Introduction to the Wildlife Habitat Benefits Estimation Toolkit

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Acknowledgments

List of key terms

See the Glossary at the end for brief definitions of the terms listed below

Benefit transfer (BT)

Consumer surplus (CS)

Meta-analysis

Net benefit

Policy site

Study site

Willingness to pay (WTP)

Purpose of the Wildlife Habitat Benefits Estimation Toolkit

This Introduction section provides an overview of the different components that make up the Wildlife Habitat Benefits Estimation toolkit. It lays out the various models and value tables included in the toolkit, identifies what questions the toolkit can and cannot be used to answer, and helps the user select the model(s) or value table(s) most appropriate for answering the questions of interest to them.

In addition to this Introduction, the toolkit includes two technical reports – "Technical Documentation of Benefit Transfer and Visitor Use Estimating Models of Wildlife Recreation, Species and Habitats" and "Open Space Property Value Premium Analysis". These reports discuss the development of the different models and tables, present the economic concepts underlying natural resource valuation, and provide a review of the relevant literature. These reports also include user manuals and examples that guide users step-by-step through the application of the models and tables. Finally, the toolkit includes the actual spreadsheet-based value and visitor use estimation models, databases, and valuation tables as well as a summary output model that compiles the outputs generated with the different individual models or tables.

The need for a Wildlife Habitat Benefits Estimation toolkit

The purpose of the toolkit is to systematically analyze and synthesize in an easily-accessible format the findings from the large volume of studies that have examined the economic value of species and natural lands. The toolkit allows users to draw upon this wealth of data and generate value estimates for areas of interest to them. The large body of natural resource valuation studies often is not easily available or technically accessible to the non-economist. The Wildlife Habitat Benefits Estimation Toolkit addresses these limitations by providing 1) syntheses of the literature findings in the form of statistical models and average-value tables that allow users to draw upon the wealth of available data and apply it to a particular site, and 2) databases that list the available studies, their findings, study characteristics and contexts, thereby making it easier for users to locate studies and findings that may be of particular applicability to their site.

The toolkit assembles and in some cases updates previously estimated valuation models for wetlands, aquatic habitat improvements, terrestrial habitats, salmon and other threatened, endangered and rare species and adds newly-developed models for open space-related property value premiums and wildlife-associated visitation. It also includes previously developed and updated average-value models and databases, thus compiling in one place a wealth of resources on the economic valuation of wildlife and natural lands. Furthermore, the toolkit directs users to readily available additional resources that allow them to obtain estimates of the substantial economic impact of wildlife-associated recreation, which is estimated at over $200 billion per year for the U.S. as a whole.[1]

One of the key features of the toolkit is that it allows users to develop estimates of the economic value omitted in traditional recreation spending-based analyses that focuses solely on economic the impact of recreation. Such expenditure-based analyses do not capture the consumer surplus value associated with recreation, which in the case of wildlife-related activities often accounts for

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[1] Trip and equipment expenditures for wildlife-associated recreation activities in the U.S. in 2006 totaled over $122 billion (U.S. Fish and Wildlife Service and U.S. Census Bureau, 2007). Assuming conservatively an average total effects output multiplier of 1.65 for all states, this spending generated total sales of over $200 billion in 2006.

between over one third and over one half of the total economic value of these activities to participants (see Box 1). Thus, the toolkit provides crucial information that allows public policy and private decision makers to account for the full economic value of wildlife and habitat conservation and incorporate it into conservation and land use planning.

Box 1: Comparison between spending by recreationists and consumer surplus

Surveys of recreationists show that their total willingness to pay for wildlife-associated recreation activities for the average participant is substantially larger than her spendi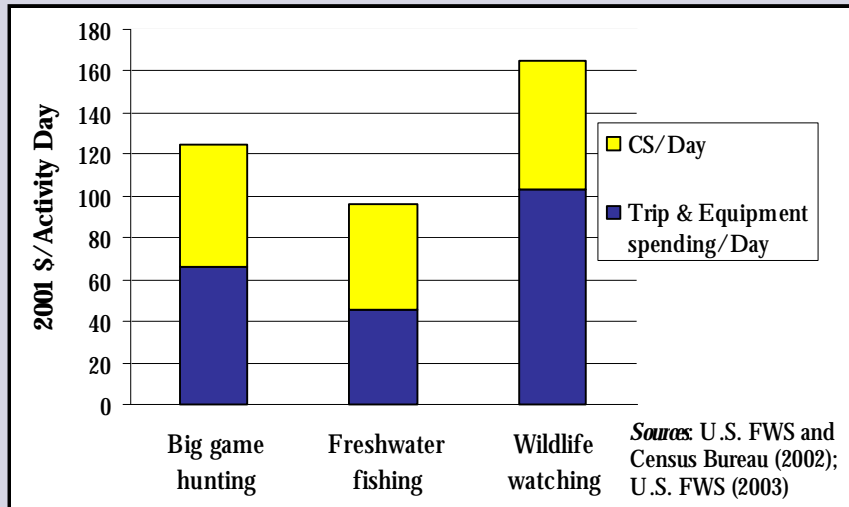ng on trip and equipment-related items. Figure 1 presents the findings of results from the 2001 National Survey of Fishing, Hunting and Wildlife-Associated Recreation (U.S. Fish and Wildlife Service and U.S. Census Bureau, 2002), which beginning in 1991 is conducted every five years by the Fish and Wildlife Service (FWS) and the Census Bureau, and of additional surveys by the FWS on consumer surplus of wildlife-associated recreation activities (U.S. Fish and Wildlife Service, 2003).

Sources: U.S. FWS and Census Bureau (2002); U.S. FWS (2003)

Figure 1: Relative size of trip and equipment spending and consumer surplus per day for wildlife-associated recreation activities

Figure 1 shows survey-based estimates of consumer surplus and spending for the average participant in these activities. To compute the averages, we weighted consumer surplus and spending data reported in the two studies by the shares of state residents and out-of-state participants, because average spending and surplus vary between the two groups. We also weighted the average consumer surplus and spending estimates for particular species by the shares of the different species in the total number of hunting days. The spending data are based on the national-level average for the three activities; the consumer surplus data for big game hunting are the averages from 43 states; for freshwater fishing, from all states except Hawaii, and for wildlife watching, from all fifty states. The results show that the net benefits, or consumer surplus, of wildlife-associated recreation activities on average are roughly as large as trip and equipment spending. Thus, any analysis that focuses on spending measures as indicators of the value to participants of wildlife-associated recreation activities will substantially underestimate the total value of these activities for society and individuals.

What the toolkit does

The Wildlife Habitat Benefits Estimation Toolkit allows the user to generate estimates of the economic value of a wide range of benefits that wildlife and their habitat provide to people in cases where an original, site-specific study is infeasible due to time or budget restrictions. The valuation models and value tables the toolkit offers are the result of comprehensive literature reviews and syntheses and incorporate the findings of dozens to hundreds of studies on the different benefits associated with wildlife and habitat. In addition to the spreadsheet-based value

estimation models and valuation tables, the toolkit also includes databases that present the relevant information and findings from the original studies used to estimate the value models and compile the value tables. Users thus have three options for generating value estimates: they may choose to 1) Use our estimation models, which allow them to match the model outputs to the site of interest by setting a small number of variables such that they match site characteristics; 2) Use median or mean values from the literature presented in our value tables; or 3) search the study databases in order to check whether there exists a study that closely matches the characteristics of the site of interest to them, and use the values reported in that study. The two user manuals accompanying the two technical reports that form part of the toolkit assist the user in identifying which of these three options might be preferable in a particular situation (the following section *Guide to model/table selection* also provides a brief discussion on the choice of approach). The user is encouraged at a minimum to read the manuals before using the models and, if possible, to also read the technical reports in order to better understand what information was used to derive the models and what the limitations might be of applying the models to a particular case.

Questions the toolkit can answer

The toolkit allows the user to generate information to answer the following questions:

- What is the level of wildlife-associated recreation (hunting, fishing, wildlife watching) supported by an existing conservation/natural area, and what is the net economic benefit to participants of these activities?

- What is the expected increase in wildlife-associated recreation that would result from the creation or expansion of a conservation/natural area, and what is the net economic benefit to participants that is associated with this increase?

- Does the expansion of an existing conservation area or the creation of a new area generate net economic benefits for the region or for the U.S. as a whole?

- What is the expected reduction in wildlife-associated recreation that would result from a reduction in size or complete loss of a conservation/natural area, and what is the net economic benefit to participants that is associated with this reduction?

- What is the share of residential property values that is attributable to existing surrounding natural open spaces?

- What is the expected impact of a proposed new or enlarged open space on the market value of surrounding residential properties?

- What would be the impact on the market values of nearby residential properties that would result from a reduction or loss of open space?

