PASSIVE USE VALUES OF WILD SALMON AND FREE-FLOWING RIVERS

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This technical chapter defines what is meant by passive use or existence values, describes their relevance to Lower Snake River feasibility study and presents the results of applying the existing literature to measure such values for the Lower Snake River.

Importance Of Passive Use Values In Economic Analysis Of Endangered Species And Free-Flowing Rivers

Avoiding extinction of endangered species is recognized as a source of existence or passive use values (Meyer, 1974; Randall and Stoll, 1983; Stoll and Johnson, 1984). Existence values are defined as the benefit received from simply knowing the resource exists even if no use is made of it. Free-flowing rivers, were one of the first examples of such resources with existence values (Krutilla and Fisher, 1975). Essentially people who never plan to visit, raft, or fish these rivers may still pay something to have a free flowing river. Wild stocks of Snake River Sockeye and Chinook Salmon clearly fit into this picture. As noted by Olsen, et al. in his existence value of salmon study "Existence values as the value an individual (or society) places on the knowledge that a resource exists in a certain state is theoretically sound and can be measured for assessment within the resource decision making arena". Passive use value are also public goods, in that these benefits can be simultaneously enjoyed by millions of people all across the region and the country (Loomis, 1996a).

Incorporating non-use values has become fairly routine in many Federal benefit-cost analyses for critical habitat designations of endangered species. For example, the USDA Economic Research Service's economic analysis of salmon recovery efforts on the Snake River included estimates of non-use values drawn from the existing literature (Aillery, et al. 1996). Nonetheless, passive-use values are not formally part of the COE's National Economic Development analysis. This may be due, in part, to the benefit-cost procedures which must be followed by the COE being originally written about 20 years ago (US. Water Resources Council, 1979), before measurement of passive use values had become common. These benefit-cost procedures are silent on measurement of passive use values, although they do allow for measurement of other categories of benefits as long as the procedures are documented and willingness to pay is used. Passive use values are estimated using a method recommended by the U.S. Water Resources Council for valuing recreation, but its use to measure passive use values has been controversial (Diamond and Hausman, 1996; McFadden, 1994) although it has been given a limited endorsement by a Blue-Ribbon panel chaired by two Nobel Laureate economists (Arrow, et al).

Although the COE will not formally include the passive use values in their official NED analysis, the Drawdown Economic Workgroup (DREW) asked that passive use values be included in an overall presentation of benefit and cost summary in the Economic Appendix. Therefore, passive use values were calculated to be included in that part of the overall economic analysis. DREW had originally requested an original passive use value survey as part of the recreation survey and such a survey was pretested. However, due to political pressure the COE decided passive use values would be approximated based on existing passive use value estimates (e.g., using a benefit-transfer approach) rather than a new survey as was originally proposed. The final passive use value survey was not conducted.

While the possibility exists that constructed objects such as dams or development may have existence value, economic theory and empirical evidence to date (Lockwood, et al., 1994) suggests this is likely to be small. As noted above, scarcity and uniqueness are major determinants of the size of passive-use values. Dams and reservoirs are not scarce on rivers in the Pacific Northwest. Most of the value of development such as dams or barge transport comes from the market outputs created or the non-market recreation use values. Most public support for the dams can be traced to commodities produced or the recreation benefits provided by reservoir. These are being measured as part of the overall economic analysis and therefore are already reflected in the opportunity cost estimates. The other source of public support for projects is due to the local economic activity supported by the projects. While very important at the local level, the economic activity will be relocated elsewhere in the U.S. if the dams are removed. Thus from a benefit-cost standpoint, we cannot count jobs and local incomes that would be lost in the region as these will be gained in other regions of the U.S. Finally, if the concrete structure making up the dams is the source of existence value, it will still be present even with alternative #3. This is because, the COE plans to only remove the earthen part of the dam, not the concrete structure itself. If there truly is a non-use value for the dams, they will still be standing to provide that value even without the earthen embankment.

