USER MANUAL

Benefit Transfer and Visitor Use Estimating Models of Wildlife Recreation, Species and Habitats

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PURPOSE

This user manual provides:
  (1) guidance on selection of appropriate benefit transfer methods (average values, point estimates from databases or meta analysis) and visitor use estimating models;
  (2) description of and user instructions for the spreadsheet programs;
  (3) examples of applying the different benefit transfer models.

There is a separate technical documentation (Loomis and Richardson, 2007) providing details of the data sources and statistical analysis as well as more comprehensive discussion of the valuation methods and benefit transfer. Those unfamiliar with performing benefit transfer or non market valuation are encouraged to read the technical documentation.

A. GUIDANCE ON USING THE BENEFIT TRANSFER AND USE ESTIMATING MODEL TOOLKIT

To quantify annual economic benefits the analyst usually needs two pieces of information:

1. An estimate of quantity, such as angler, hunter or viewer days or an estimate of the quantity of habitat (acres of wetlands) or change in population of species (e.g., salmon or T&E species).
2. An estimate of the economic value for that quantity.

The tables and spreadsheet programs on the CD were designed to provide both.

The valuation files on the CD provide:
- Tabular estimates of fish and wildlife recreation values, habitat values and species values
- Databases of original valuation studies
- Spreadsheet models that calculate a value per angler day, hunter day, per acre of wetland, and per household for salmon and T&E species

The analyst has complete flexibility in selecting which valuation method to apply. The analyst may apply these values to their own estimate of the change in angler days, hunter days, viewer days, acres of wetlands or percentage change in species population, or to those estimated using the models.

However, if the analyst does not have data to estimate how angler days, hunter days or viewer days changes with increases or decreases in acreage of habitat they may use either of the recreation use estimating models provided on the CD and described in this user manual.

The use estimation files on the CD provide spreadsheet models that calculate angler days, hunter days and viewer days as a function of acres and surrounding demographics for:
- National Wildlife Refuges, State Wildlife Management Areas and similar wildlife areas;
- Lower 48 State wildlife recreation models for different types of private and public lands

B. GENERAL GUIDANCE ON PERFORMING BENEFIT TRANSFER

1. Defining Benefit Transfer

Benefit transfer involves applying a benefit per unit estimate (per visitor day, per household, per acre) **from an existing study site to an unstudied policy site** where such a benefit per unit value is needed. Benefits are defined by economists for economic efficiency or benefit-cost analyses as the user's **willingness to pay in excess of current costs (e.g., net willingness to pay) or consumer surplus**. This is the benefit measure used by federal and state agencies for benefit cost analysis. These dollar values are not visitor expenditures and should not be applied to regional economic multipliers.

2. Defining Benefits

Economic benefits are defined as how much the user (e.g., visitor, household) would pay to continue to have access to a given natural resource or for an improvement in the natural resource (e.g., increased fish catch of a desired species). This measure of benefits is appropriate for evaluating the net gain to society, from an investment to improve or acquire habitat. Thus, we wish to know what are the additional benefits received by the user to compare that to the costs of the habitat improvement. One cannot use the actual visitor cost or expenditures as a measure of benefit, because these dollars have already been spent on gasoline, bait, ammunition, etc. Those dollars are not available to pay for the habitat improvement. What is relevant for determining if the benefits of the habitat improvement exceed the cost of the habitat improvement is whether the habitat improvement generates sufficient additional monetary benefits that the user would be able and willing to pay for that improvement. For example, if there is an annual cost of a conservation easement of $1000, we want to know if the 100 hunters that would use those lands would pay, on average, $10 each year to hunt there. If so, the benefits equal the cost and this is an economically justifiable decision. We can't use the $20 the hunters would spend on travel as a measure of benefits, since that $20 is spent on gasoline and other recreation-related travel inputs and is not available to pay for the conservation easement. Only the "consumer surplus" or benefits in excess of the $20 travel cost are available to pay for the easement.

3. Units of Analysis for Benefit Transfer and Implications for Appropriate Analysis

The typical application of benefit transfer involves selecting a per unit benefit measure from a listing of existing studies or a table of average values and applying it to the site/activity for which values are needed. These per unit values can be per visitor day, per household or per acre. The per unit measure is then multiplied by the change in human use (e.g., number of visitors or households) or number of acres associated with a policy or management action. In an Environmental Impact Statement (EIS), the per unit value may be multiplied by the human use without the management action and with the management action so that the economic value of each alternative can be compared in monetary terms.

4. Total Economic Value: Recreation Use + Passive Use Values

It is important for the user to keep in mind that some of the benefit transfer studies provide estimates of just on-site recreation use values such as hunting or viewing. These direct use values may often reflect the majority of societal benefits for abundant game species, such as deer, bass

or hatchery trout. However, for some rarer species or rare habitats (e.g., old growth forests, wetlands, free flowing rivers) people who do not actually hunt or view these species or visit their habitat still may receive benefits from preservation of these species or habitats. Economists refer to these off-site benefits by a variety of names including existence value, non-use value (Krutilla, 1967; Randall and Stoll, 1983) or passive use values. In the meta analyses if the analyst sets variables for recreation use equal to one, then the equation will provide both use and passive use values, i.e., total economic value. If all recreation use variables are set to zero, then the resulting value would be just passive use value.