- What would be the impact on residential property values that would result from a change in the open space characteristics, for example, from agriculture to forest, or from unprotected to protected?

- What is the value of the ecosystem services provided by a terrestrial or aquatic area or a wetland? How would this value change as a result of changes in the types or quality of services provided, or as a result of a reduction or increase in size of the area?

By providing answers to the foregoing questions, the toolkit is useful in a variety of contexts, including but not limited to the following:

Open space planning

1) Assess whether the existing supply of public-access wildlife conservation lands in an area is economically optimal, or whether additional areas would provide net economic gains.

2) Identify open spaces whose conservation generates the highest benefits, and direct development to locations that minimize losses in open space values/maximize gains from open space conservation.

3) Quantify expected losses in wildlife-associated recreation that result from changes in land use plans and zoning regulations

4) Incorporate (increased) preservation of natural areas into development plans/zoning regulations. Increases in property values translate into increased property tax revenues after the next reassessment of property values by the county assessor's office.

Conservation incentives for private landowners

5) Estimates of the value of ecosystem services provided by private lands can help strengthen the case for tax breaks, ecosystem service payments or other incentive mechanisms for private landowners who dedicate their lands to conservation uses, or for the introduction of wildlife habitat tax credits for private lands. The toolkit can help in establish the size of tax breaks or habitat credits.

6) The toolkit can help in the justification and appropriate scaling of property tax exemptions or tax credits for agricultural land that provides wildlife benefits.

Prioritization of lands for public conservation spending

7) The toolkit can help states in the prioritization/ranking of lands that are competing for limited conservation cost share funds, by providing estimates of the values generated by the various lands/properties.

8) The toolkit can help quantify wildlife-associated recreation benefits to help justify the economic importance of a particular wildlife area or activity in applications for federal or state wildlife grants and habitat conservation funds (e.g., USFWS' Partners Program; various USDA conservation programs)

9) The toolkit can help calculating the benefit-cost ratios of different and competing wildlife projects.

Identification of research needs

10) The databases in the toolkit can be consulted for determining whether there are any existing studies that match a particular wildlife or habitat conservation policy or project whose economic benefits are sought to be determined. If no similar study exists, the question arises whether there is a need for an original study for the policy/project site.

What the model outputs mean in concrete terms and their relevance for policy makers and planners

The outputs of all models are of direct relevance to policy makers and land use planners because they measure the value of the benefits wildlife and protected areas provide to local or state residents and to visitors.

The **open space property value premium estimator model** measures the benefits residential property owners receive from the presence of nearby natural areas. These benefits are measured in the form of the increased market prices their properties command as a result of those undeveloped areas. The model estimates the price premium associated with a particular open space, which, as dozens of econometric studies in the U.S. have shown, is capitalized into the market values of nearby residential homes (see the accompanying report "Open Space Property Value Premium Analysis"). The open space premium represents the portion of a home's value that is attributable solely to the presence of the open space in the vicinity of the home.   This is the value that would be lost or reduced if the open space in question were lost or reduced in size. Conversely, the premium and thus the home value generally would increase if total open space acreage in the area were increased. Open space increases the market value of the residential properties in an area compared to an otherwise identical area without open space. This has two implications for land use planning. First, the conservation or restoration of open spaces generates benefits for nearby residents, be they owners or renters. Secondly, the presence of open spaces, via the associated premiums in home values, directly translates into higher local property tax revenues.

The **wildlife activity day value estimation models** measure the benefits participants in wildlife-associated recreation activities receive as a result of their direct interaction with wildlife and their habitats. These models express the value participants gain from a day spent fishing, hunting or wildlife viewing and employ the economic concept of "Consumer Surplus" or net willingness to pay (WTP). Consumer surplus is measured in dollars and in our case expresses the amount a person would have been willing to spend on a day of fishing, hunting or wildlife viewing *above and beyond* what they actually spent in the form of trip and equipment costs. Thus, consumer surplus is the *net benefit* people receive from engaging in wildlife-associated activities, and measures the contribution to people's well-being from fishing, hunting or wildlife watching. It may be thought of as representing a kind of "personal profit" in the sense that participants receive more benefits from these activities than they incur in costs. To the extent that public policy making has the purpose of maximizing the well-being of local constituents, the net benefit (benefits minus costs) constituents receive represents the ultimate measure policy makers should account for and thus should be a key consideration in any policy decisions. Economists analyze the benefits of recreation activities in terms of the consumer surplus of participants precisely because it is this *net benefit* someone receives from an activity that determines how much the activity enhances their personal well-being. Net benefit is the benefit measure used in cost-benefit analyses by federal water agencies (U.S. Water Resources Council, 1983) and by regulatory agencies such as the U.S. Environmental Protection Agency (U.S. EPA, 2000) and in natural resource damage assessments by federal agencies (U.S. Department of Interior, 1994). Net benefit also is the benefit measure required by the U.S. Office of Management and Budget (2000) for measuring impacts on individuals in cost-benefit analyses by federal agencies.

The **terrestrial, aquatic and wetland value models** generate estimates of the value of the ecosystem services supplied by these lands. These services represent free inputs into human

production as they do not have any input costs associated with them. Thus, these ecosystem service values constitute net benefits for society.

The **threatened, endangered or rare (T&E/R) species and salmon models** generate estimates of the willingness to pay (WTP) of an individual for an increase in the population of a threatened, endangered or rare species, or for the prevention of a decrease in the population of the species. Threatened, endangered or rare species are those listed under the U.S. Endangered Species Act or state Endangered Species Acts or identified in the states' comprehensive wildlife conservation strategies or wildlife action plans. This WTP is equivalent to the net benefit individuals receive from T&E/R species population increases if they are not actually paying for those increases. If they are paying for the increases, then the net benefit they receive is the difference between their WTP (i.e., the value they assign to species population increases or avoided population declines) and their payments.

Relation of value measures used in the toolkit to other economic measures

Of the two value measures used in the toolkit models – market price in the case of the open space property value premium model and consumer surplus in the case of all other models – the consumer surplus measure may be one many people are unfamiliar with, although one would hope that public policy makers certainly would be familiar with this important concept. In order to allow toolkit users to correctly interpret the generated results and to facilitate appropriate comparisons of the results with other widely-used units of economic analysis, Table 1 provides a brief overview of the measures the toolkit uses to quantify the value of wildlife and habitat conservation and their corresponding counterparts commonly-used in analyses of the value associated with land development. The most commonly-used measures are revenues (also referred to as sales or output), earnings and employment. Following conversion to non-conservation uses, some portions of the converted lands still may provide some of the former conservation values (see entries in the table in grey font), depending on the degree to which natural land cover is maintained and the spatial arrangements of that land cover. The table does not list tax revenues because taxes are merely resource transfers from the private to the public sector (Tietenberg, 1990) and thus already are accounted for in the values shown in the table.

Perhaps most important to point out is that because consumer surplus of recreationists and ecosystem services benefits represent net benefits associated with uses of natural lands, it is not appropriate to compare these values with the revenues those lands could generate if they were converted and utilized for alternative uses incompatible with conservation. Revenues do not take into account input costs and thus, unlike consumer surplus, do not measure net benefits, that is, real increases in people's well-being. Rather, revenues represent *gross benefits* that may result in positive or negative net benefits once costs are accounted for.

Likewise, the consumer surplus to recreationists is fundamentally different from and not comparable to the economic *impacts* associated with recreation activities. Economic impacts, which include direct impacts on sales, earnings and employment resulting from trip and equipment spending by recreationists, indirect impacts resulting from the multiplier effects of trip and equipment spending on related industries, and induced effects created by the increase in household incomes of employees in directly and indirectly impacted industries, measure total sales and earnings, neither of which is a useful measure of net benefits. A later section in the Toolkit Introduction directs the user to analyses and data for quantifying trip and equipment

expenditures associated with recreation activities as well as resulting economic multiplier effects (total output, income, and employment).

Table 1: Comparison of values of conservation lands quantified in the toolkit and widely-used value measures for alternative land uses

Value Measure	Value in conservation	Value in development
Net benefits	o Consumer surplus from recreation activities	o Producer surplus (profits) from alternative uses, minus tax losses from net increase in costs of community services [1]
	o Consumer surplus from open space (WTP for open space proximity in excess of capitalized open space premiums)	o Remaining consumer surplus from open space, if any
	o Ecosystem services benefits	o Remaining ecosystem services benefits, if any
	o WTP for populations of T/E/R species (if not made to pay)	
Gross benefits	o Consumer surplus plus trip and equipment expenditures associated with recreation	o Revenues (sales) from alternative uses
	o Open space premiums	o Remaining open space premiums for existing residential units, if any, plus open space benefits for new units, if any
	o Ecosystem services benefits	o Remaining ecosystem services benefits, if any
	o WTP for populations of T/E/R species minus payments	
Economic impacts	o Total sales/output, earnings and employment effects from recreation uses [2]	o Total sales/output, earnings and employment effects from alternative uses [2]

Notes: CS – consumer surplus; T/E/R – threatened, endangered or rare; WTP – willingness to pay. [1] On average, costs of community services exceed tax revenues from residential development by around 15 percent (Crompton, 2001). [2] Total impacts include direct, indirect and induced effects from activities.

