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BASELINE RECREATION VALUE

OF THE UPPER CLARK FORK RIVER BASIN

Report for Montana Department of Fish, Wildlife and Parks

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I. INTRODUCTION

This paper provides a summary of baseline values for river-related recreation in the upper Clark Fork River basin of Montana. Baseline recreational values are values associated with the current or baseline circumstances including human population and participation levels.

The following section provides an introductory discussion of the economics of fish and wildlife resources. This section is used to define basic concepts and terms used in economic valuation and to describe the characteristics of recreation, particularly fishing, as an economic activity. The third section provides a literature review and discussion of the specific methods used for placing values on recreational activity. The fourth section describes the baseline recreation value estimate for the upper Clark Fork basin. Sections five and six discuss the validity and precision of those estimates as well as future research needs. Two statistical appendices document the baseline value estimates in greater detail.

II. ECONOMIC VALUES FOR SPORT FISHERIES

As described in greater detail below, a good share of the value associated with recreational use of the upper Clark Fork River and its tributaries derives from fishing. Because it may not be obvious that fishing can be economically important, the following discussion outlines how fishing compares to other types of economic activities and how the economic significance of fishing is measured.

There are basically three different types of fishing activity: commercial, subsistence and sport fishing. All three of these types of fishing are economic activities in that they utilize scarce resources and, therefore, entail costs of time and materials. In some areas, such as Southeast Alaska, all three types of activity are economically important, but in the Clark Fork Basin sport fishing is the dominant type. Commercial fishing obviously parallels other commercial activities in that a product is produced (in this case, by being caught and transported) and sold in a market. In subsistence fisheries, the fish product is an important food source, but is generally not sold. In a sport fishery the fish kept may or may not be an important outcome of the activity, but the experience itself is always an important outcome.

Expenditures and the Regional Economy

All three types of fishing are similar in that they entail costs. These include equipment, transportation and labor time. Sport fishing differs in that, except for guide services, labor is the individual angler's uncompensated time. Like any economic activity, fishing has a positive economic impact on the regional economy through the costs or expenditures associated with the activity. These can be large for all types of fishing. In Montana, the total expenditures associated with stream and lake fishing were on the order of $100 million in 1985 (Duffield, Loomis and Brooks 1987). These expenditures, particularly those by nonresident anglers, contribute to the the local and regional economy in the same way as other natural resource based activities such as farming and ranching.

The primary natural resource input for the fishery is, of course, the surface water streamflow. In Montana, the major alternative use of this streamflow is irrigation, which accounts for 96 percent of consumptive water use (Gibbons 1986). Note that the latter estimate is on the basis of water consumed and is corrected for return flows. The Montana Department of Natural Resources and Conservation (1986) reports the same estimate for the irrigation share of water consumed and also notes that the irrigation use share of water withdrawals is 98 percent. It is interesting to roughly compare river-related recreation expenditures in the Upper Clark Fork basin to cash sales for agriculture. In 1985, stream angler expenditures associated with use of the major Clark Fork Basin streams including the upper Clark Fork, Rock Creek, Bitterroot and Blackfoot were about $9 million (derived from Duffield, Loomis and Brooks 1987). Since fishing is approximately half of all river-related recreational use on these streams, expenditures for all river-related recreation is probably no higher than $18 million.

For comparison, cash revenue from the sale of crops in Granite, Powell, Deer Lodge and Ravalli counties was $6.7 million in 1985 and livestock sales were $45 million (Montana Agricultural Statistics Service 1988). Only part of these agricultural sales are due to irrigation.

Another way to examine the economic importance of irrigation is to estimate the value of this use of surface water from the standpoint of the irrigator. As noted by Johnson and Schmidt (1988), the value of irrigation to a given operation depends on many site-specific factors and is estimated to range between $5 to $60 per acre-foot (Frank et al. 1984). Given the number of irrigated acres in the upper Clark Fork, Flint Creek-Rock Creek, Blackfoot and Bitterroot subbasins (about 230,000), Johnson and Schmidt suggest that the value of irrigation in these areas is between $2 and $28 million. These figures generally suggest that the recreational use of surface waters in the upper Clark Fork basin may be of the same order of importance to the regional economy as irrigated agriculture.

Profits and Net Economic Benefits

The preceding discussion describes the economic significance of recreation from the standpoint of impact on the local economy. Another perspective is to examine the net contribution of the activity to national economic well-being. This is the approach taken in benefit-cost analyses. These procedures are required for the evaluation of some federal and state programs, for example, as described in federal guidelines for the evaluation of water development projects (U.S. Water Resources Council 1983). The basic idea is that economic activities should be compared based on their net benefits to society.