Passive use values are also measured using what a person would pay for a change in rare species abundance or protection of a given area of habitat. As such, the units of value for passive use value are often annual willingness to pay per household. Since no one can be denied the enjoyment from knowing a particular species or habitat is protected, passive use values can potentially accrue to millions of households simultaneously. Thus, to apply values per household requires the analyst to decide how many households may benefit from protection of a given area of habitat. There are no hard and fast rules on this. However, there have been several studies on the spatial extent of WTP for preservation of several endangered species that can provide some guidance on this topic. Loomis (2000) presents a graph that shows how WTP falls off with distance for preservation of salmon, wetlands and T&E species in the southwest U.S. Generally, about 80% of the local WTP is received by those living within 300 miles of the habitat or species. About 60% of the local WTP is received by those living within 1500 miles. See Loomis (2000) for more details. Nonetheless, there is still a significant WTP for salmon and wetlands, since anadromous species migrate great distances up rivers, and wildlife using wetlands migrate hundreds of miles along flyways. Thus, the path of benefits for such wide ranging species or habitats to wide ranging species is quite plausible.

For some resources such as wetlands, the original studies performed the calculations of the number of households affected and therefore report values per acre that reflect the spatial market for the natural resource. In this case the analyst can simply transfer the value per acre to their study area. This implicitly assumes that the wetland is of equivalent regional significance to the ones studied in the literature.

It is also important for the user to carefully decide if the management action or policy primarily affects just visitor use values (e.g., hunters, viewers or anglers) or has a significant passive use value to the general population. It is important to avoid the temptation to "pile on" passive use value benefits to recreation use values to make benefit estimates larger. The analyst should document the rationale for applying use and/or passive use values to their particular study.

One last concern relates to avoiding double counting of the same benefits using different benefit transfer methods. For example, using a value per acre of wetland that includes waterfowl hunting, along with a separate estimate of waterfowl hunting benefits, would double count these values.

C. GUIDANCE IN CHOOSING AMONG TYPES OF BENEFIT TRANSFERS AVAILABLE

As illustrated in Figure 1, there are two broad types of benefit transfer: (a) value transfer and (b) function transfer (Rosenberger and Loomis, 2001). We have provided data to perform both.
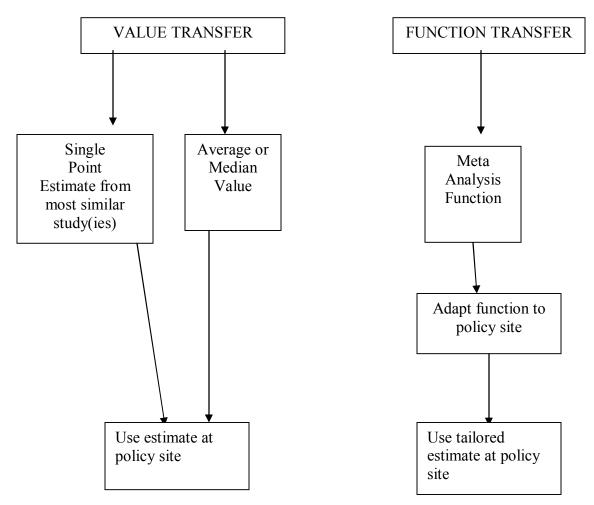

Figure 1. Benefit Transfer Approaches (From Rosenberger and Loomis, 2001)

Ideal Criteria for a Valid Benefit Transfer

There are three criteria that have been proposed for an ideal benefit transfer. These are ideal criteria provided by Boyle and Bergstrom in the 1992 special issue on benefit transfer in Water Resources Research (page 659) as:
a. The nonmarket commodity valued at the study site must be identical to the nonmarket commodity to be valued at the policy site.
b. The human populations affected by the nonmarket commodity at the study site and the policy site have identical characteristics.
c. The assignment of property rights at both sites must lead to the same theoretically appropriate benefit measure (e.g., original study uses WTP and a measure of WTP is desired for the policy site).

As a practical matter most adherents to benefit transfer recognize that it is unlikely that all three of these can be met exactly. This is particularly true of condition (a) and (b). For example, in terms of (a), available studies on antelope hunting may be unavailable in the state needing the policy analysis. The analyst might be faced with two choices: either apply a value of antelope hunting study from another state, or apply a value of deer hunting from the same state. This is essentially a trade-off between meeting condition (a) by having identical species (antelope), but departing from condition (b) since the antelope values are from a different state. If the other state is an adjacent western state, with similar human population demographics, this might be acceptable. If the two states are quite different (e.g., California versus Nevada), then it may be better to take the value of hunting deer from the same state and apply it to antelope. While this departs from condition (a), the error in WTP values might be less than from departing from condition (b) if the state where the original values came from is quite different from the policy state where the values would be applied. The advantage of using a benefit-transfer function approach as compared to transferring point estimates is that it may be possible to adjust WTP for differences in socio-demographics between the two states using a benefit function transfer approach. Thus in this case, the value of antelope could be estimated for the state of interest using a benefit transfer function with values of demographic set at those for the state of interest, and therefore could better meet conditions (a) and (b).

Value Transfers

> Single Point Estimates from the Literature Database

To best meet the ideal benefit transfer criteria, one should first look at the database tab (layer) of the value table files to see if one can locate a study that matches the recreation activity and/or species and general geographic location to the one they need. If a match is found, one can simply transfer an inflation adjusted point estimate from that study to theirs. As part of the CD provided, each average value table has as a second layer a database of recreation values, T&E species values, wetland values, etc., that the analyst can search to determine if there is a good match between their policy site and an existing study site.

> Average Value Transfer

However, many times there is not a perfect match between the species and the specific geographic location of the available studies and the policy site. For example, one may need a value of wildlife viewing for Riverside County in California. However, all that may be available is an average value in the table for wildlife viewing in California as a whole, or the west coast. In this case use of such an average value is a reasonable approach to arriving at a benefit estimate for the study site in Riverside County. Alternatively a search of the database may uncover multiple existing studies of the species at the policy site. For example, if an average value for big game hunting in Montana is needed, there are several studies, using multiple methods for both deer and elk. In this case, rather than selecting just one study, a more accurate measure of benefits may be obtained by averaging the values from the several studies.