The central importance of the consumer surplus lies in its ability to measure the net benefits people receive from recreation activities, expressed in terms of their "excess" willingness to pay for these activities above and beyond what they currently are spending. The consumer surplus measure thus allows for a comparison of the benefits of a conservation policy/project, such as the creation of a new protected area in which hunting, fishing and wildlife viewing will be allowed, with the costs of that policy/project in the form of the purchase or easement cost of the land and the management costs. It is the consumer surplus and not the trip spending by recreationists that is the appropriate benefit measure for evaluating the net gain for the region or for society as a whole from a public conservation investment (or any other public investment, for that matter).

Also, because the consumer surplus of wildlife-associated recreation provides an indication of the additional amount the average participant in hunting, fishing and wildlife-viewing would be willing to spend on these activities, it represents the currently untapped amount of money the

average recreationist potentially would be willing to pay in order to maintain their ability to fish, hunt, or observe wildlife. Similarly, the consumer surplus that would be generated by recreation activities on a newly created conservation area represents the amount of money that could be tapped into to pay for the costs of acquiring and managing that area. The actual spending by recreationists is not money available for funding a project because that money has already been spent on trip and equipment inputs (transportation, food and lodging, gear, entrance or permit fees) and is no longer available to recreationists. Thus, it cannot be used to finance acquisition or maintenance of additional conservation areas.

Valuation approaches used in the toolkit

The toolkit generates estimates of the economic value of open space-related scenic benefits, wildlife-associated recreation benefits and several ecosystem services using an approach economists refer to as value transfer or benefits transfer.

Benefit transfer

Benefits transfer commonly is defined as the adaptation of value estimates generated at a previously studies site (the "study site") to a "policy" site for which such estimates are desired but for which implementation of an original valuation study is infeasible (Rosenberger and Loomis, 2001). Benefit transfer is a convenient tool for the efficient generation of value estimates for a policy site, provided that several conditions are fulfilled that ensure the validity of the transfer estimates. These conditions include (a) a precisely defined policy context, including type and magnitude of the expected policy impacts, characteristics of the population affected, type of value measured (average or marginal value), category of value measured (direct, indirect, non-use, or total economic value), and degree of certainty surrounding the transferred data; (b) sufficient quality of the data (sample size, sound economic method and empirical technique, and sufficient number of similar study sites to allow credible statistical inferences) and sufficient background information (population characteristics); and (c) similar characteristics of study and policy site (similar resource, type, degree and source of change in resource, similar demographic characteristics, and, if recreation activities are valued, a similar condition and quality of the recreational experience) (Rosenberger and Loomis, 2001; Brouwer, 2000).

Benefit transfer can take the form of either a value or a function transfer. A *value* transfer is the application of a single-point or average-value estimate from a study site(s) to the policy site. Benefit *function* transfers are based on demand or benefit functions estimated for a study site, or on meta-analysis. Meta-analysis is a regression analysis of the findings of several empirical studies that systematically explores study characteristics as possible explanations for the variation of results observed across primary studies (Brouwer, 2000; U.S. Environmental Protection Agency [EPA], 2000). In both function transfer approaches, the values of key variables from the policy case are inserted into the benefit function to generate policy-site-specific value estimates.

The toolkit allows users to conduct both point (single or average) value benefit transfers and function transfers. Point value transfers can be carried out using the value reported in an individual study (listed in our study databases or tables), using an average of values reported in two or more studies, or using the values we report in the average value tables for wildlife-associated recreation activities and wetlands. Function benefit transfers can be carried out using our meta-analysis-based models for open space property value premiums, fishing, hunting, and several ecosystem services. In the function-based benefit transfers, the user sets several variables in the respective functions at values that match the policy site for which he or she wants to generate value estimates. These variables are clearly marked in the spreadsheet-based benefit transfer models, and the values the user can select are discussed in the model documentation included in the spreadsheets as well as in the user manuals.

Value measures used in the toolkit

Since our estimation models and value tables are based on the findings of other studies, the outputs generated by the toolkit are based on the valuation approaches employed in those

studies. In particular, the property value premiums are based on revealed preferences in the form people's expressed willingness to pay as reflected in market prices for open space scenic amenities.[2] Consumer surplus values for wildlife-associated recreation activities are the result of both stated and revealed willingness to pay approaches. Stated willingness to pay methods include contingent valuation studies in which people are asked directly how much more they would have been willing to pay for those activities, and conjoint/choice analysis, in which people are asked to chose between different bundles of goods priced differently and their willingness to pay is then estimated statistically based on respondents' choices. The revealed willingness to pay methods employed in estimates of the consumer surplus associated with recreation activities comprise several varieties of travel cost methods, where people at several recreation sites are asked how much they spent on their recreation trip and the expenditure data of respondents are then combined with the characteristics of the recreation sites to statistically estimate the willingness to pay function for various activities and individual site characteristics.

The threatened, endangered and rare species valuation model and aquatic habitat improvement models are based exclusively on the results of contingent valuation studies, while the wetland model and average value table   and the terrestrial habitat valuation model are based on a variety of approaches (see the report "Technical Documentation of Benefit Transfer and Visitor Use Estimating Models of Wildlife Recreation, Species and Habitats" and the documentation in the respective spreadsheets).

The choice of valuation approach matters because it may influence the resulting value estimates. This is due to the fact that not every valuation method is able to capture the total economic value of a natural resource. In particular, methods that rely on observed behavior such as market transactions will not be able to capture the non-use (passive use) portion of the value of a resource. Non-use values comprise existence, stewardship and bequest values which with few exceptions to not result in market transactions. Thus, an analysis that uses revealed/observed valuation approaches like house price or travel cost data will fail to capture the non-use portion of the total economic value of a resource (e.g., a particular protected area) is that resource or associated resources (e.g., threatened or endangered wildlife species onsite or off-site relying on the habitat on the site) is in part valued by people for its existence, stewardship or bequest functions.[3]

The toolkit allows users to avoid the problem of omitted economic values that often is inherent in using a single valuation approach for a natural resource because the toolkit allows users to apply several different models and thus to estimate the different economic values that may be associated with the various uses a resource may support. For example, if a site supports direct uses in the form of recreation and open space for nearby residents, indirect uses in the form of ecosystem services such as water quality, and passive uses such as habitat for cherished non-game species, users can estimate these values separately using the different appropriate models or tables the toolkit contains.

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[2] Of the 55 observations extracted from the literature and used in the estimation of our open space property value premium model, all but five are based on hedonic analysis, that is, observed market prices.
[3] For more detailed discussions of different economic valuation approaches and the values they capture, please refer to the two technical reports that accompany the toolkit and to Kroeger and Manalo (2006; available online – see references).

Guide to tool (model/table/database) selection

The toolkit in most cases offers users three choices for generating value estimates for a particular use at a site. As shown in Figure 2, users can:

a) Identify a particular study listed in the studies database for that particular use (e.g., fishing) that is similar to their policy site in terms of site characteristics and demographics and use the value estimate from that study;

b) Use the average or median value estimates provided in the value tables the toolkit provides for a number of activities or habitats;

c) Use administratively prescribed values for particular activities, if such values exist for their area; or

d) Use the meta-analysis based models programmed into the toolkit spreadsheets and tailor those models to match the context of their policy site by setting key variables in the models at the appropriate values.

