** Percentage of the study area occupied by the open space of interest. Example: A 20 percent increase in open space in the area of interest is indicated as "20".
STEP 4:	**Enter the appropriate values for the indicator variables**		
	ENTER >	1	FOR. Enter "1" if the open space is a forest. Otherwise, enter "0".
	ENTER >	0	PARK. Enter "1" if the open space is a park. Otherwise, enter "0".
	ENTER >	0	AG. Enter "1" if the open space is agricultural land. Otherwise, enter "0".
	ENTER >	1	PROT. Enter "1" if the open space is protected. Otherwise, enter "0". Protection is defined as the absence of the possibility of development (i.e., easement, public ownership).
	ENTER >	1	PRIV. Enter "1" if the open space is privately owned. Otherwise, enter "0".
	P_{OS} =	8.5	**% increase in average residential property value from open space of interest**
STEP 5:	**Enter the number of residential properties located in the area**		
	ENTER >	137	Number of properties located in study area. NOTE: Include only single-family homes.
	ENTER >	$462,731	Average value of properties ($)
	OUTPUT:	$5,415,004	**Estimated total property premium in study area attributable to open space of interest**

Conclusion

The examples above illustrate easy-to-use, pre-programmed meta analyses-based valuation and use estimating models. These can facilitate a quick benefit transfer analysis that is tailored to the particulars of a study area. The benefit estimation toolkit also contains tables of average values by species, habitat type and recreation activity along with a database of individual study values underlying each of these average value tables. Thus, users preferring to calculate their own average values from the underlying database can also exercise this option with the toolkit. The toolkit also provides several spreadsheet models to calculate the economic value of wetlands, aquatic habitat improvements, wildlife habitat and open space.

Typically value estimates from benefits transfer models have less precision than benefit estimates from carefully conducted original studies. On any single benefit transfer, the percentage error that results from using benefit transfer relative to a single original study can be quite large. Average value transfers have an average absolute error of 10% to 180% with a median error of 4% to 87% (Rosenberger and Loomis, 2003). By contrast, benefit function transfers (which include meta analyses) have a smaller absolute average error of 5% to 135% with a median error of 1.5% to 68% (calculated from Rosenberger and Loomis, 2003: 458). The toolkit T & E species meta analysis has an absolute error of 35% for studies measuring annual total economic value, and 45% for studies measuring one-time total economic value.

Whether or not these benefit transfer estimates are "close enough" depends on several factors. They are certainly close enough if the alternative is to completely omit an estimate of recreation or total economic values from land management plans or Environmental Impact Statements. The toolkit's average value tables are also far more reflective of economic values received by society than the ancient U.S. Water Resources Council unit-day values many federal agencies currently use as a simplistic form of benefit transfer. While benefit transfer is not perfect, it is more accurate than adjusting the 1979 unit-day values for inflation every year.

The range of average errors with benefit transfer can also be informative to the decision maker. How much risk of being wrong is the decision maker willing to take? In part this depends on how important the non market values are in the overall benefit-cost analysis and decision. This leads to the third factor, the magnitude of the values at risk in the decision. In the case of a multi-million dollar irreversible decision, it is very likely that a more accurate original study of non market values is warranted. Allen and Loomis (2008) provide guidance on balancing the cost of an original study versus using a less precise benefit transfer.

The geographic scope of the value tables and meta analyses are limited by the available literature. Thus, for recreational activities such as wildlife viewing there are some regions for which the value estimates are based on very small sample sizes. Thus another use of the toolkit value tables and databases is to identify high priority gaps where future agency original valuation studies might be best targeted.

Economists and agency personnel should find these models useful enough that it increases the likelihood of including non-market values in public decision making. It is hoped that these examples will spur agencies such as BLM, USFS, USFWS, Natural Resources Conservation Service, Bureau of Reclamation, and U.S. Army Corps of Engineers to pool their resources to expand the toolkit to include other recreation activities and natural environments such as wilderness, scenic visibility, etc. Further, as new empirical studies are performed, it is important to keep the valuation databases current and periodically update the meta analyses as well. We hope users find these value tables and spreadsheet templates useful enough to support keeping them up to date.

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