Net benefits are benefits less costs. For a commercial activity like ranching, the net benefits are well-approximated by sales revenue less costs. This difference is, of course, net income or profit. Sales revenue for products sold in more or less competitive markets provides a good measure of the value society places on the product. The market price for these types of products reflects the willingness of consumers to pay for the product and, therefore, the value to society in our market economy.

Sport fishing differs from commercial fishing and other commercial activities in that the product, in this case the recreational experience, cannot be sold or transferred but is enjoyed by the individual angler. In this case, the value of the experience is measured by how much the angler is willing to pay for the experience. Some insight into the value of the activity to the angler is provided by situations where there are markets for access to the fishery. Most trout streams in Montana have open public access, but there are a few fee fisheries. For example, anglers pay $40 per day in summer and $20 per day in winter for access to Nelson Spring Creek near Livingston. The current fee on the Red Rock River near Dillon is $45 per day.

In other countries, such as Norway and Scotland, most fishing access is obtained through organized markets. From personal experience, the author is aware that fees in Norway in the early 1980s for access to Atlantic salmon streams ranged from about $15 per day to around $200 per day, depending on the quality of the fishery. Some of the better streams on the west coast of Norway were not accessible at any price because of long-term leases, often held by French or German anglers. If this type of market system for fisheries existed in Montana, one would probably observe a similar wide range of prices with some of the more productive waters like the Madison, Rock Creek and the Bighorn commanding very high fees.

Market prices do not exist for fishing access to the major streams in the upper Clark Fork basin. Even if these prices did exist, one would have to be cautious in using them to estimate total fishing benefits. This is because the market for fishing rights would not be what one would call "perfectly competitive".

Perfectly competitive markets are ones where there is a homogeneous commodity and there are a large number of producers in the market. An example is the market for hard red winter wheat; it doesn't matter whether the wheat comes from Montana or Kansas (aside from protein content) and there are many substitutes for any given farmer's production. In these cases, the market price provides a good approximation of the value or benefit of the product.

Fishing sites are not homogeneous but differ in terms of many characteristics such as access, success rates, scenic beauty and solitude, all of which have been shown to be important to anglers (Allen 1988). Additionally, spatial location is an important feature for outdoor recreation. Because of this, other sites are only imperfect substitutes; there is only one Madison River and one Bitterroot River. There are also differences among anglers in terms of the type of experience they want and the value they place on any given experience (Duffield and Allen 1988; Hobson 1979). Because of these features, the benefits associated with activities like sport fishing are best measured by the average willingness of anglers to pay for the experience of using a given site.

The question remains as to how the individual angler's willingness to pay is measured when market transactions are unavailable. An approach to this problem, so-called nonmarket valuation, is described in the following section.

To summarize the discussion to this point, sport fishing is clearly an economic activity. The economic significance of a given activity can be measured either through regional economic impact analysis or through benefit-cost analysis. The remainder of this paper is concerned with measuring net benefits rather than expenditures. Only the net benefit perspective can answer questions as to whether a given change will, on net, make society as a whole better or worse off economically.

III. METHODS FOR ESTIMATING RECREATIONAL VALUES

There are two primary methods for estimating the economic value of outdoor recreation: the travel cost method (TCM) and the contingent valuation method (CVM).

In the TCM approach, surveys are undertaken of visitors to a given recreational site. One uses observations of trip distance and costs as a measure of price, and observed trips per capita from a given zone of origin (such as a county) taken as a measure of quantity, to statistically identify how visits vary as a function of costs. For example, one might look at how many trips are taken to the Clark Fork from various origins such as Missoula, Butte, and Helena. Based on the assumption that recreationists would react to a site fee in the same way as the observed response to higher travel costs, the analyst can estimate the additional amount recreationists would pay for use of the site over and above their actual travel costs.

In the CVM approach, individuals are directly surveyed as to their willingness to pay for the services of a given resource based on their acceptance of a hypothetical market situation. For example, visitors to the Clark Fork might be asked to suppose that they might have to drive an additional distance or pay additional travel costs to continue to use the site. Under this hypothetical situation, they are asked how much they might be willing to pay before choosing not to visit the site.

Note that both of these methods directly provide net benefit estimates that are comparable to profits or net income for a commercial activity like a farm or a gas station or a guide service. This is because both methods establish the individual's willingness to pay for the experience over and above the actual costs incurred.