Benefit Function Transfer

If the analyst cannot find a similar study and feels the average values in the literature do not reflect the particular details of the recreation activity, species or geographic location under study, then a Benefit Function transfer will allow the user to "customize" or adapt the economic value relationships in the literature to interpolate a value for the species or activity in the relevant geographic location.

A separate set of files provides several meta analysis WTP functions that literally reflect a regression equation of all the available empirical studies, and therefore is quite comprehensive and broadly applicable for benefit transfer. From the standpoint of expediency, a single meta analysis function can be applied to many more activities and species than is usually the case with any single individual demand function from the empirical literature. Given the widespread applicability of meta analysis benefit functions, these have been pre-programmed in this project for a wide variety of resources including fishing and hunting, T&E species, salmon, wetlands and aquatic resources. Meta analyses have received qualified support as a technique for benefit transfer by a number of economists.

Table 1 provides a listing of the file names along with the type of benefit transfer protocol that is available for that activity, species or habitat type.
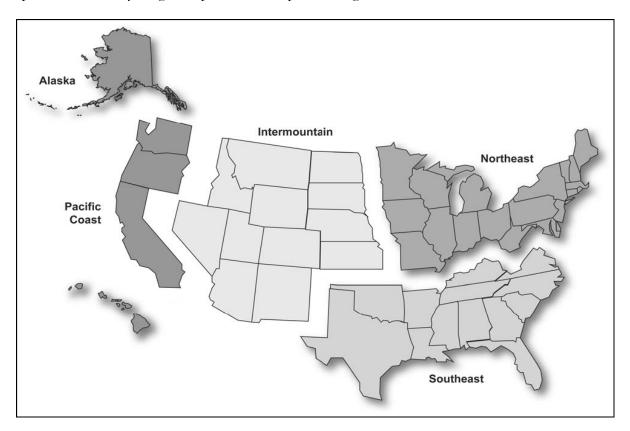
Table 1: Benefit Transfer Files

What	Value Tables Folder File Names	Meta Functions File Names
Fishing	Fishing Value Table.xls	Fishing Value per day META Function.xls
Hunting	Hunting Value Table.xls	Hunting Value per day META Function.xls
Wildlife Viewing	Wildlife Viewing Value Table.xls	N/A
Wetlands	Wetland Value Table.xls	Wetland Value per acre Meta Function 1.xls
		Wetland Value per acre Meta Function 2.xls
Salmon	Salmon Value Table.xls	Salmon Value Meta Function.xls
T&E Species	T&E Value Table.xls	T&E Value Meta Function
Aquatic Habitat	N/A	Aquatic Habitat Nonuse Value Meta Function.xls
Terrestrial Habitat	N/A	Terrestrial Habitat Value per acre Meta Function.xls

D. INSTRUCTIONS FOR USING SPREADSHEET FILES

1. Value Tables
a. Recreation Value Tables

The spreadsheets for fishing, hunting and wildlife viewing all have the same structure. They have three layers (as denoted by folder-like tabs at the bottom edge of the spreadsheet). By clicking on the tab you get that particular sheet layer. The top layer is titled **Summary Table** and contains the economic values (consumer surplus or net willingness to pay) for fishing or hunting by species type, the average (mean) and median values per day of activity. The sample size used to calculate the average and median is given in the column labeled N. The four main U.S. Census regions are given across the top. Pacific is California, Oregon and Washington. The column referred to as National represents values that were calculated from studies that provided a national average value for that species and activity. Figure 2 provides a map of the regions.

The tab labeled **Detailed Table** is similar to the Summary Table except the maximum and minimum values are also reported to provide the user with some idea of the range in values per day in the underlying data.

The **Summary Table and Detailed Table** are useful for conducting average value transfers per angler day, hunter day or viewer day.

The tab labeled **Database** provides the database of original studies used to compute the averages in the Detailed and Summary Tables. The data includes the complete literature citation to the study,

specific geographic location of the study, species being valued, valuation method, year of the study, etc.

This **Database** layer is particularly useful for performing Single Point Estimates from the Literature by matching characteristics of your policy site (i.e., location, species) to the existing study sites in the literature. By extracting studies and their values from the **Database** layer, you could compute a new average value that might better reflect the value per day for your policy site.

The **Code Sheet** tab provides definitions of the variables that are used in the **Database** layer. To fully understand description of the studies listed in the **Database** layer, it will be useful to print out the **Code Sheet**.

A Fishing Average Value Estimate Transfer Example
Application of the average values per day from the fishing, hunting and viewing tables is relatively straightforward. The analyst simply needs to multiply the average value per day times the number of angler, hunter or viewer days of that activity. This will often be done twice, once for the number of user days under the current conditions (without the project or policy) and then multiply user days with the project policy. The difference between these two estimates of the value of the activity is the project or policy induced benefit. The present value of the benefits (sum of the discounted annual project or policy induced benefits) would be compared to the cost of the project.

So if a stream restoration for coldwater species in the Northeast would increase angler days from 1,000 annually to 1,500 annually, the difference in days times the value of $39.54 per day would yield project induced annual benefits of $19,770.

b. Habitat Value Tables
There is one wetland value table. It follows the same basic structure as the recreation tables. Thus, there is a **Summary Table** with average and median values per acre for the four U.S. Census regions, along with the sample sizes (N) used to calculate the averages and median. These values generally reflect total economic values (use and passive use) provided by the wetland. The **Detailed Table** augments the Summary Table by adding minimum and maximum study values to provide the user with some idea of the range of values around the average and median, as the large differences between average and median suggests a skewed distribution.

Finally, the wetland value table has a **Database** layer that provides the details of the original studies including location, what ecosystem services were valued, valuation method and size of the wetland. This information is useful for performing a Single Point Estimate from the literature. It is also useful if the analyst wishes to calculate their own average value from studies in the region more similar to the policy site.