As a general rule, if there exists a study that is very similar to the valuation context found at the policy site, that is, a study that meets the criteria for a valid benefit transfer reasonably well, the application of the value estimate reported in that study to the policy site often will yield a more accurate value estimate for the policy site than would be obtained from applying an average value derived from several studies that are less similar to the policy context or from application of a benefit function to the policy site. Unfortunately, in many cases, no such "reasonably good fit" may exist, because the number of variables found to be significant (that is, to influence value estimates at the site) often is large enough to make unlikely the existence of two sites and contexts that are reasonably similar to each other in all those variables. Nevertheless, the databases included in the spreadsheets will allow the user to check for the existence of any matches for their policy site.
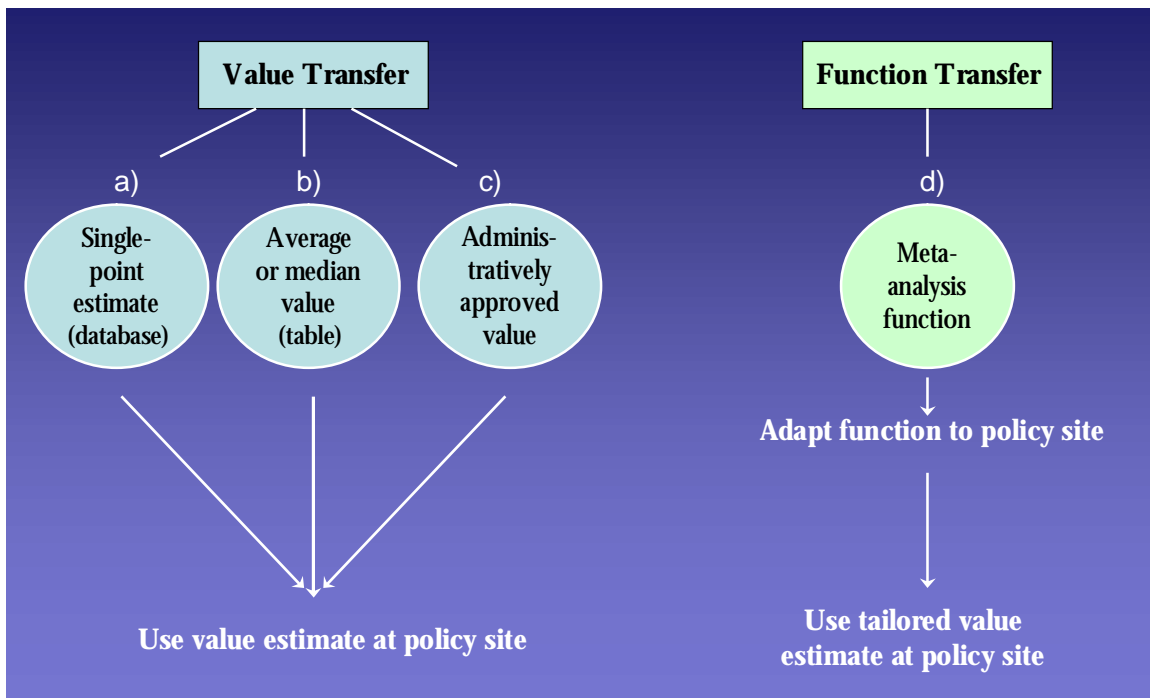

Figure 2: Valuation tools offered by the toolkit

If no good match can be found for the use(s) in question between a study site and the policy site, it is often preferable to use the average or median of the values reported in the set of next-best studies rather than using the value from one particular study. The same is true in a situation where several similarly good matches exist. Since none of the studies exactly matches the policy site, averaging over the values reported in the different studies reduces the risk of relying on a single study whose value estimate for the activity of interest might be an inaccurate estimator for the policy site as a result of a difference in one or several key variables. The toolkit provides several average/median value tables for wildlife-associated recreation activities and wetland ecosystem services. These values were calculated from the studies listed in the respective databases included in our toolkit spreadsheets. Users may select the appropriate values from these tables for the region and species or ecosystem service relevant for the policy site, or they may take the average of values reported in a particular subset of studies that match the valuation context found at the policy site.

Finally, if there is no good match between the policy site and a valuation study or studies in the literature, the analyst can generate value estimates by using the appropriate meta-analysis-based valuation functions/models provided in the toolkit. The models require the user to set the values of key variables such that they match the specifics (e.g., species, land cover type, size of area) of the site for which he or she wants to generate value estimates. The models generate value estimates for a site of interest on the basis of the numeric values of the variables at the site and the size of the impact of each variable on the model output (that is, the economic value estimated by the model). The size of the impact of each variable on output was derived through our meta-analysis of the available studies. Thus, by setting the model variables at their appropriate values for the policy site and by the models' employing literature-based estimates of the impacts of each variable on economic values, users can draw on the often large number of literature findings and systematically adjust them to match a particular site of interest.

Toolkit components

This section provides users with an overview of the different components that form part of the toolkit. This will allow users to identify which toolkit components – valuation and visitation models, average value tables, and study databases – are available for quantifying the values of interest to them for a particular site.

Overview: Valuation models, tables and databases and visitation models

The toolkit includes two types of estimation models: valuation models and visitation models. The valuation models comprise the *Open Space Property Value Premium* model that generates estimates of the portion of the value of a property/ies in an area that is attributable to a particular open space nearby, *Activity Day Value* models that generate estimates of the value of wildlife-associated recreation activities (hunting, fishing, wildlife viewing) per activity day; *Habitat* or *Habitat Improvement* models that generate estimates of the annual per-acre values of the ecosystem services provided by an area, and *Threatened, Endangered and Rare Species* and *Salmon* models that generate estimates of the annual value to people of a change in the population of a particular species, or the value of avoiding a reduction in the population of the species.

> **Valuation models included in the Toolkit**:
>
> o *Open Space Property Value Premium* model
>
> o *Activity Day Value* models for hunting, fishing and wildlife viewing
>
> o *Habitat Value* or *Habitat Improvement Value* models for terrestrial and aquatic habitats and wetlands
>
> o *Threatened, Endangered and Rare Species* Value model and *Salmon Value* models

The visitation or visitor use estimation models generate the number of fishing, hunting or wildlife viewing days a particular area is expected to attract per year. The toolkit contains separate sets of models, one for estimating visitation at areas managed primarily for wildlife (National Wildlife Refuges and State Wildlife Management Areas, "NWR/SWMA"), the other for estimating the state-wide recreation days on lands managed for a variety of uses but also providing wildlife habitat ("State-level"). Each set is comprised of freshwater and saltwater fishing, big game, small game, migratory bird and total (all) hunting models as well as a wildlife viewing (State-level) and non-consumptive recreation (NWR/SWMA) model. [4]

The total annual economic value of a wildlife-associated recreation activity on a site is derived by combining valuation and visitation models, specifically, by multiplying the output of a particular activity day value model (say, freshwater fishing), expressed in $/day, with that of the relevant visitor use model, expressed in number of visitor/participant days per year (Figure 3). (As discussed above, instead of using the model-based activity day values users may choose values from a particular study or studies or from the average/median value tables we provide.) All other models – the Open Space Property Value Premium model, the Wetland, Terrestrial Habitat and Aquatic Habitat Improvement models, and the Threatened, Endangered or Rare species model and Salmon models – do not require any such multiplication of the model outputs (i.e., per-capita WTP) with the number of recipients. Rather, these models ask the user to input information on the number of affected households as part of the information needed to generate model outputs.

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[4] Non-consumptive recreation includes wildlife viewing but in addition includes a number of other recreation activities not necessarily associated with wildlife, such as picnicking, photography, walking on nature trails or use of observation platforms and beach/water use (Caudill and Henderson, 2005).

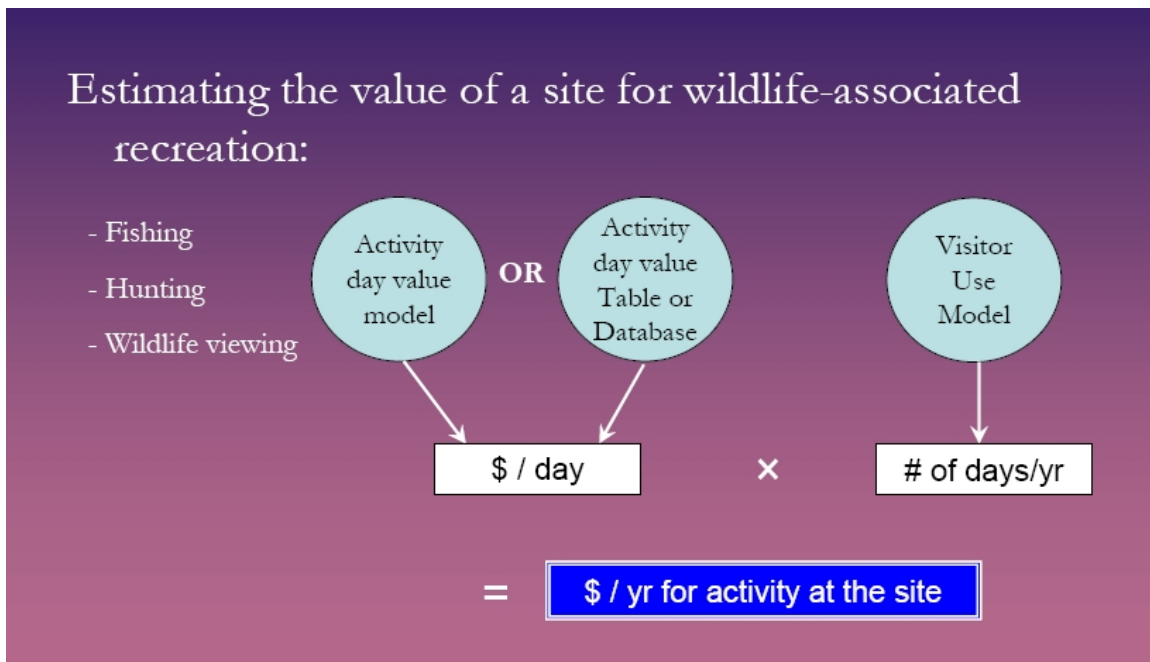Thus, the value estimates generated by these models already take into account the number of beneficiaries.