There is considerable evidence that these are accepted procedures for valuing recreation. Federal benefit-cost guidelines require the use of these procedures in the evaluation of water development projects. Specifically, TCM and CVM are endorsed by the U.S. Water Resources Council for site-specific estimates of recreation values, as noted in the current standards. More recently, TCM and CVM have been designated as among the "best available procedures" for estimating natural resource damages under the Comprehensive Environmental Response, Compensation and Liability Act of 1980 (CERCLA). This is detailed in the Department of Interior regulations for evaluating damages in "superfund" cases. The latter were issued in August, 1986.

These methods have also been endorsed by some courts. As a recent example, industry petitioners challenged Interior's endorsement of contingent valuation as a best available procedure in CERCLA-related natural resource damage assessments. The D.C. Court of Appeals emphatically rejected this challenge in its ruling issued July 14, 1989 (Ohio v. United States Dep't Interior, 880 F.2d 432 (D.C. Cir. 1989)).

It should also be noted that these methods have been widely used and that there has been increased application of the methods in recent years. The U.S. Forest Service has commissioned reviews of the outdoor recreation valuation literature every five years as part of its resource planning process as required by the Resource Planning Act (RPA). The number of studies identified in these RPA reviews provides a good index to the work being done on outdoor recreation valuation. In 1978, only 15 completed studies were identified; by 1982 there were 36, and in the most recent review in 1988 a total of 120 were identified (Table 1).

Research specifically related to the value of recreational fishing shows the same trend. The U.S. Forest Service category of fishing relevant to Montana trout streams is "cold water fishing". There were only 5 specific estimates of values for this activity identified in 1978, but 40 by 1988 (Table 1). Similarly, there were no estimates identified for either fishing or big game hunting in the Forest Service Region 1 (primarily Northern Idaho, Montana and North Dakota) in 1978 or 1982, but by 1988 there were 10 such estimates (Table 1).

Based on this literature review, the best way to estimate recreational values in the Clark Fork basin is by using the travel cost method or the contingent valuation method. Both procedures are endorsed by federal benefit-cost guidelines and have been widely applied.

IV. BASELINE RECREATIONAL VALUES

Overview of Previous Research

Both contingent valuation and travel cost methods have been applied in the Clark Fork basin. From these efforts there are two different data bases available for the analysis of recreation values in the basin. The first was developed by Carol Hagmann in a master's thesis project at the University of Montana (Hagmann 1979). Duffield (1981) used this data base to develop travel cost model estimates of the value of recreation in the Clark Fork Basin (Table 2). The second data base is from the Montana Bioeconomics Project, which was an extensive series of TCM and CVM estimates of statewide hunting and fishing values undertaken by Montana DFWP in 1985-1988. This data base complements a longer series of statewide angler and hunter use (or "pressure") estimates also developed by Montana DFWP.

Three different estimates of baseline values for the Clark Fork basin are summarized in Table 2. The first estimate is based on Hagmann's data base. The second estimate was developed in the Montana Bioeconomics project statewide angler travel cost study (Duffield, Loomis and Brooks 1987). The third estimate was derived for purposes of this paper using the Montana Bioeconomics project data base but with revised estimates of the travel cost models. Travel cost models were reestimated because there have been advances in methodology since the Montana Bioeconomics project was initiated in 1985. In particular, there are now methods available for computing the precision of nonmarket valuation estimates. Secondly, the estimate in Duffield, Loomis and Brooks (1987) is limited to values for angler use and provides no estimate of the value associated with other river-related recreation activity. Finally, none of the earlier materials compares use estimates across the two data bases.

Note that the contingent valuation method was used during the

Table 1. Nonmarket Valuation Studies of Outdoor Recreation Available for Forest Service Resource Planning Act Reviews, by Year.

	Year		
	1978[1]	1982[2]	1988[3]
A. Total Recreation Studies			
United States	15	36	120
B. Number of Valuation Estimates for Specific Recreation Activities - United States			
Big Game Hunting	7	15	56
Cold Water Fishing	5	15	40
Total all Activities	34	95	287
C. Number of Valuation Estimates for U.S. Forest Service Region 1 (Primarily Northern Idaho, Montana,and North Dakota)			
Big Game Hunting and Trout Fishing	0	0	10

1. Review by Dwyer, estimating recreational values for the 1980 RPA program (unpublished paper presented at RPA workshop on resource values, Washington, D.C., 1978)

2. Loomis and Sorg, A Critical Summary of Empirical Estimation of the Values of Wildlife, Wilderness and General Recreation Related to National Forest Regions (1982). (Unpublished Rocky Mountain Station Report). C. Sorg and J. Loomis, Empirical Estimates of Amenity Forest Values: A Comparative Review, U.S.D.A., Forest Service General Technical Report. RM-107 (1984).