Empirical Measurement of Passive Use Values for Salmon

Three approaches were used to transfer benefits from the existing literature to estimate the change in existence value for salmon populations in the Lower Snake River. While none of them is perfect (which is why the original passive use value study was to be implemented), each provides an indication of the likely range of the passive use values for increasing salmon populations. All three of these approaches do a reasonable job of meeting the criteria for benefit transfer laid out by Boyle and Bergstrom. In particular, all studies measure the same resource, salmon. Three out of the four studies measure this value of salmon in the same state as the Lower Snake River (e.g., Washington). They all use the same valuation measure, e.g., willingness to pay.

We should note that to the extent these existing studies do not perfectly match the policy setting on the Lower Snake River, that the direction of error is in the conservative direction. That is, most of the other studies did not provide specific reference in the survey to the threatened or endangered species. The salmon in the Lower Snake River are listed as threatened and endangered. If the surveys were of threatened and endangered stocks and this was pointed out to survey respondents, the resulting values per fish would have likely been higher. Thus, the existing estimates are conservative measures of WTP to increase threatened and endangered stocks in the Lower Snake River. Second, most of the existing studies valued a larger increase than is being evaluated at the Lower Snake River. Given diminishing marginal existence values found in these studies and confirmed in other literature, the larger the increase in fish proposed the smaller the marginal value per fish. Thus taking a marginal value per fish from a study that valued a large increment and applying it to a smaller increment on the Lower Snake River, will also underestimate the value of that smaller increment.

Regression Approach

The first approach statistically estimates a willingness to pay function for salmon using incremental existence values per salmon calculated from four contingent valuation method studies of West Coast residents' WTP for increasing salmon populations. The four original studies are Olsen, et al., Hanemann, et al., Loomis, 1996b and Layton, et al., 1999. From these four studies we have five estimates of incremental value of an additional salmon (two estimates were obtained from Layton, et al). The regression has an explanatory power of 62% and the number of salmon is significant at the 1% level, even given the limited degrees of freedom. The procedures for estimating the function are reported in Loomis, 1999. Using the function the change in annual total passive use values with different levels of wild salmon and wild steelhead recovery is calculated for *non*-user households in the Pacific Northwest and California to avoid any double counting of passive use values and recreation use values. Data on run size of wild Chinook salmon and wild steelhead was obtained from PATH analyses provided by Shannon Davis (Radtke, Davis and Johnson, 1999). Application of this function to **wild** salmon and steelhead populations in alternative A1 is treated as the baseline or future without. The **change** in annual passive use values is then calculated for each of the three alternatives for an increase in wild salmon and steelhead populations.

The natural river drawdown alternative A3, is estimated by PATH to yield a 66% higher run of wild salmon and wild steelhead and produces a $879.3 million average annual increase in passive use values. Given the reduction in wild salmon and steelhead run sizes of A2a and A2b from the future without (A1), there is a slight reduction in passive use values for A-2a (loss of $9.538 million annually from baseline-A1) and but a fairly large loss with A-2b (loss of $97.366 million annually from baseline A1).

Value Per Fish Estimate Transfer From Elwha River

A second and more conservative approach to calculate the passive use value can be made by matching the change in anadromous fish populations in A3 to the one existing study which valued a similar size change in salmon (Loomis, 1996b) rather than using the statistical function estimated from all four studies. The value per household from Washington residents was used with 93% of this value for residents in the rest of the Pacific Northwest and California. As discussed in more detail below, the 93% value reflects the reduction in benefits of more distant residents as calculated in the Elwha survey. Applying the respective values per household to non-user households in the Pacific Northwest and California, yields a gain in passive use value of about $142 million per year gain (A1-A3). This is a reasonable and conservative benefit transfer five reasons. First, it is reasonable because the good being valued is salmon in both cases. Second, it is conservative because the Lower Snake River salmon are threatened and endangered while the salmon returning to the Elwha were not at the time the survey was written. Thus, while the definition of the public good is not exact, the direction of the error is once again to underestimate the passive use values for the Lower Snake River's threatened and endangered salmon. Third, the proposed action to increase salmon, is dam removal in both the original Elwha case study and the Snake River policy case. Fourth, the rivers are both in Washington and Washington households will be affected in both cases. Finally, the change in number of salmon with the Elwha (around 300,000) is the closest match of the change in salmon likely to result from dam removal on the Lower Snake River. While the change in salmon on the Elwha River is about 2-3 times that expected on the Lower Snake River, this further reinforces the conservative nature of the passive use value per fish calculated from the Elwha due to diminishing marginal existence values.