Figure 3: Linking activity day values and visitor use models

In addition to the valuation models, the toolkit also includes average/median value tables and/or value databases for most values analyzed in the toolkit. Table 2 and Figure 4 provide an overview of the models, tables and databases available in the toolkit as well as the form in which the values are expressed in the toolkit.

Table 2: Values quantified by toolkit and provided value models, tables and databases

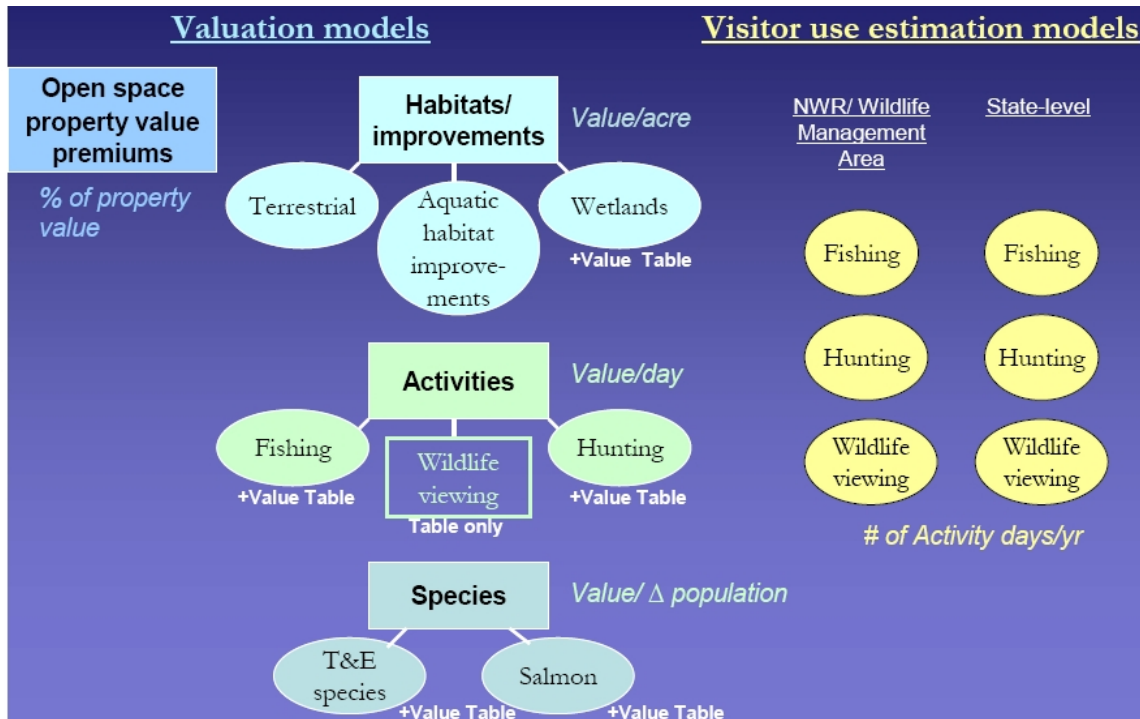| Value analyzed	Value expressed as	Valuation model	Avg/median value table	Database table
OS property value premiums	- % of property value - total $ for all properties near site	ü	-	ü
Ecosystem service values	- $/acre/year at site - total $/year for site			
Terrestrial		ü	-	-
Aquatic improvements		ü	-	-
Wetlands		ü (2)	ü	ü
Wildlife-associated recreation net benefits (CS)	- $/activity day at site; multiply w/ visitor days to get total $/year for site			
Fishing		ü	ü	ü
Hunting		ü	ü	ü
Wildlife viewing		-	ü	ü
T/E/R species values	- $/household for species population change;	ü	-	ü
Salmon	- total $ for species population change	ü	ü	ü

Figure 4: Overview of estimation models contained in the Toolkit

Combining model outputs for a comprehensive estimate of the economic value provided by a natural area / conserved wildlife habitat

Each of the models or tables can be used as a stand-alone for an analysis that aims to develop an estimate of the value of a particular use (say, fishing) at a site of interest. Alternatively, as shown in Figure 5, multiple model or table outputs can be combined to develop a more comprehensive estimate of the conservation-related economic value of a site. To facilitate such more comprehensive analyses, the toolkit also includes a *Summary Output Model* that allows the user to conveniently organize and display the results obtain from individual valuation models of tables in one place. This Summary Output Model is discussed in the next section.

Some of the ecosystem service models include uses whose values are estimated individually in other models. Therefore, to avoid double-counting, users must set the indicator variables that represent those uses in the ecosystem service models at zero when combining ecosystem service model results with the results of other models. For example, if both the Terrestrial Habitat model and the Open Space Property Value Premium model are used to quantify the ecosystem service value of a site and also its open space value for residential property owners, the open space indicator variable in the Terrestrial Habitat model must be set to zero even if the site provides open space values for nearby residences. (As explained in more detail the model manuals, indicator variables can take only two values: "1" if the feature they represent, like open space amenity values in the foregoing example, is present at the site; and "0" if it is not present.) Otherwise, the open space values of the site will be counted by both models resulting in an overestimation of benefits.

Figure 5: Combining individual toolkit outputs for a comprehensive estimate of the conservation value of a site

Accompanying technical reports and user manuals and presentations

In addition to the Introduction, the valuation and visitation models and value tables and databases and the Summary Output model, the toolkit includes several additional documents:

- o **Open Space Property Value Premium Analysis**, which reviews the relevant literature, provides brief summaries of individual studies and discussed the development of the open space premium estimation model. This analysis also includes a **user manual** with step-by-step guidance on the application of the model that presents several examples of applications of the model; the
- o **Technical Documentation of Benefit Transfer and Visitor Use Estimating Models of Wildlife Recreation, Species and Habitats** , which discusses key concepts of economic valuation of natural resources and common valuation approaches and details the development of the Activity Day value models, the Wetland, Aquatic and Terrestrial Habitat ecosystem service value models, the T&E/R species and Salmon value models and the Visitor Use models; and the
- o **User Manual: Benefit Transfer and Visitor Use Estimating Models of Wildlife Recreation, Species and Habitats**, which provides step-by-step guidance on applying the models and tables and several application examples.

The Toolkit also includes two PowerPoint presentations. The first, "**Quantifying the Economic Value of Habitat Protection: Application of a Benefits Estimation Toolkit**", provides an overview of the toolkit. The second, " **The Wildlife Habitat Benefits Estimation Toolkit: Application Examples**", contains step-by-step application examples for many of the models.

Finally, the Toolkit includes a **Community Economic Competitiveness Analysis**, which reviews and synthesizes the literature on the economic impacts of natural amenities in general, and of protected lands in particular, on output, employment, income and population.

Summary Output Model

For the user's convenience, the Toolkit includes a Summary Output Model that displays the results the user has generated with the individual visitation models and valuation models or tables. The Summary Output Model consists of an input area (the blue-shaded area, shown in Figure 6) in which the user specifies the particular Toolkit models or tables he wants to use to generate Summary Output data, and an output area that displays the results (the yellow-shaded area, shown in Figure 7).

The use of the Summary Output Model is optional. The model is simply intended to provide a convenient compilation in one place of the results generated with individual valuation and estimation models or tables. Thus, the Summary Output Model is particularly useful for users interested in generating estimates of the values associated with several different uses of an area, such as for example several wildlife-associated activities (hunting, fishing, wildlife viewing), amenity (scenic) uses by local residents (property values premiums), and ecosystem services. However, the user may elect to generate results with particular individual valuation and visitation models or tables without using the Summary Output Model to display the results.

Figure 6: Summary Output Model: Input area

Output Area

Benefits Associated with: *Proposed/New Conservation Area/Habitat Acreage*

OPEN SPACE PROPERTY VALUE PREMIUMS

Discount rate and time period used to derive Net Present Values of annual benefits:

Discount rate:	**0%**	*/year*
Time period	**0**	*years*

ACTIVITY-RELATED BENEFITS

(Wildlife associated recreation	2006 $/year	NPV (2006$)
Hunting-Total		
or: Hunting - Small game		
Hunting - Big game		
Hunting - Waterfowl		
Fishing - Freshwater		
Fishing - Saltwater		
Wildlife viewing/non-consumptive*		
TOTAL ACTIVITY-RELATED		

HABITAT-RELATED BENEFITS	2006 $/year	NPV (2006$)
Terrestrial		
Aquatic habitat improvements		
Wetlands		

E&T/R SPECIES-RELATED BENEFITS

AVOIDED COST OF PUBLIC SERVICES   not included   *(user estimate)*

TOTAL BENEFITS, Net Present Value   0

Note: Only selected ecosystem services are included in estimates (see models for detail

* Non-consumptive: includes wildlife viewing, picnicking, photography, nature trails, observation platforms, and beach/water use.