3. R. Walsh, D. Johnson and J. Mckean, Review of Outdoor Recreation Economic Development Studies with Nonmarket Benefit Estimates. (Dec. 1988 (Colorado Water Resources Research Institute Technical Report No. 54, Colorado State University, Fort Collins).

Table 2. Comparison of Previous Baseline Values for Upper Clark Fork.

Study/Users	Original Est.[1] (000 dollars)	1990[2] Dollars (000 dollars)
(1) Duffield, 1981 / All Recreational Users (1979 dollars)	202 - 310	373 - 571
(2) Duffield, Loomis and Brooks / Anglers (1985 dollars)	1499 - 3212	1861 - 3987
(3) Current Estimate / All Recreational Users (1985 dollars)	3371	4185

[1] These are the original estimates based on price levels that held at the time the data was collected for the given study.

[2] Consumer Price Index for late 1990 = 400.7, for mid-1985 = 322.8, and mid-1979 = 217.4.

Montana Bioeconomics project (Duffield and Allen 1988) and provided estimates of values for some of the major streams in Western Montana (Rock Creek, Blackfoot and Bitterroot). Unfortunately, the contingent valuation survey did not achieve a sufficiently large sample of users of the upper Clark Fork River to provide a value estimate from this method. Accordingly, the remainder of this section is focused on the travel cost model results. The contingent valuation results will be discussed below (Part V. and Appendix B) for the streams where both methods could be applied. Comparison of findings from both methods is one way of examining the validity of the estimates.

The best current estimate of the baseline recreational value for the streams in the upper Clark Fork basin, in 1990 dollars, is $4.2 million (Table 2). This is for the mainstem Clark Fork River above the confluence with the Bitterroot and for tributaries to this mainstem, but excluding Rock Creek and the Blackfoot River.

The remainder of this section provides a discussion of how the current estimate was derived. A technical discussion in Appendix A provides a comparison of the three different estimates summarized in Table 2.

The current estimate was derived in two steps. First a value per day was developed for the two major types of river-related recreational use in the basin: fishing and general shoreline use. Secondly, a best estimate of total days of recreational use for each activity was developed. The estimate of value per day and total days are multiplied together to get total baseline value.

Value per Day for Anglers

Recreational value per day was estimated from a regional travel cost model using the Montana Bioeconomics Project data base on angler use in Montana for 1985. The specification of this model (estimated parameters and key variables) is provided in Table 3. In the development of this model, survey responses were screened so that only trips for the primary purpose of visiting the given site to fish were included in the data base.

The model provides a good fit to the data in that it explains approximately 80 percent of the variation in the dependent variable (trips per capita) across 45 specific river sites in Montana. All estimated parameters are highly significant in the sense that there is only a very low probability that their true value is zero. The signs (negative or positive) of the estimated parameters are also consistent with economic theory. The travel cost variable, which is like a price in this model, is negatively correlated with per capita trips (and is very precisely estimated). The sign on the substitute variable is also as one would expect. There is a positive correlation between visitation and measures of the number of fish caught. Based on the

Table 3. Estimated Travel Cost Model[1] for Montana Streams.

Variable[2]	Parameter Estimate	T-Statistic
Intercept	-2.5853	-2.854
LTC	-2.2724	-50.226
LSVSTRTX	-.0301	-3.145
LSUMTRT	.2671	3.997
LTRPFISH	-.5621	-5.242
LSWRMFSX	.0832	1.947
LTPSCOOL	.7352	2.009

1 Regional zonal travel cost model for 45 specific rivers or tributaries. Dependent variable is trips per capita from origin i to destination j. Total sample size is 741 origin-destination pairs. Adjusted R-square is .7988 and F Statistic is 491.21 (Prob.=.0001).

2 Variable definitions: LTC = Natural log of estimated travel cost, LSVSTRTX = Natural log of substitute variable based on the sum of trout at alternative sites, LSUMTRT = Natural log of the sum of trout at a site, LTRPFISH = Natural log of average years of fishing, LSWRMFSX = Natural log of the sum of all sportfish for a site, LTPSCOOL = Natural log of average education.

statistical results, this model compares favorably with other travel cost models reported in the economics literature.