A Wetland Average Value Estimate Transfer Example

Application of the average values per acre of wetland is relatively straightforward. The analyst simply needs to multiply the average value per acre times the number of acres of wetlands being protected or restored. The present value of the benefits (sum of the discounted annual project or policy induced benefits) then could be compared to the cost of restoring or purchasing the wetland.

So, if a wetland restoration in the southeast would create 100 acres of wetlands, the value of $448 per acre would yield project induced annual benefits of $44,800. The present value of this stream of

benefits into the future (which can be approximated by dividing the annual benefits by the discount or interest rate, e.g., $44,800 divided by a 5% discount rate yields $896,000) would be compared to the restoration and maintenance costs of the wetland.

c. Species Value Tables

There are two general species value tables, one for anadromous fish such as salmon and one for Threatened, Endangered and Rare species. Both of these tables provide value per household reflecting total economic value (recreational use and passive use values).

Both of these provide a **Summary Table** that provides values per household, the location of the study and year of the study. The T&E Value **Summary Table** provides a numerical reference number (1,2, … 67). These numbers link to the **Literature** tab or layer, which provides the complete citation for the individual studies. Finally, the T&E Values **Summary** Table provides additional details about the study that are defined in the **Code Sheet** tab. These include whether the study valued a **loss** or gain in T&E species, the **pay frequency** which is whether the WTP reported is annual or one time (coded as one). Also reported is whether **visitors** or households were surveyed (Visitor=1 when visitors were surveyed).

In the Salmon Value Table, the **Database** layer provides information about the study authors and more detail about the specific study. The **Literature** tab or layer provides the exact citations to the salmon studies for analysts wishing to document the source of values they selected from the table, and wishing to read the original document for themselves.

Salmon and T&E Species Average Value Estimate Transfer Example

Application of the average values per household for salmon and T&E species is more of an art than for recreation and wetland values. First, the tables provide a value per household. Thus, to arrive at a total annual value, the analyst must decide on what the relevant number of households are that benefit. There are no hard and fast rules on this. However, there have been several studies on the spatial extent of WTP for preservation of several endangered species that can provide some guidance on this topic. Loomis (2000) presents a graph that shows how WTP falls off with distance for preservation of salmon and T&E species in the southwest U.S. Generally, about 80% of the local WTP is received by those living within 300 miles of the habitat or species, suggesting using a state level estimate of the number of households. However, about 60% of the local WTP is still received by those living within 1500 miles, a multi-state region may be plausible for some migratory species (e.g., whooping cranes, whales) or high profile T&E species. Federally listed species might very well be expected to generate national level benefits. However, it is worthwhile to look at the region surveyed in the original WTP survey to determine if those authors went outside the state. Most of the WTP studies of T&E species only surveyed residents of the state where the species or its habitat was concentrated. As such to be conservative, we recommend using state level number of households as the base population. (See Loomis 2000 for more details).

For benefit transfers involving salmon in the Pacific Northwest matching the species (e.g., salmon) and the region should be relatively straightforward. The salmon value table also provides the value per household per thousand salmon, so the analyst can scale their household value according to the number of adult salmon provided by the project or policy.

For T&E species, there are a couple of challenges. If there is a good match between the species and region you need a value for and the ones listed in the table, then the primary challenge is to scale the

reported WTP value per household, by the percentage change in species population used in the existing valuation study. For example, most surveys valued a 100% gain (doubling) of the species population or avoiding extinction of the species. If your project or policy involves a much smaller change in populations it would be appropriate to scale the household WTP by the percentage change in population expected by the management action. For example, if your project would only result in a 10% change in species population, then a rough estimate of the annual household WTP would be one-tenth of that of a study reporting a WTP for a 100% change in population. The meta analysis equation can also be used to scale WTP for small changes in species population.

If there is not a good match between species and geographic region, then the analyst should consider using the meta analysis equation to "customize" an estimate for the type of species under study in the geographic region of interest.

2. Meta Analysis

There are two types of Meta benefit transfer functions provided. One provides the recreational value of consumptive uses of hunting and fishing. Another type provides Total Economic Values of species or habitats.

a. <u>Hunting and Fishing Meta Analyses Spreadsheets</u>

The basic structure of this spreadsheet involves an opening spreadsheet layer that is entitled "Model Input & Results". This is where the analyst types in the variables specific to the fishing or hunting area they wish to calculate a value per day for. For example, the analyst would put a one (1) in the cell indicating the relevant type of species being fished or hunted for, water type (fishing) or habitat type (hunting) and region (for the hunting model). The output is a value per angler day for fishing and hunter day for hunting in 2006 dollars. By setting the value of the species and habitat variables in the underlying equation the resulting values are "customized" to that particular species and habitat type or geographic location.

Table 2 provides an example of the Fishing Value per Day META function. This example shows sport fishing spreadsheet and an example calculation for the value of trout fishing per day (so trout is set to 1, and all other species variables are set to zero). It also reflects trout fishing in a river or stream, so that habitat variable is set to 1, and the other water types are set to zero. The resulting value is $56.11 per angler day.

Table 2: Example of Fishing Value per angler day META Function Spreadsheet Input Page for Trout Fishing in Rivers or Streams.

STEP 1: Enter a 1 next to the primary species to be valued; 0 otherwise

ENTER >	0	Salmon
ENTER >	1	Trout
ENTER >	0	Pike
ENTER >	0	Bass
ENTER >	0	Walleye
ENTER >	0	Other freshwater species
ENTER >	0	Other saltwater species
ENTER >	0	Other aggregate groupings (bottomfish, etc.)