Transfer of Layton, Brown and Plummer Columbia River Estimates

The third approach uses just the most recent stated preference discrete choice survey of Washington residents undertaken by Layton, Brown and Plummer (1999) to estimate the passive use value of increasing salmon on the Lower Snake River. Their stated preference survey asked Washington residents to rate four different scenarios which involved five different stocks of fish species. These species included the species of relevance for the Snake River (Eastern Washington and Columbia River migratory fish) as well as freshwater species and Western Washington/Puget Sound freshwater, migratory and saltwater. This study was specifically designed to allow valuation of a wide variety of fish improvement scenarios in the state of Washington, similar to its application here to the Lower Snake River.

Half the respondents received a survey that set a nondeclining future fish population as the baseline future without and half received a baseline future without that involved further declines if nothing is done. Given the diminishing marginal value of incremental gains in fish the stable or non-declining baseline results in lower values per fish than the declining baseline. Layton, et al., found their estimated values per household were consistent with past passive use value studies of Loomis, 1996 and Olsen, et al. (1991) using the non-declining future baseline. While the PATH salmon numbers assume a non-declining future, other biologists using past trend data suggest continued future declines (Weber, 1999).

The survey by Layton, et al., was conducted by mail and had a response rate of 68%, which is quite good. The survey design included a budget reminder exercise which involved households having to determine how their household spending would change with a reduction in monthly income that was equal to the dollar amounts the households were asked to pay for the four different fish programs. Layton, et al., analyzed their data using a censored rank order logit model.

From the results of their statistical analysis a value per household for a 1 million increase in Eastern Washington/Columbia river migratory fish (e.g., salmon and steelhead) was computed by the authors. This represents a 50% increase in fish population, comparable to the relative change from A1 to A3. The resulting value is $119 per household annually for each additional 1 million salmon and steelhead. This is a larger absolute increment than A1 to A3, and will result in a very conservative estimate of the passive use values per fish.

To adapt this Washington household value to what households in the rest of the Pacific Northwest and California would pay, we make a downward adjustment based on a past survey (Loomis, 1996a) which compared Washington residents willingness to pay for salmon on the Elwha River to what households in the rest of the U.S. would pay for the same increase in salmon on the Elwha River. Specifically, Washington household WTP was $73 annually while rest of U.S. households would pay $68 annually (Loomis, 1996a:445). Dividing the $68 by $73 yields a downward adjustment ratio of .93

meaning households outside of Washington would pay 93% of what a Washington household would pay. This .93 is an average adjustment and actually overstates the downward adjustment since the rest of U.S. households included those in the eastern U.S. where the ratio was .75. See Loomis (1999b) for a graph of the distance-WTP function for salmon. Next, we multiply the downward adjusted value per household by the number of non-angler (e.g., non-user) households in Oregon, Idaho, western Montana and California. Given the public good nature of restoring salmon in the Snake River, the value per household in our study area is the sum of non-angler households in Oregon, Idaho, western Montana, Washington and California. This is quite conservative as it assumes that users receive no passive use values, a unlikely situation.

The value per fish is then applied to number of wild salmon and steelhead that would return with each EIS alternative to estimate the passive use values associated with each alternative. Using the Layton, et al. first scenario of an assumed stable future salmon population baseline, the gain from A1 to A3 is $66.46 million annually. Repeating these same procedures for the Layton, et al., using their declining salmon future baseline populations values yields a value of $508 million, similar in magnitude to the regression estimate of $879 million.

These aggregate values are conservative estimates as it assumes no passive use value for households in the rest of the U.S. outside of the study area, despite evidence from past surveys that such households do receive passive use values from salmon recovery and dam removal in the Pacific Northwest (Loomis, 1996a,b).