Standard procedures were used to estimate average willingness to pay from the travel cost model described in Table 3 (see for example the technical discussion in Duffield, Loomis and Brooks 1987). There are two important methodological choices in estimating net willingness to pay. One choice is the spatial extent of the market for use of the given site. In other words, from how far away do visitors take trips to specifically visit the given site to fish. In order to examine the sensitivity to this choice, two alternative approaches were used. The first was to use the maximum observed distance from the data set as being representative. The second approach was the more conservative one that corresponds to the upper limit of willingness to pay from the companion contingent valuation study. The latter placed the furthest distance that individuals would visit Montana fishing sites at about 900 miles distance which corresponds to a round trip travel cost of $500.

The other important choice is the value per mile of the cost of travel to the site. Like many travel cost data bases, the observed price index is round trip distance. It was necessary to estimate the travel cost per mile from a phone survey undertaken in 1985 as part of the Montana Bioeconomics Project (Duffield, Loomis and Brooks 1987). The cost per mile used here is based on actual reported trip expenses, which averaged about 27 cents per mile, including the time cost of travel. The alternative is to set the cost per mile based on federally estimated costs of driving a new passenger car and time costs of travel or about 13 cents per mile. These costs badly underestimate the true costs of recreational travel, in part because not everyone has a new efficient car and because many vehicles are four-wheel drive. Additionally, federally estimated costs do not include the variable costs of lodging and food that are part of longer trips. A detailed discussion of this issue is provided in Appendix B of Duffield, Loomis and Brooks (1987).

Site specific estimates of the value per trip for waters in the upper Clark Fork basin are provided in Table 4 for both assumptions on the spatial extent of the market and for reported travel costs. For example, at the maximum observed distance, the value per trip for a visit to the upper Clark Fork mainstem or tributaries is about $55/trip. At the $500 maximum travel cost, the Clark Fork values are around $45 per trip. A basic finding is that other streams in the basin are more valuable than the Clark Fork mainstem and tributaries. For example at a $500 maximum travel cost, trips to the Blackfoot are valued at $78/trip and visits to Rock Creek at $134/trip. Based on the average number of days per trip, values per day can be derived from the value per trip as in Table 5.

Table 4. Summary of Estimated Net Economic Value Per Trip for Clark Fork Basin Waters. Travel Cost Model Current Trip Means and Standard Errors.

River	TCM (MAX)[1]	TCM (500)[2]
Upper Clark Fork Tributaries	51.69 (4.69)	43.74 (3.49)
Upper Clark Fork[3]	55.38 (5.95)	44.69 (4.23)
Middle Clark Fork[4]	64.10 (6.36)	52.96 (4.68)
Bitterroot	75.37 (10.63)	55.11 (6.88)
Blackfoot	103.74 (9.54)	78.72 (6.28)
Rock Creek	197.09 (22.35)	134.15 (12.34)

1 TCM (MAX) is the current trip mean value calculated with a spatial extent of the market equal to the maximum observed distance traveled to a river and based on the predicted intercept.

2 TCM (500) is the current trip mean value calculated with a spatial extent of the market equal to travel costs of $500 dollars (or a one-way distance of about 900 miles).

3 Mainstem from Bitterroot River to Warm Springs Creek.

4 Mainstem from Paradise to Bitterroot River.

Table 5. Clark Fork Basin Value of a Recreation Day for Anglers.

River	Value Per Trip[1]	Days Per Trip[2]	Value Per Day
Upper Clark Fork Tributaries	43.74	1.00	43.74
Upper Clark Fork	44.69	1.01	44.25
Middle Clark Fork	52.96	1.05	50.44
Bitterroot	55.11	1.05	52.49
Blackfoot	78.72	1.01	77.94
Rock Creek	134.15	1.30	103.19

1 Based on Travel Cost Model estimates with spatial extent of the market corresponding to $500 travel cost as in Table 4.

2 From Duffield, Loomis and Brooks, The Net Economic Value of Fishing in Montana (1987).

The estimated values in Table 5 are somewhat lower for every site than the corresponding estimates provided in Duffield, Loomis and Brooks (1987). For example, the value per trip to the upper Clark Fork River in the latter study is $52 compared to $45 in Table 5. The current model is an improvement over the one used in the 1987 study in that it includes a substitute variable. This tends to make the estimated response to higher travel costs more "elastic", which is to say use drops off faster at higher price increments. This also results in lower average values. The current model also uses estimated travel cost rather than observed travel distance as the "price" variable which results in a better fit to the data.