STEP 2:   Enter a 1 next to the   type of water body   containing the species; 0 otherwise

ENTER >	0	Lakes, ponds, and reservoirs
ENTER >	0	Brackish, saltwater embayments (bays)
ENTER >	0	Saltwater, offshore
ENTER >	1	Rivers, streams, flowing-water systems
ENTER >	0	Great Lakes

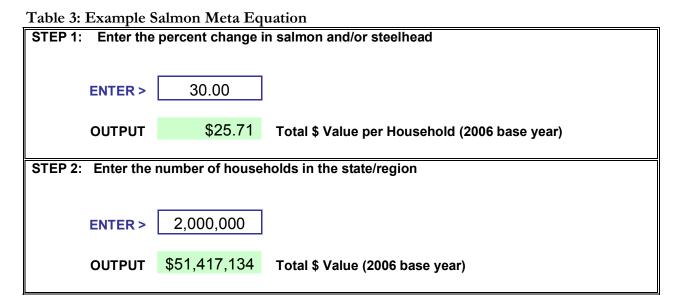|		
OUTPUT	$56.11	$/ Angler Day (2006 base year)

Of course the analyst can calculate the value of multiple species occurring in the same river by setting those species values to one. So for example, a reservoir might contain several warmwater species such as Bass and Other Freshwater Species. In this case those two species would be set to one, and Reservoirs would be set to one. The resulting value per angler day would be $27.17 per angler day.

The second layer of the spreadsheet provides analysts with definitions of what the species and habitat variables are in the model as well as a citation to the model. The third sheet provides documentation of the meta function statistical model. There are many more variables in the statistical model than are presented in the input sheet, because many of the meta function variables control for valuation methodology or survey data collection method. These have been set at the mean of the literature to provide a value representative or consistent with the existing valuation literature.

b. Meta Analyses Spreadsheets for Total Economic Value of Salmon, T&E Species and Habitat

These spreadsheets provide total economic values (use and passive use—existence and bequest values). The basic set up of these spreadsheets involves the opening page that is the Model Input & Results page. This is where the analyst types in the variables specific to percentage change in species population being valued (e.g., salmon or T&E species). The first output is the annual value per household in 2006 dollars. Then the analyst enters the number of households that receive benefits from the increase in species population to calculate a total annual value. By entering the species population change in the underlying equation the resulting values are "customized" to that change in population and particular species (in the case of T&E species). As noted in the beginning of the document on guidance for performing a benefit transfer, the number of households would be set at the number in the state, or a multi-state region for high profile T&E species.[1]

Table 3 provides an example of the Total Economic Value of Salmon Meta Equation for a 30% increase in salmon populations for a state with 2 million households.

Table 3: Example Salmon Meta Equation

STEP 1: Enter the percent change in salmon and/or steelhead		
ENTER >	30.00	
OUTPUT	$25.71	Total $ Value per Household (2006 base year)
STEP 2: Enter the number of households in the state/region		
ENTER >	2,000,000	
OUTPUT	$51,417,134	Total $ Value (2006 base year)

There are some subtle differences between the salmon and T&E meta models that will influence how the user applies them to evaluate management alternatives or policy scenarios. Both models do conform to the economic principle of diminishing marginal value per household for larger and larger percentage increases in species population. That is, a 100% increase in species population will yield a gain in value per household of less than double that of a 50% increase in the species population. This is sensible, as each increment is worth less and less (as long as all increments are over minimum viable population thresholds). Both models can also value reductions in species populations by entering a negative percentage change. In the salmon meta model this will yield a negative value per

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[1] The average WTP values per household account for the share of responding households that would not pay. However, there are often 40-60% of households that do not respond to the survey at all. To be conservative some economists treat their values as zero. However, this is not always done by adjusting downward average household WTP, but rather by adjusting downward the number of households to apply the average WTP to. For example, if the original survey response rate is 50%, then the average household WTP value is applied to 50% of the households in the state or region. This is the approach most consistent with the tabular and meta values per household reported in our document.

household corresponding with the percentage reduction in salmon. However, in the T&E meta model, the negative percentage change will reduce the value per household due to the presence of a constant term in the linear T&E meta equation. Thus to calculate the loss in T&E species value per household, the user would need to subtract the new lower value per household from the baseline value of T&E species per household. To calculate the baseline T&E value per household set the percentage change in species population to zero. Note the percentage reduction in the T&E species population should be limited to -50%, as the model is most valid within that bound. For the salmon meta model, a zero percent change will yield a zero value per household due to the lack of a constant term in the non linear equation. If the analyst needs a baseline value for the existing number of salmon they should use the Salmon Value Table.xls as follows: Multiply the $/household/1000 fish times the number of fish (divided by 1000) in the baseline situation. The analyst can either use the average of the $/household/1000 fish or select the value for the study with the best match of state and absolute magnitude of number of fish change. Then repeat this process using the same per unit value ($/household/1000 fish) for the number of fish in each management alternative or policy scenario.

The second layer of the spreadsheet provides analysts with definitions of the meta equation variables in the model as well as a citation to the model. The third sheet provides documentation of the meta function statistical model. There are many more variables in the statistical model than are presented in the input sheet, because many of the meta function variables control for valuation methodology or survey data collection method. These have been set at the mean of the literature to provide a value representative or consistent with the existing valuation literature.

The Total Economic Value of Terrestrial Habitat per Acre model is similar in structure to the Salmon and T&E species model in terms of an input layer, variable definitions and statistical model.

In the Total Economic Value of Terrestrial Habitat per Acre, Wetland and T&E Species meta analyses if the analyst sets variables for recreation use equal to one, then the equation will provide both use and passive use values, i.e., total economic value.[3] If all recreation use variables are set to zero, then the resulting value would be just passive use value.