Figure 7: Summary Output Model: Output area

The Summary Output Model is programmed to retrieve the relevant outputs from the value tables and valuation and visitation models. In the case of valuation or visitation models, the outputs the Summary Model draws on are those shown in the output fields of the respective models. In the case of value tables, the Summary Output Model draws on the values the user selects from the various options contained in those tables and enters into specially marked cells in the tabular value spreadsheets.

If the Summary Output Model is used to display the values associated with uses of an area, certain straightforward procedures should be followed in order to ensure that the Model displays the appropriate values. These procedures are outlined in the next section, *Directions for using the Summary Output Model*.

The Summary Output Model can be used either to estimate the benefits associated with a proposed new conservation area or habitat acreage, or to estimate the benefits associated with a change in an existing conservation area or habitat. In the former case, the Summary Output Model generates estimates of the value for the new area in its entirety. Alternatively, if used to

analyze the benefits associated with changes in an existing protected area or habitat, the model generates estimates only of the value associated with the changes in that area, where "change" entails additions *or decreases* of acreage, additional uses, or improvements in water quality in the area. Users should be consistent in their application of the individual fishing, hunting, viewing and habitat models and visitor use estimation models by using them all to value either a "change in existing area" scenario or all to value a "new conservation area" scenario. Users should not mix these two scenarios. If both scenarios represent possibilities (e.g., expansion of an existing area or creation of a new area) then users should run them separately and thus generate a separate summary output model for each.

The Summary Output Model may be used to estimate the economic values associated with an area that is composed of different ecosystem types. The only condition for this is that the user specify the respective acreages in the particular valuation or visitation models or tables (spreadsheets). For example, the value of an area that contains 200 acres of terrestrial and 600 acres of wetland habitat may be expressed jointly in the Summary Output Model by selecting "200" as the acreage in the wetlands value model or table and "600" as that in the terrestrial model or table.

The individual spreadsheets of the valuation tables and visitation or valuation models the user needs to fill out need not all be filled out in one session. The user may chose to interrupt the filling out of the spreadsheets at any time and resume the process at a later time, provided that he/she save the already filled-out spreadsheets (make sure to choose an appropriate file name!) so the entered information and outputs in those spreadsheets are preserved.

Directions for using the Summary Output Model

Because the Summary Output Model draws on the contents of the individual spreadsheets that contain the visitation models and valuation models and tables, the user must take care to ensure that the values generated (in the case of visitation or valuation models) or selected (in the case of value tables) in those spreadsheets match the characteristics of the conservation area for which the Summary Output Model is generated. In other words, all spreadsheets must be filled out or at least checked as to their outputs each time the user would like to use the Summary Output Model. Otherwise, the Summary Output Model may not show the correct value estimates for the area the user would like to assess, because the outputs generated by particular spreadsheets may be the results of estimates previously generated by the user for other areas with those models or tables.

To ensure that the Summary Output Model displays the correct estimates for the area of interest to the user, the following procedures must be followed:

- Make sure you have generated outputs in the table and model spreadsheets you want the Summary Output model to use. The outputs in these spreadsheets serve as the inputs to the Summary Output model. **NOTE**: if you choose for the Summary Output model to return individual hunting (Small game, Gig game, Waterfowl) values, make sure you generate outputs in each of the visitation spreadsheets for the three hunting types. Otherwise, the Summary Output model will return the error message "#VALUE!" in the output cells for the hunting type(s) whose spreadsheets are left unfilled. This is intended

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to help the user not to accidentally overlook some hunting values that may be relevant for the site of interest.

- If you open the Summary Output Model file after working with individual valuation or visitation spreadsheets, make sure you accept the "update" option in the pop-up box when you open the Summary Output Model file. This way you ensure that the outputs of the spreadsheets you worked on are carried over into the Summary Output Model.

- Make sure you have generated outputs in the table and model spreadsheets for the case at hand; otherwise, the Summary Output table will display existing outputs from past applications of those spreadsheets that may not match the area for which you want to generate values.

- Make sure you enter the appropriate information in the blue-bordered fields in the Input Area of the Summary Output Model. This directs the Model to draw the information from the correct cells of the relevant spreadsheets. The Model's output fields, indicated by the white cells with black borders in the shaded area on the left side of the spreadsheet, are preformatted to draw upon the appropriate spreadsheet cells, depending on the information the user enters in the blue-bordered cells in the Input Area.

- In order to use data from the spreadsheet value tables (for example, value per user day for wildlife-associated activities or value per acre for wetlands or terrestrial habitats) when generating the Summary Output Model, the user must fill in the indicated boxes on the Summary Table tabs of the respective spreadsheets. The boxes ask the user to select from among the different values shown in the Summary Tables, Detailed Tables or underlying databases (if any) the value(s) she wants the Summary Output Models to use for valuing the wetland, species (T&E/R or Salmon) or activity (fishing, hunting, wildlife viewing) relevant for the area of interest. In the case of ecosystem service values, the user also needs to provide the acreage of the area of interest. For example, as shown in Figure 8, the Summary Table tab in the Wetland Value Table file contains a cell into which the user enters the appropriate value from the Summary Table, Detailed Table or underlying database, as well as a cell into which she enters the acreage of the area she wants to value. These are the cells the Summary Output Model draws upon to generate value estimates from value table spreadsheets. In the valuation or visitation model spreadsheets, there is no need for the user to fill in any information as the models themselves generate this information.

- Finally, again, take the time to look at the individual spreadsheets you have filled out that feed the Summary Output Model. Make sure the spreadsheets are filled out for the case at hand. It is comparatively easy to catch obvious errors, such as values appearing in the habitat-related benefits fields (Terrestrial, aquatic habitat improvements, wetlands) if those habitats that in fact are not present in your area of interest. It is easier to overlook wrong data entries in value categories that apply to your study area. You can avoid those by verifying that the data entered in the respective spreadsheets pertain to your area of interest.

Average Wetland Value (per acre)

converted to 2006 base year

	N	NORTHEAST	N	SOUTHEAST	N	INTERMOUNTAIN	N	PACIFIC	N	CANADA
Wetland $/Acre	19		27		7		7		4	
Average		$49,873		$448		$80		$1,555		$137
Median		$618		$21		$17		$718		$149

Values represent Total Economic Value (recreational use and passive use, or existence, value)

Woodward, Richard and Yong-Suhk Wui *The Economic value of wetland services: a meta-analysis* Ecological Economics 37 (2001) 257-27

1) ENTER the average or median value from the column in the above table that matches your wetland's loc ▶ [   ]

   OR, ENTER a value from the Detailed Table (next tab)

   OR, ENTER a per-acre value from the Database tab, if you think the wetland valued in the study from which that value stems is

      a close match to the wetland you want to value.

2) ENTER the acreage of the wetland you want to evaluate: ▶ [   ]

Figure 8: Example of tabular value model with cells the user is required to fill out when using the Summary Output Model

Deriving the Net Present Value (NPV) of the future uses of a resource

Most models generate value estimates expressed in annual (per-year) benefit flows. The exception is the open space property value model, which expresses values in the form of the total "capital" value of open space for the residential properties of interest. The same distinction into annual and total capital measures also holds true for the value tables. The activity day models (fishing, hunting and wildlife watching) yield values per activity day. These values, multiplied by the output of the respective visitor use estimation models which yields annual visitation estimates, also yield annual benefit flows.

In cases where the valuation of a particular use provided by a conservation area is based on annual values, the Summary Output Models can perform net present value (NPV) conversions of the annual value stream. The NPV conversion expresses the value of the stream of future benefits derived from the area in its equivalent, discounted present value. It thus facilitates comparisons between the various values associated with uses of the conserved land that are expressed in different temporal units (annual vs. capitalized value). This NPV conversion also facilitates comparison of the value of the conservation benefits provided by the conserved land with land protection/acquisition costs in the form of the fee-simple purchase price of the land or the cost of placing a conservation easement on the land. Calculating the NPV of the benefits of conservation lands also allows the user to account for the fact that those lands can be expected to generate benefits for long periods of time. Conversely, the loss of the lands through development results in foregoing forever some or all of the benefits the conserved lands provided. Thus it is important to incorporate the temporal dimension into any assessment of the value of the lands. The NPV conversion facilitates this consideration of the full value of the resource through time.