Recreational Use Estimates

Table 6 provides a summary of angler total days of use per year as estimated by Montana DFWP (McFarland 1989) including average use for years 1982-1986 and also use for the most recent year available (1985-86). Table 6 also shows estimated angler and shoreline use estimated by Carol Hagmann for 1978-79. Neither source provides a total use estimate for the basin. DFWP does not sample shoreline users who are not anglers (which Hagmann does), and Hagmann did not sample on all tributaries. Additionally, Hagmann measures visits while DFWP uses days. Given that angler trips to the upper Clark Fork average 1.00 to 1.01 days long, these two measures are approximately the same at these sites.

In comparing the two use estimates, one finds remarkable consistency. For example, looking at the tributaries which Hagmann did sample (Warm Springs Creek, Little Blackfoot River and Flint Creek), Hagmann's estimate is for 13,454 angler visits while the DFWP average for 1982-1986 is 14,798 angler days. Similarly, Hagmann estimated 18,945 angler visits for the mainstem Clark Fork, while DFWP's average days is 17,690. These estimates are almost certainly not significantly different. In other words, any difference may be due to unavoidable statistical error arising from the sampling procedure.

Given that there are no substantial differences between Hagmann's 1979 angler use estimates and the 1985-86 DFWP estimates, there does not appear to be any trend in recreational use of the Clark Fork. Probably much larger sample sizes than those used in either study would be needed to determine if a trend exists and its magnitude. It appears that recreational use is fairly stable for the years observed.

Given that there is good agreement between Hagmann's and DFWP's angler use estimates, DFWP's estimates for 1985-86 were used for the baseline estimate because they are the most recent and because they include several tributaries that Hagmann did not study. Total angler use in the upper basin is estimated by DFWP to be 43,211 angler days. Hagmann found that angler use was 46

Table 6. Estimated River-Related Recreational Use in Upper Clark Fork Basin.

River	Montana DFWP (Days)[1] 1985-1986	Montana DFWP (Days)[1] 1982-1986 ave.	Hagmann 1978-1979[2] (visits)
A. Tributaries Excluding Rock Creek and Blackfoot River			
Warm Springs Crk., Little Blackfoot and Flint Creek			
-Anglers	15,955	14,708	13,454[5]
-Shoreline Use	--	--	15,793[5]
Subtotal	--	--	29,247
Other Upper Basin Tributaries			
-Angler Use	9,678	10,384	--
Subtotal[3]			
-Angler Use	25,633	25,092	
-Shoreline Use	[30,091][8]	--	
Subtotal	[55,724]	--	
B. Mainstem Clark Fork River			
-Angler Use	17,578	17,690	18,945[5]
-Shoreline Use	[20,635][8]	--	22,240
Subtotal	[38,213]	--	41,185
C. Total Use in Upper Basin			
-Angler Use	43,211		32,619
-Shoreline Use	[50,726][8]		37,813
Total	[93,937]		70,432[7]

1 McFarland (1989) and Montana DNRC, Final EIS for Water Reservation Applications, The Upper Clark Fork Basin (Jan. 1991).
2 Carol Hagmann, 1979, p.59.
3 All tributaries above Milltown except the Blackfoot & Rock Cr.
4 McFarland (1989)
5 Activity share of 46 percent anglers reported by Hagman, p.64.
6 Bitterroot River to Warm Springs Creek.
7 Excludes 32,199 private campground visits.
8 Derived based on Hagman's 46% angler share of total use.

percent of total use in her study (Table 7). If this ratio is assumed to hold for the entire basin, then given angler use of 43,211 days, this implies shoreline use of 50,726 days. Adding together the angler and shoreline estimates yields a total of 93,937 days of river-related recreational use in the upper Clark Fork basin.

This estimate may be conservative in that other recreational use in the basin may be tied to the presence of the river. Hagmann also reports a total of 32,199 private campground visits in her sample. It is possible that one motive for these visits is the presence of the river and riparian environment.

Value per Day for Shoreline Visitors

In order to estimate the value per day for general shoreline use, the recreational values for fishing and the values for shoreline types of use were reviewed in the economics literature. Specifically, the most recent of the Forest Service-commissioned reviews of outdoor recreation values found that, on average, a day of shoreline use was valued at about two-thirds the average value of a day of cold water fishing (Walsh, Johnson and McKean 1988). Given the Table 5 estimate for a day of fishing in the basin at about $45 dollars per day, a day of shoreline recreation is assumed to have two-thirds as much value or about $29.

Baseline Recreational Value

Based on total use from Table 6 and value per day from Table 5, a total annual value for river-related recreation in the upper Clark Fork basin is $3.4 million in 1985 dollars (Table 8). The estimated baseline value in 1990 dollars, as previously noted in Table 2, is $4.2 million per year.