However, the Nonuse value (e.g., existence and bequest values) per household for Aquatic Habitat Improvements model is somewhat more complicated as it has numerous input variables. This has the advantage of allowing greater customization of the resulting value to the particular geographic region, income of households residing in the geographic region, water body type and aquatic species involved. This model also allows for valuing water quality improvements, using the Resources for the Future (www.rff.org) water quality ladder. To calculate this non use value per household the user must set the indicator variables at their appropriate level (1 for applicable, zero for not applicable). We have provided additional tabs for state household income and for the RFF water quality ladder scale (a one to ten scale). The water quality (WQ) change in Step 6 of the spreadsheet is calculated by the analyst by taking the difference between current water quality score (number) and the new level of water quality score. This difference is entered in Step 6 next to the species affected by the change in water quality.

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[3] We caution the user to be careful not to double count the same values by adding up values derived from using multiple models that reflect similar types of benefits. An example would be using both the wetland meta and T&E meta analyses to value a wetland species. Another possibility for double counting is running the Terrestrial Habitat meta model which is capable of providing a per household value of open space, and the separate Open Space Property Value Benefits model which provides homeowner values of adjacent open space.

Completing steps 1-6 yields an annual value per household that is then multiplied by the number of households benefiting in Step 9 to yield the total annual value of the change in water quality for the species or species or habitats of interest. Analysts desiring more details on this model are encouraged to see the original article cited in the spreadsheet.

E. RECREATION USE ESTIMATION MODELS

If the analyst needs to estimate angler, hunter or viewing use associated with an existing wildlife area or an increase or decrease in wildlife habitat on private or public lands, we have provided two types of spreadsheet models.

Table 4 provides an overview of the available visitor use estimating models. These include hunting, fishing and viewing. One type of model is for land areas dedicated to and managed primarily for wildlife (e.g., National Wildlife Refuges and State Wildlife Management Areas) and one for private and public lands managed for a variety of uses, but that incidentally provide wildlife habitat.

Table 4: Model Description and File Names for Visitor Use Estimating Models

File Description	File Name
Refuge & Wildlife Mgmt Area Big Game Hunting Visitor Use Estimating Model	Refuge Big Game Visitor Use Estimating Model.xls
Refuge & Wildlife Mgmt Area Small Game Hunting Visitor Use Estimating Model	Refuge Small Game Hunting Visitor Use Estimating Model.xls
Refuge & Wildlife Mgmt Area Migratory Bird Hunting Visitor Use Estimating Model	Refuge Migratory Bird Hunting Visitor Use Estimating Model.xls
Refuge & Wildlife Mgmt Area Total Hunting Visitor Use Estimating Model	Refuge Total Hunting Visitor Use Estimating Model.xls
Refuge & Wildlife Mgmt Area Freshwater Fishing Visitor Use Estimating Model	Refuge Freshwater Fishing Visitor Use Estimating model.xls
Refuge & Wildlife Mgmt Area Saltwater Fishing Visitor Use Estimating Model	Refuge Saltwater Fishing Visitor Use Estimating model.xls
Refuge & Wildlife Mgmt Area Nonconsumptive Visitor Use Estimating Model	Refuge Nonconsumptive Visitor Use Estimating Model.xls
State Level Big Game Hunting Visitor Use Estimating Model	State Level Big Game Hunting Visitor Use Estimating Model.xls
State Level Big Game Hunting Visitor Use Estimating Model	State Level Big Game Hunting Visitor Use Estimating Model.xls
State Level Small Game Hunting Visitor Use Estimating Model	State Level Small Game Hunting Visitor Use Estimating Model.xls
State Level Migratory Bird Hunting Visitor Use Estimating Model	State Level Migratory Bird Hunting Visitor Use Estimating Model
State Level Total Hunting Visitor Use Estimating Model	State Level Total Hunting Visitor Use Estimating Model.xls
State Level Freshwater Fishing Visitor Use Estimating Model	State Level Freshwater Fishing Visitor Use Estimating Model.xls
State Level Saltwater Fishing Visitor Use Estimating Model	State Level Saltwater Fishing Visitor Use Estimating Model.xls
State Level Wildlife Viewing Visitor Use Estimating Model	State Level Wildlife Viewing Visitor Use Estimating Model.xls

1. Description of the Two Types of Models Provided

a. Refuge and Wildlife Management Area Use Estimating Models

The purpose of these models is to relate National Wildlife Refuge or State Wildlife Management Area (or similar area dedicated to wildlife conservation) visitation to habitat acres, natural features of the wildlife area (e.g., lakes, rivers, ocean), as well as human population and income in the surrounding area. These models were estimated using USFWS Refuge visitation data.

b. State Level Wildlife Recreation Use Estimating Models

The purpose of these models is to relate state-level wildlife related recreation activity days (hunting, fishing, and wildlife viewing) to acres of habitat and land access for that state, as well as human population and median income for that state. This is a predictive model that can be used by field biologists and planners to estimate changes in wildlife related recreation with changes in habitat and state demographics for public and private land that serves as de facto wildlife habitat. These models were estimated using USFWS National Survey of Fishing, Hunting and Wildlife Associated Recreation data and USDA Natural Resource Inventory data.

2. Guidance for Choosing Between Models

As can be seen in Table 4 both sets of spreadsheet models provide the ability to estimate non-consumptive or wildlife viewing, total hunting, as well as big game, small game and migratory bird hunting. Both sets of models also provide the ability to estimate freshwater and saltwater fishing.

Thus the choice between which model to use depends on the types of analysis being conducted. If the analysis involves changes in land area to a National Wildlife Refuge, State Wildlife Management Area or similar area dedicated to wildlife conservation, then the Refuge models should be used.

However, if a forecast of recreation visitor use is needed for analysis of changes in acreage to general lands, whether private (e.g., farmland) or public multiple use lands (e.g., National Forest or BLM), then the State level models are most appropriate.