The Summary Output Table automatically calculates the NPV of a benefit expressed in annual value terms. The user simply needs to specify the number of years he wants to include in the analysis and the discount rate, and enter this information in the respective cells in the input area of the Summary Output model spreadsheets.

Selection of the appropriate discount (interest) rate for NPV calculations is not a straightforward matter, although, as noted below, some federal agencies suggest or mandate discount rates that may be appropriate for use in many types of economic analyses. To begin with, it is generally accepted in natural resource and environmental economics that private market interest rates are not appropriate for use in public policy analysis.

This view is based on the recognition that the state has a responsibility to society as a whole and the empirically observable fact that society as a whole, for a variety of reasons, exhibits a lower rate of time preference than individuals do (Caplin and Leahy, 2004). The social rate of time preference (SRTP), or social discount rate, is the rate at which society as a whole is willing to trade off (at the margin) present consumption for future consumption. The SRTP is the rate that should be used as a discount rate in the evaluation of public projects (Arrow et al., 1996). [5] Though not directly observable, this rate is reflected in private market interest rates, together with perceived investment risk, uncertainty, tax rates, and inflation expectations, all of which increase market rates.[6] The average of the market interest rates on practically risk free investments, adjusted for inflation, represents a reasonably good starting point for an estimate of the pure rate of social time preference, but this rate still is biased upward because it still contains the effects of taxes and imperfections in capital markets. In its *Guidelines for Preparing Economic Analyses* (EPA, 2000), the U.S. Environmental Protection Agency (EPA) adopts the social discount rate as the appropriate rate for evaluating the impacts of public environmental policies:

> "...practical economic analyses must use social discounting to assist in evaluating environmental policies. What is offered in the empirical literature for choosing a social discount rate focuses on estimating the consumption rate of interest at which individuals translate consumption through time with reasonable certainty. For this, historical rates of return, post-tax and after inflation, on "safe" assets, such as U.S. Treasury securities, are normally used, typically resulting in rates in the range of one to three percent..." (EPA, 2000:47).

For projects involving intra-generational time frames, the EPA suggests discount rates between two to three percent (EPA, 2000).

By contrast, in its *Guidelines and Discount Rates For Benefits Cost Analysis of Federal Programs*, the White House's Office of Management and Budget (OMB, 1992) prescribes a seven percent real discount rate for use in cost-benefit analysis of public projects. OMB argues that public projects generally displace private investment and thus their impacts should be discounted at the same rate as private investments, which according to OMB averaged a pre-tax rate of return of seven

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[5] This approach derives the social discount rate from the discount rates of individuals. An important criticism of basing social discount rates on individuals' rates of time preference is that myopia and selfishness lead to a suboptimal and unjust allocation of resources across time. The former is a result of the shortsightedness of people; the latter results because future generations are not participants in present-day credit (and political) markets (Bishop, 1993). The state as guardian of society's welfare should be expected to prevent the resulting misallocation through employing appropriately corrected (i.e., lower than individuals' private) discount rates in the evaluation of public projects (Caplin and Leahy, 2004). That is especially called-for in projects that generate temporally far-off effects, for which much lower inter-generational discount rates are suggested (EPA, 2000; Weitzman, 1994, 2001). Based on this argument, a social discount rate derived purely on the basis of the preferences of present market participants is still higher than the rate that would maximize social welfare over time.

[6] The real interest rate (that is, the interest rate net of inflation) is defined as i_r = rate of time preference + risk adjustment + uncertainty adjustment; the nominal interest rate as in = $(1 + i_r)(1 + $ rate of inflation$) - 1$.

percent in recent years. For reasons briefly discussed in this section, it is clear that the private pre-tax interest rate is not suitable for use as a social discount rate.

Table 3 provides a sample of social discount rates suggested in the literature, as well as the rate prescribed by OMB. With the exception of OMB's rate, the suggested rates range from 1-4 percent. As a result of differences among individuals in their rate of time preference, the chosen discount rate should decrease over time (Weitzman, 2001).

Table 3: Selected discount rates suggested in the literature for assessing the present value of the benefits provided by natural resources

	Social discount rate (r)
Weitzman (1994)	~2 % *
Weitzman (2001)	
1-5 years	4 %
6-25 years	3 %
26-75 years	2 %
76-300 years	1 %
EPA (2000)	1 %-3 %
OMB (1992)	7 % **

Notes: * Based on a rough analysis of environmental cleanup costs and reversibility of environmental damages in the U.S. in the 1990s, Weitzman (2004) estimated that the social discount rate should be about 0.9 times the private real interest rate. Using the average rate of return on certificates of deposit during 1987-2006 of 5.1%, correcting this rate for inflation, which on average was 2.9% per year during 1987-2006, and multiplying the result by Weitzman's factor of 0.9 one obtains a real social discount rate of two percent. ** Not suitable for use as a social discount rate. See text.

Thus, unless a particular discount rate is prescribed by law or administrative order, we generally suggest that discount rates used in the Summary Output Model be between one and four percent.

Due to the uncertainty as to the correct discount rate to be used, we recommend that the user calculate the Summary Output Model NPVs using several of the discount rates suggested in Table 3, so as to obtain a feel for the range of NPVs that results from using different, commonly employed environmental discount rates.

Values not addressed in the Toolkit and useful information sources

Due to the still-limited information on the quantitative nature and value of many ecosystem services, the toolkit currently cannot generate value estimates for a number of ecosystem services. Incorporation of these services into the toolkit may become feasible when their measurement and expression in economically meaningful terms become easier (Boyd and Banzhaf, 2007). Currently, the toolkit omits economically important services such as water provision and water quality services by terrestrial habitats, crop pollination provided by lands that provide habitat for native insects (De Marco et al., 2004; Kremen et al., 2002, 2004), air quality improvement services performed by forests and urban vegetation, and carbon net sequestration services provided by most conserved lands, to name but a few.[7] For example, the water provision services from National Forest lands alone are valued conservatively at over $4.3 billion per year (2007 dollars; Sedell et al., 2000); the value of native insects for agricultural production is estimated at about $8 billion per year (Losey and Vaughan, 2006)[8]; and the value of the human health benefits, reduced energy use, and carbon sequestration provided by Houston's regional forest is estimated at over $450 million per year (Nowak et al., 2005).

Areas that provide habitat for recreationally important wildlife species also support outdoor recreation activities that are not primarily tied to wildlife, such as hiking, backpacking and camping, scenic photography, picnicking, nature education and research, among many others. The economic values associated with these activities are dependent on these areas but are not captured in our analysis, because our recreation value models and tables address only wildlife-associated recreation activities.

Conserved lands whose conversion for residential development is avoided also generate benefits in the form of the avoided cost of public services. Crompton's (2001) review of over 70 empirical studies reveals that new residential developments usually lead to net increases in property taxes for existing residents, with a median net cost of residential development in the reviewed studies of about 15 percent. Thus, avoided conversion of undeveloped lands generates cost savings for communities compared to the development of these areas.

As a consequence of omitting some of the economic values associated with conserved lands, our toolkit currently is not able to capture the total economic value of a particular undeveloped area. Below we direct interested users to sources that provide information on the value of some of these benefits currently not included in our toolkit, or on how to estimate this value.

Data sources for quantifying omitted values

Outdoor recreation values not primarily associated with wildlife:

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[7] While net carbon uptake by forests and many other vegetation-rich ecosystems has long been an established finding, recent research suggests that even deserts may perform important net sequestration services (Wohlfahrt et al., 2008; Xie et al., 2008). Some ecosystems change from being net absorbers of climate change related gases to becoming net releasers as a result of climate change-induced impacts. The prime example of this are thawing permafrost areas whose soils release large quantities of methane and carbon dioxide.

[8] Native insects also are estimated to be the main food source for a number of recreationally important wildlife species that support an estimated $50 billion in sales in the outdoor recreation industry (Losey and Vaughan, 2006). However, the value of this recreation is already accounted for in the value estimates generated by our wildlife-associated recreation value models and tables and visitor use models.

Loomis, John B. 2005. Updated Outdoor Recreation Use Values on National Forests and Other Public Lands. USDA FS General Technical Report PNW-GTR-658. October, 2005. Pacific Northwest Research Station. Available at http://www.fs.fed.us/pnw/pubs/pnw_gtr658.pdf

This report includes a link to a downloadable database of recreation studies (http://www.fs.fed.us/pnw/pubs/pnw_gtr658.pdf) that contains over 1,200 value (net benefit/consumer surplus) estimates. The database information includes all value-relevant study characteristics and thus allows users to search for a study whose context matches that of their site of interest.