V. VALIDATION AND PRECISION

This section provides a discussion of approaches to the validation of estimated values for outdoor recreation. A discussion of the precision of estimates is also included. Because these issues can be highly technical, the summary discussion in this section is supplemented by two appendices.

Validation

The first issue in this section is the reconciliation of the three different baseline estimates from the 1981, 1987 and current study as previously discussed and summarized in Table 2. This topic is taken up in considerable technical detail in Appendix A. The basic finding is that differences in estimates from these models can be explained by differences in key assumptions and parameters. Specifically, the relatively low values from the 1981 study result from the use of a data base

Table 7. Activity Shares for Upper Clark Fork Basin River-Related Recreation[1].

	Summer		Winter		Total	
	Visits	%	Visits	%	Visits	%
Fishing	23,364	41.8	7,632	52.5	30,996	44.0
Float Fish	1,565	2.8	58	.4	1,623	2.3
Fishing Subtotal	24,929	44.6	7,690	52.9	32,619	46.3
Floating	1,900	3.4	262	1.8	2,162	3.0
Hunting	168	.3	3,344	23.0	3,512	5.0
General Shoreline	28,897	51.7	3,242	22.0	32,139	45.6
Nonfishing Subtotal	30,965	55.4	6,848	47.1	37,813	53.7
Total	55,894	100	14,538	100	70,432	100

1 Source is Hagmann, 1979, Table 26, p.64.

Table 8. Baseline Annual Recreation Value Estimate for Recreational Use of Upper Clark Fork River and Tributaries.

Site/User	Value/Day	Use[2] (Days)	Total Value ($000,s)
Tributaries Above Bitterroot River Excluding Blackfoot River and Rock Creek			
Anglers	43.74[1]	25,633	1,121
Shoreline	28.87[3]	30,091	869
Subtotal		55,724	1,990
Mainstem Clark Fork Above Bitterroot River			
Anglers	44.25[1]	17,578	778
Shoreline	29.21[3]	20,635	603
Subtotal		38,213	1,381
Total Upper Clark Fork			
Anglers		43,211	1,899
Shoreline		50,726	1,472
Total		93,937	3,371

1 Table 5.

2 Table 6.

3 Based on Walsh, Johnson and McKean (1988), Review of Outdoor Recreation Economic Demand Studies with Nonmarket Benefit Estimates, 1968-1988. Technical Report No. 54. Colorado Water Resources Research Institute. The ratio of average estimated values for shoreline type activity to the average estimated value for cold water fishing is .66.

that was not designed for travel cost modeling. Accordingly, very conservative assumptions were used with regard to travel costs per mile and spatial extent of the market. It is demonstrated in Appendix A that there is consistency between the estimated values when similar assumptions and parameters are used.

There are a number of approaches to examining the validity of nonmarket valuation estimates. One approach is to compare findings across different methods. For example, there is an extensive literature that compares findings from using both travel cost and contingent valuation methods on the same site. This issue is addressed in Appendix B which reports on an extensive comparison of both TCM and CVM estimates for 17 Montana streams. The basic finding is that there is remarkable consistency among the estimates.

Another approach to examining the validity of nonmarket valuation estimates is to set up experiments providing a side by side comparison of actual cash transactions in a market setting with either TCM or CVM or both. The general finding of this research is that there is fair consistency between the fee experiments or "simulated market" values and both TCM and CVM, particularly for willingness to pay measures. For example, Richard Bishop at the University of Wisconsin has conducted a number of such studies on goose hunting and deer hunting (Bishop and Heberlein 1979). One can also note that the average willingness to pay values derived here are similar to those observed in actual fee fisheries in Montana.

Another approach to validating these methods is to compare values from related markets. For example, Duffield (1988) estimated net willingness to pay for elk hunting from the response to changes in nonresident license fees, which have increased from $151 in 1970-75 to $450 in 1988 for a season combination big game hunting license. The values derived from the relationship of market price and quantity of nonresident hunting licenses sold are quite similar to values based on both TCM and CVM studies of elk hunting in Montana (Duffield 1988; Loomis, Cooper and Allen 1988).

One can conclude that there is considerable evidence that the estimates in Table 5 are valid, based both on the comparison across methods specific to Montana streams and on the more general validation of the methods found in the economics literature.