The results of these calculations are displayed in Table 1

TABLE 1					
Passive Use Value Analysis for Salmon					
Change in Annual Passive Use Values from A1 (millions)					
Alternative	Avg. Annual	Adapting Layton, et al.,		Regression	Adapting
	Wild Return			Based	Elwha
		Stable Baseline	Declining Baseline		
A1	71110				
A2a	70682	-$.60	-$4.58	-$9.54	-$1.28
A2b	69641	-$2.06	-$15.7	-$97.36	-$4.41
A3	118571	$66.47	$508.4	$879.34	$142.3

PASSIVE USE VALUE OF RETURNING THE LOWER SNAKE TO A FREE FLOWING RIVER

Besides the existence and bequest values of the salmon themselves, is the existence value of having the Lower Snake River as a free-flowing river once again. This is the value of restoring the canyon back to its natural condition. Like the estimating the passive-use value of salmon, we were asked by the Corps of Engineers to make a rough estimate of this value using existing studies.

A mail survey of WTP to preserve free-flowing rivers was performed by Sanders, Walsh, and Loomis (1990) of Colorado households statewide. The mail survey had a 51% response rate of deliverable surveys. The annual WTP per household for option, existence and bequest value was $77 in 1983 dollars or $116 in 1996 dollars. Dividing this by the 555 miles being valued yields a value of 21 cents per mile. Multiplying this by the 140 miles of the Lower Snake River yields a value per household of $29.40 per year per household. The rivers included in this list are all within Colorado and include the Yampa, Dolores and Green River.

Another study was a contingent valuation method estimate of preserving the Black Canyon of the Upper Snake River from development. This study was performed by Scott and Wandschneider (1993). The University of Idaho conducted telephone interviews of residents of the four counties in Southeastern Idaho surrounding this section of the river. The study was conducted for the Bureau of Land Management. The survey had a response rate of 76% and a sample size of nearly 350.

The survey identified that slightly more than half of the sample were non-users (n=196) and they had an annual WTP of $58 for preservation of the Upper Snake River (as compared to users who had a WTP of $92). Dividing this value by the 63 miles protected yields a value of 92 cents per mile per household. This value is naturally higher since only individuals living in counties adjacent to the river were sampled. This value per household per mile is applied to the counties surrounding the Lower Snake River. Thus a value of 92 cents times 140 miles or $129 would be multiplied by non-use households in the counties surrounding the Lower Snake River. Using data from Loomis (1999) we subtract out the number of non-angling households that would visit the Lower Snake River from the total non-angling households. This yields 305,467 non-angling, non-user households. Therefore $129 per household times 305,467 households yields our estimate of $39.4 million in passive-use value for restoring a free-flowing Lower Snake River. We use the Sanders, et al., value of $29.40 for the rest of non-user households in Washington, Oregon, Idaho, Montana and California. Using data from Loomis (1999) we estimate 12.95 million non-angling, non-user households. Multiplying by Sanders, et al. value of $29.40 per household yields an estimated non-use value for restoring the Lower Snake River of $380.73 million. Thus aggregate passive use value for just the restoration of the free-flowing nature of the Lower Snake River is the sum of the two region's value, or $420.13 million.

CONCLUSION

It is clear that passive use or existence value is a relevant value for decision making involving threatened and endangered salmon at risk in the Lower Snake River. Passive use or existence values have been measured by other Federal agencies for use in benefit-cost analysis. The challenge in this study was to approximate these values based on the existing literature. Four studies, three of which valued salmon in the Pacific Northwest, were applied in different ways to estimate the passive use values of increases in salmon populations in the Lower Snake River.

The incremental passive use values for the increase in anadromous fish due to the dam breaching is ranges from a high of $879 million for households in the Pacific Northwest and California to a low of $66 million with a middle range between $142 and $508 million.

Also based on the existing literature there appears to be a passive use value of $420 million annually for returning the Lower Snake River to a free-flowing condition, independent of any effect on salmon populations.

REFERENCES

Aillery, et al., Salmon Recovery in the Pacific Northwest: Agricultural and Other Economic Effects. Report #727. USDA Economic Research Service, Washington DC.

Arrow, K., R. Solow, P. Portney, E. Leamer, R. Radner and H. Schuman. 1993. Report of the NOAA Panel on Contingent Valuation. Federal Register 58(10):4602-4614.

Boyle, K. and J. Bergstrom. Benefit Transfer Studies: Myth, Pragmatism and Idealism. Water Resources Research, 28(3):

Champ, P., R. Bishop, T. Brown and D. McCollum. 1997. Using Donation Mechanisms to Value Nonuse Benefits from Public Goods. Journal of Environmental Economics and Management 33(2):151-162.