<u>Ecosystem service values</u>

Carbon sequestration
The economic value of the carbon sequestration services provided by ecosystems is equivalent to the discounted value of avoided or reduced future losses from climate change-related events such as floods, storms, or beach erosion. The magnitude of the avoided losses is difficult to estimate due to the multiple uncertainties involved: the uncertainty of particular events (i.e., their location, strength, and timing); the uncertainty of the relationship between atmospheric greenhouse gas concentrations and the increased frequency or magnitude of particular types of events; and the costs associated with the future events. A second-best valuation approach relies on market prices for carbon to value sequestration services. Currently, all carbon markets in the U.S. are voluntary, but regulation-driven markets are emerging at the state (e.g., California) and regional levels (the Western Regional Climate Action Initiative or the northeast Regional Greenhouse Gas Initiative) and are increasingly likely to appear at the federal level as well.

Estimating the value of sequestration services provided by the vegetation and soil at a particular site is a two-step process. First, the net quantity of sequestered carbon needs to be estimated (usually expressed as tons of carbon dioxide equivalent, or tCO_2e; 1 ton of C is equivalent to 3.667 tons of tCO_2e). Following this, the net sequestered quantity of carbon dioxide is multiplied by the appropriate market price. The appropriate price is determined by the prices on those markets to which the provider of the generated sequestration credits has access. For example, as of 2007, U.S. suppliers of sequestration services do not have access to any Kyoto-based carbon markets like the European Union's Emission Trading Scheme (EU-ETS) because the U.S. has not ratified the Kyoto Protocol. Thus, currently, U.S. individuals or firms wanting to sell carbon credits only have access to voluntary markets where carbon credit prices are much lower than on international markets.

The quantity of net carbon uptake or "flux" into site vegetation and/or soil can be estimated either on the basis of values generated by specific studies, or with the help of a model. The most-widely used model is the Forest Service's COMET-VR (**C**arb**O**n **M**anagement **E**valuation **T**ool - **V**oluntary **R**eporting), which generated estimates of the net soil carbon flux for agricultural lands. This model was developed as a decision-support tool for agricultural producers, land managers, soil scientists and others. COMET-VR provides an interface to a database containing land use data from the Carbon Sequestration Rural Appraisal (CSRA) and calculates in real time the annual carbon flux using a dynamic Century model simulation. COMET-VR requires the user to provide certain information on the site for which sequestration estimates are to be generated. The tool and information on its use can be found at http://www.cometvr.colostate.edu/ Another

recently developed model that develops estimates of the carbon sequestration resulting from conservation practices on agricultural lands is the U.S. EPA's RAPCOE (Reforestation Afforestation Project Carbon On-Line Estimator) developed by researchers at Duke University's Nicholas Scholl of the Environment, available at http://ecoserver.env.duke.edu/rapcoev1/

Information on net sequestration rates for lands in natural vegetation often may be obtained from the extension services of universities with forest and agricultural departments or from local Forest Service offices.

Information on prices on the currently existing, voluntary carbon markets in the U.S. can be found at the following sites:
- Chicago Climate Exchange: http://www.chicagoclimateexchange.com/
- The Katoomba Group's Ecosystem Marketplace: State of the Voluntary Carbon Markets 2008: http://ecosystemmarketplace.com/pages/article.news.php?component_id=5794&component_version_id=8505&language_id=12

These sources will also provide information on prices in regulated carbon markets in the U.S. once these markets become operational.

Relation of Toolkit value measures to measures of economic impact of wildlife-associated recreation

As already discussed in the section "Purpose of the Toolkit" above, the toolkit does not generate estimates of spending by recreationists attributable to the areas analyzed or of the resulting economic impacts in terms of total sales, income or jobs.

Users interested in the size of wildlife-associated recreation spending attributable to a conserved/natural area and the resulting economic impacts, for example for the purpose of comparing these estimates with the spending and impacts that might result from partial or full development of the area (see Table 1), may consult several sources.

Data sources and approaches for generating economic impact estimates

Wildlife-associated recreation spending
Average spending on trips and equipment for fishing, hunting and wildlife watching is available for each state from the Fish and Wildlife Service's Survey of Fishing, Hunting and Wildlife-Associated Recreation: http://www.census.gov/prod/www/abs/fishing.html The reports contain information on total annual trip and equipment spending separately for fishing, hunting and wildlife watching. They also contain information on the numbers of participation days for each of these activities. By dividing the total spending, say, for fishing, by the total number of days spent fishing, the user can calculate the estimated spending per fishing day. Then, by multiplying the spending estimate by the number of visitor days for the site of interest, generated by our visitation models, the user can generate an estimate of the total annual spending by recreationists as a result of their visits to the site of interest.

Economic impacts
The dollars spent by recreation visitors from outside of the area for which impact estimates are

sought ripple through the local, regional and state economies, generating additional sales, income, and employment. For example, recreation visitors to an area spend money on gasoline, lodging, restaurants, groceries and gear. Their purchases generates sales for local retailers, who in turn replenish their stocks through purchases from local and out-of-area wholesalers. These in turn place orders with manufacturers, who in turn use inputs from still other industries. In this way, each dollar spent by visitors generates a series of further sales throughout the economy. To estimate total, final output (sales), income and employment in the local, regional or state economy from visitor spending, the spending is multiplied by coefficients that measure the relation between first-round and final sales, and the income and employment associated with final sales. The size of the total impact multipliers or coefficients increases with the size of the area for which impacts are sought. For example, each dollar spent on recreation-related goods and services will, on average, have a smaller total impact in a village than in the corresponding county, and the impact in the county will be smaller than the impact on the state, and so on. The reason for this is that the smaller the area of impact analysis (village, county, state, nation), the more of the initial spending is transferred to producers outside of the area because the smaller the area, the fewer of the goods and services sold in the area are produced locally. As a result, more of the economic impacts from local spending occur outside of the area in the form of sales, income and employment. Thus, it is important to select the multipliers appropriate for the area of analysis (local, county or multi-county area, or state-level).

Two approaches are commonly employed to generate impact estimates: one uses multipliers developed by the U.S. Department of Commerce's Bureau of Economic Analysis (BEA). These RIMS-II (Regional Input-Output Modeling System) multipliers can be custom-ordered for $225 per region (county or contiguous multi-county area). The multipliers and an instruction manual are available at http://www.bea.gov/regional/rims/index.cfm.

The other approach uses an impact model, IMPLAN (http://www.implan.com/), that is available commercially. IMPLAN-derived multipliers also form the basis of the University of Michigan's Money Generation Model (MGM2) that is available free of charge. This model was developed to generate impact estimates for National Park Service units, but it is applicable also to other lands, provided the spending data entered into the model are appropriate for the site of interest. This should generally be the case if these data are obtained from the FWS's National Survey of Fishing, Hunting and Wildlife-Associated Recreation, which represent statewide average estimates. The MGM2 model and detailed instructions for its use are available at http://web4.msue.msu.edu/mgm2/default.htm

Alternatively to generating multiplier estimates themselves using the above approaches, toolkit users can obtain or calculate economic multipliers from published studies or report. For example, the American Sportfishing Association's (Southwick Associates, 2008) report "Sportfishing in America" contains both spending and total economic impact estimates for each state, from which the user can calculate the state-wide total output, income and employment multipliers. The report also provides data on state and local and federal tax income from total output, which allows users to estimate the tax multipliers. Note that these are state-level multipliers and thus would overestimate the impact on a local or other sub state-level area, because, as explained above, multipliers decrease in size as the area of analysis becomes smaller. The updated 2008 version of the American Sportfishing Association's report is available at
http://www.asafishing.org/asa/images/statistics/reports/SIA_2008.pdf

Another report by the Fish and Wildlife Service (Henderson, 2005) provides the same data (spending, total output, income/earnings, employment, state and federal tax revenues) for waterfowl hunting, and thus allows the user to calculate the state-wide multipliers for waterfowl hunting. This report can be found at
http://library.fws.gov/nat_survey2001_waterfowlhunting.pdf

Finally, a similar report is available for hunting (Southwick Associates, 2007):
http://www.southwickassociates.com/freereports/Default.aspx

Economic Glossary of Key Terms

Benefit transfer (BT) – The application of a benefit per-unit estimate (e.g., dollars per visitor day, per household, or per acre) from an existing study site to a policy site for which such a benefit per unit value is needed but an original study is infeasible.

Consumer surplus (CS) – The additional amount a person would have been willing to spent on a good or service above and beyond what they actually spent. The consumer represents the net benefit the person receives from the good or service.

Meta-analysis – A regression analysis of the findings of several empirical studies that systematically explores study characteristics as possible explanatory factors for the variation of results observed across primary studies.

Net benefit – The benefits associated with a good or service less the (opportunity) costs of the good or service.

Policy site (benefit transfer) – A location for which a value estimate is sought for a particular use

Study site (benefit transfer) – A location for which a value estimate for a particular use has been derived by an original study

Willingness to pay (WTP) – The maximum amount of money or goods a person would be willing to give up in order to obtain a particular good or service.

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