3. Instructions for Using Refuge and Wildlife Management Area Use Estimating Models

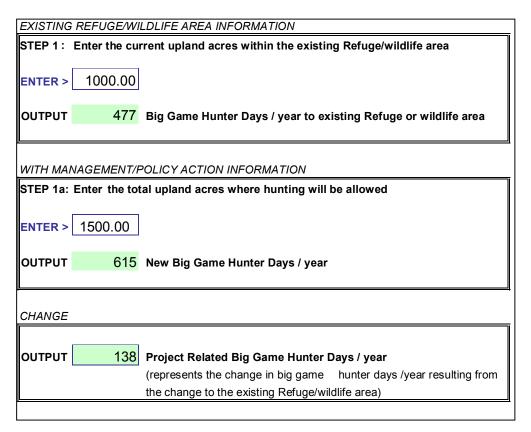The basic structure of these spreadsheets involves four layers or tabs:

- Input for a New Refuge
- Input Change to Existing Refuge
- Variable Definition and Citations
- Statistical Model

The Input for a New Refuge would be used to estimate visitation (hunting, fishing, viewing days) at an area of land being considered to create a NEW National Wildlife Refuge or new State Wildlife Management Area. A hunter, angler, or viewer (nonconsumptive user) day is defined as any part of a day spent in this given activity, regardless of the number of hours spent (USFWS). As noted in Table 4, there is a separate spreadsheet for each recreation activity. Most of these models (e.g., big game, small game and migratory bird hunting visitor use models) simply require the user to enter the acres

of habitat that are being acquired and the spreadsheet will calculate hunter days. Some of the models require that an indicator variable be set to one (1) if these acres include either open freshwater (e.g., total hunting model) or open coastal water (e.g., nonconsumptive visits model). The nonconsumptive visit and freshwater fishing models also require the user to enter the per capita income of the counties surrounding the refuge (the Bureau of Economic Analysis—BEA weblink is given to obtain this information). The nonconsumptive and freshwater visitation models also require the size of the human population surrounding the proposed Refuge or Wildlife Management Area. This information on human population should be obtained from U.S. Census or state demographics websites.

The structure of the **Input Change to Existing Refuge** is similar to the **Input for a New Refuge**, except that for the **Input Change to Existing Refuge**, the calculations are made twice: once for the existing condition and once for the change associated with a Management or Policy Action. The Management or Policy Action can be acquisition of additional acres or possible reduction in acres (sale, trade) or reduction in effective acres (conversion to uses not compatible with wildlife such as oil/gas drilling). The difference in hunter days, angler days, or nonconsumptive user days are then calculated at the bottom of the spreadsheet.

Table 5 illustrates the **Input Change to Existing Refuge** input screen for a big game hunting example involving adding 500 acres to an existing National Wildlife Refuge of 1000 acres. In step 1a, the new TOTAL acres (1500) is entered, and the new level of visitation calculated. The output yields the difference in big game hunter days associated with the additional 500 acres.

Table 5: Input change to Existing Refuge Visitor Use Estimating Model for Big Game Hunting

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EXISTING REFUGE/WILDLIFE AREA INFORMATION

STEP 1 : Enter the current upland acres within the existing Refuge/wildlife area

ENTER > | 1000.00

OUTPUT | 477 | Big Game Hunter Days / year to existing Refuge or wildlife area

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WITH MANAGEMENT/POLICY ACTION INFORMATION

STEP 1a: Enter the total upland acres where hunting will be allowed

ENTER > | 1500.00

OUTPUT | 615 | New Big Game Hunter Days / year

CHANGE

OUTPUT | 138 | Project Related Big Game Hunter Days / year
(represents the change in big game   hunter days /year resulting from the change to the existing Refuge/wildlife area)

As can be seen in this example, increasing big game habitat from 1000 acres to 1500 acres yields an additional 138 big game hunter days. These hunter days can be valued using either the benefit transfer value table for hunting days or using the hunting meta analysis.

If this same habitat is suitable for small game hunting or would be accessible and suitable for nonconsumptive uses when hunting is not taking place, then the small game hunting model and nonconsumptive visitor use models would also be run with the additional 500 acres. Total gain in recreation use would be the sum of these three activities.

The other two layers of these spreadsheets are the **Variable Definitions & Citations** and the **Statistical Model**. As described by the tabs on these layers, they contain the definitions of the variables asked for in the input screens, along with the citation to the study and data used to develop the model. Finally, the **Statistical Model** provides the full statistical visitor use estimating model including the variable means, coefficients and standard errors.

4. Instructions for Using State level Wildlife Recreation Use

The basic structure of these spreadsheets involves for layers or tabs:

- Model Input & Results
- State Variable Input Values
- Example
- Variable Definition and Citations
- Statistical Model

The **Model Input & Results** is the basic input screen that asks the user to enter in Step 1 the current acres of each relevant land type for the model (the land types that are included vary from model to model due to which variables were statistically significant). This is the amount of that land currently in the state. This information is given in the tabbed layer labeled **State Variable Input Values** for each of the 48 states. In Steps 2 and 3, state population and state median income are to be entered.[4] The values of these variables for each of the 48 states are given in the **State Variable Input Values** tab layer. Once this data is entered, then the spreadsheet calculates the State Wildlife Visitor Days (e.g., angler days if fishing, hunter days if hunting or viewer days). Again, a day is defined as any part of a day spent in a given activity, regardless of the number of hours spent (USFWS).

Then in Step 1a, the new level of acres of each land type with the Management or Policy Action is entered. This can be:

a) A gain or loss of acres of one or more land types associated with some explicit management or policy action by the agency (e.g., purchasing a conservation easement on a Private Rangeland or Cropland) or expansion of State Forest by purchase of land.

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[4] When opening the page, there may already be an estimate of state level visitor days in the Output box, even though acreage is set to zero. This is due to the constant term in the regression equation. The user can disregard that visitor day number, as it will change to the appropriate visitor day number once the state-specific values of acreage, income and population are entered.

b) It can be an impact analysis associated with a private landowner's request to rezone their property from private forest or rangeland to suburban development that is treated in the model as having no habitat value.