Diamond, P. and J. Hausman. 1994. Contingent Valuation: Is Some Number Better than No Number? Journal of Economic Perspectives 8:45-64.

Krutilla, John and Anthony Fisher. 1975. The Economics of Natural Environments. Resources for the Future, Johns Hopkins University Press. Washington DC.

Hanemann, Michael, John Loomis and Barbara Kanninen. 1991. Statistical Efficiency of Double Bounded Dichotomous Choice Contingent Valuation. *American Journal of Agricultural Economics*, Volume 73(4): 1255-1263.

Layton, David, Gardner Brown and Mark Plummer. 1999. Valuing Multiple Programs to Improve Fish Populations. Dept. of Environmental Science and Policy, University of California, Davis, CA.

Lockwood, Michael, J. Loomis and Terry deLacy. 1994. The Relative Unimportance of a Non-Market Willingness to Pay for Timber Harvesting. Ecological Economics 9:145-152.

Loomis, J. 1993. "An Investigation into the Reliability of Intended Visitation Behavior." Environmental and Resource Economics. 3:183-91.

Loomis, John. 1996a. Measuring the Economic Benefits of Removing Dams and Restoring the Elwha River: Results of a Contingent Valuation Survey. *Water Resources Research,* 32(2):441-447.

Loomis, John. 1996b. How Large is the Extent of the Market for Public Goods: Evidence from a Nationwide Contingent Valuation Survey. Applied Economics 28:779-782.

Loomis, John. 1999. Recreation and Passive Use Values from Removing the Dams on the Lower Snake River to Increase Salmon. Report from AEI to U.S. Army Corps of Engineers, Walla Walla, WA.

Loomis, John and Richard Walsh. 1997. Recreation Economic Decisions: Comparing Benefits and Costs. 2nd. Edition. Venture Publishing, State College, PA.

McFadden, D. 1994. Contingent Valuation and Social Choice. American Journal of Agricultural Economics 76(4): 689-708.

Meyer, Phillip. 1974. Recreation and Preservation Values Associated With Salmon of the Frasier River. Environment Canada. PAC/IN-74-1, Vancouver, Canada.

Olsen, Darryll, Jack Richards and R.Douglas Scott. 1991. Existence and Sport Values for Doubling the Size of Columbia River Basin Salmon and Steelhead Runs. Rivers 2(1):44-56.

Pate, Jennifer and John Loomis. 1997. The Effect of Distance on Willingness to Pay Values: A Case Study of Wetlands and Salmon in California. Ecological Economics 20:199-207.

Radtke, Hans, Shannon Davis and Rebecca Johnson. 1999. Anadromous Fish Economic Analysis. Lower Snake River Juvenile Salmon Migration Feasibility Study EIS.

Randall, Alan and John Stoll. 1983. "Existence and Sport Values 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.

Sanders, L., R. Walsh and J. Loomis. 1990. Toward Empirical Estimation of the Toal Value of Protecting Rivers. Water Resources Research 26(7):1345-1357.

Scott, R.D. and P. Wandschneider. 1993. A Hedonic Model of Preservation Value Components: A Contingent Valuation Study of the Black Canyon of the Upper Snake River. in Proceedings of the Twenty-Seventh Annual Pacific Northwest Regional Economic Conference. Kennewick, WA.

Sassone, Peter and William Schaeffer. 1978. Cost-Benefit Analysis: A Handbook. Academic Press, San Diego, CA.

Stoll, John and Lee Ann Johnson. 1984. Concepts of Value, Nonmarket Valuation and the Case of the Whooping Crane. Transactions of the 49th North American Wildlife and Natural Resources Conference, Wildlife Management Institute. Washington DC.

U.S. Water Resources. 1979. Procedures for Evaluation of National Economic Development (NED): Benefits and Costs of Water Resources Planning (Level C) Final Rule. Federal Register 44(242): 72892-977.

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, 1983.

Weber, Earl. 1999. Stock Stability. Email from Earl Weber CRITFC Biologist to Phil Meyer. June 28, 1999.