Once this change is made the spreadsheet then calculates the new level of State Wildlife Visitor Days (e.g., angler days if fishing, hunter days if hunting or viewer days). Finally the spreadsheet calculates the difference in angler days, hunter days or viewing days associated with the change in acreage.

Table 6 presents an example for wildlife viewing in Georgia and a loss of 1,500,000 acres of private forest land to suburban development. In this example, there is a loss of 111,701 wildlife viewing days. These lost viewing days can be valued using the Value Table for wildlife viewing.

Table 6: Example of Estimating the Change in Wildlife Viewing Days in Georgia with a Reduction of 1,5000,000 Acres of Private Forest Land

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CURRENT STATE VALUES (Use the "State Variable Input" Tab)

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**

The other three layers of these spreadsheets are: (a) An example; (b) the **Variable Definitions & Citations** and (c) the **Statistical Model**. As described by the tabs on these layers, they contain an

example, the definitions of the variables asked for in the input screens, along with the citation to the study and data used to develop the model. Finally, the **Statistical Model** provides the full statistical visitor use estimating model including the variable means, coefficients and standard errors.

F. TYING RECREATION USE ESTIMATES AND VALUES TOGETHER FOR ANNUAL AND PRESENT VALUES

Once the analyst has the estimated visitor use and used either the value table or meta functions to calculate a value per day, then simple multiplication will yield the annual value. This may be the appropriate value if the comparison to the cost is in annual terms, such as an annual lease payment to a landowner for maintaining their land as wildlife habitat.

However, for many habitat acquisitions which are purchases or habitat improvements which involve one time expenditures that provide benefits for numerous years, it is appropriate to calculate a present value or present worth of the benefits. This requires "discounting" the annual values into a present worth using an interest rate or discount rate. Federal agencies have annual discount rates set by U.S. Office of Management and Budget or Congress. State agencies often have a corresponding official discount rate as well.

Spreadsheets allow conversion of an annual stream of benefits over time into a present value (PV). These functions are usually labeled PV for a constant annual benefit amount or NPV (Net Present Value) for an irregular flow of benefits over time. Nearly all benefit-cost analysis books discuss the mechanics of converting the annual benefits into a present value using a process called discounting, as well as selection of the discount or interest rate to use (see Loomis and Helfand, 2001 or Campbell and Brown, 2003 for two).

G. CONCLUSIONS

The spreadsheet tables, templates, and models provided here allow non-economists to estimate values for wildlife recreation, common wildlife habitats, and T&E species. The current versions of these programs will be posted to the Defenders of Wildlife homepage.

References

Boyle, K.J. and Bergstrom, J.C., 1992. Benefit transfer studies: Myths, pragmatism, and idealism. *Water Resources Research* 28(3):657-663.

Boyle, K., R. Bishop, J. Caudill, J. Charbonneau, D. Larson, M. Markowski, R. Unsworth, and R. Patterson. 1998. A Database of Sport Fishing Values. Prepared for U.S. Fish and Wildlife Service. Prepared by Industrial Economics, Cambridge, MA. October 1998.

Boyle, K., R. Bishop, J. Caudill, J. Charbonneau, D. Larson, M. Markowski, R. Unsworth, and R. Patterson. 1999. A Meta Analysis of Sport Fishing Values. Prepared for U.S. Fish and Wildlife Service. Prepared by Industrial Economics, Cambridge, MA. April 1999.

Cambell, Harry and Richard P. C. Brown. 2003. *Benefit-Cost Analysis: Financial and Economic Appraisal using Spreadsheets*. Cambridge University Press, New York, NY.

Caudill, J. Ph.D. and E. Henderson. 2004. Banking on Nature: The Economic Benefits to Local Communities of National Wildlife Refuge Visitation. Division of Economics, U.S. Fish and Wildlife Service, Washington, D.C.

Krutilla, J. 1967. Conservation reconsidered. *American Economic Review* 57(4):777-786.

Loomis, J. 2000. Vertically summing public good demand curves: An empirical comparison of economic versus political jurisdictions. *Land Economics* 76(2):312-321.

Loomis, J. and G. Helfand. 2001. Environmental Policy Analysis for Decision Making. Kluwer Academic Press, Boston, MA.

Loomis, John. and Leslie Richardson. 2007. Technical Documentation of Benefit Transfer and Visitor Use Estimating Models of Wildlife Recreation, Species, and Habitats. Dept. of Agricultural and Resource Economics, Colorado State University, Fort Collins, CO 80521.

Randall, A. and J. Stoll. 1983. Existence Value in a Total Valuation Framework. In R. Rowe and L. Chestnut, Managing Air Quality and Scenic Resources at National Parks and Wilderness Areas. Westview Press, Boulder, CO.

U.S. Environmental Protection Agency.2000. Guidelines for Preparing Economic Analyses. September 2000. Washington DC.

U.S. Fish and Wildlife Service. 2002. 2001 National Survey of Fishing, Hunting and Wildlife Associated Recreation. FHW/01-NAT. Washington DC.

U.S. Fish and Wildlife Service. *2001 National Survey of Fishing, Hunting, and Wildlife-Associated Recreation*. Washington, D.C., 2002.

U.S. Office of Management and Budget. 2000. Guidelines to Standardize Measures of Costs and Benefits and the Format of Accounting Statements. M-00-08, from Jacob Lew, Director. Washington DC.

U.S. Water Resources Council. 1983. Economic and Environmental Principles and Guidelines for Water and Related Land Resources Implementation Studies. U.S. Government Printing Office, Washington DC. March 10.

Woodward, R.T. and Y.S. Wui. 2001. The economic value of wetland services: A meta analysis. *Ecological Economics* 37:257-270.