Precision

The precision of estimates is generally described by a statistic called the standard error. These are provided for the recreation value estimates in Table 4 and Appendix Tables B1 and B2. Standard errors for a given point estimate can be used to define the range or interval that more than likely contains the "true" point estimate. Estimation and interpretation of standard errors is discussed in detail in Appendix B. As an example, the mean estimate of the value per trip in the upper Clark Fork is $44. Based on the computed standard errors reported in Table 4, one can be 95 percent sure that the true value per trip of recreation in the upper Clark Fork is no less than $36 and no more than $53. This is a fairly precise estimate in that this "95 percent confidence interval" is only plus or minus 15 percent of the mean estimate.

VI. DIRECTIONS FOR FURTHER RESEARCH

The focus of previous research on the economics of river-related recreation in the upper Clark Fork basin has been on obtaining average values per trip for mainstem and tributary streams. This work has been a product of the Montana Bioeconomics project which focused on fishery site valuation statewide. Because of this, the samples on which estimates are based for any given stream are relatively small, on the order of 100 observations for most sites. In fact, as mentioned, no CVM estimate was available for the upper Clark Fork because the sample was so small (29 observations) that a CVM model could not be estimated. Additionally these values are used for geographically very large units.

Existing research demonstrates that the value of these fisheries is considerable. However, the major limitation of previous research is that, from a value standpoint, very lengthy and heterogeneous stream segments are treated as a homogeneous unit. For example, the estimate for the mainstem Clark Fork is for a 122 mile river segment from Missoula to Warm Springs Creek. The estimated value of $44 per trip derived for the upper Clark Fork mainstem (Table 4) is presumed to hold for very different river sections including productive waters like the Clark Fork River headwaters and the Clark Fork River below the Rock Creek and Little Blackfoot River confluences as well as the relatively barren stretches like those around Bearmouth.

Given the considerable values that are associated with fishery resources in the basin, it would appear justified to undertake more detailed survey work that would distinguish angler values and attitudes for smaller river segments. The latter should be sufficiently small to be relatively homogeneous with regard to habitat, flow, water quality, and fish populations. In other words, future social science work on the fishery should be at a level that is sufficiently disaggregated to provide linkage to key physical and biological characteristics of the river.

It is these characteristics that will be influenced by policy changes. By having integrated social and biological models, one can do a better job of evaluating policy alternatives. There are a number of important policy issues that could affect the Clark Fork Basin fisheries in the future. These include: water rights applications; natural resource development that can impact water quality and quantity such as logging, mining and road-building; changes resulting from the "Superfund" cleanup activities on-going in the basin; changes in fishery management policies.

To conclude on this point, the most outstanding social science research need with regard to the Clark Fork Basin fishery is for more detailed studies that can be linked to river characteristics that vary spatially and over time such as flow, water quality, access and fishery populations. Much of this work can be done with carefully designed studies that include a good geographical cross-section of the basin.

Another priority should be in developing integrated bioeconomic models that use time series data. This is the only way to capture important events that may have lagged effects of one or more years. For example, low stream flows may be more harmful to fry and juvenile fish than to adults. In this case, anglers may have good success in a low flow year because of relatively resilient larger trout, but the main impact may be the absence of entire age classes of trout in later years. This will not be picked up by sampling in just one year for a given site. Similarly, there is a need to examine the dynamics that result from changes in regulations which impact the type and numbers of anglers and fishery populations simultaneously. A good approach might be to initiate several modest, integrated biological and social science studies that utilize the extensive long-term data available on a few streams like the Madison. This data is available but has not been assembled and utilized for this kind of analysis. Such an analysis could be used to interpret events on other streams such as the Clark Fork where long-term experiments in regulations and other management strategies have not been monitored or have not been initiated.

A third general area of research that could be initiated in the Clark Fork Basin has to do with so-called nonuse or existence values. These are values associated with the idea that healthy resources such as streams, fisheries or wildlife populations exist and will be available for future generations. The importance of these uses for the Clark Fork have not been previously examined.

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APPENDIX A. COMPARISON OF PREVIOUS STUDIES

This appendix provides a comparison of the three different estimates of baseline values in the upper Clark Fork basin as summarized in Table 2.

Duffield, Loomis and Brooks (1987) estimated baseline value in the upper Clark Fork at $3.2 million in 1985 dollars (or $4.0 in 1990 dollars) compared to $4.2 million for the current study. As previously noted, the 1987 study estimated angler values per day that are higher than those used here, but does not include shoreline use. The 1987 and the current TCM estimates are quite similar in that they use the same data base and same general methods. As previously discussed, the main differences are the specification of the travel cost variable, inclusion of a substitute variable, and the choice of the spatial extent of the market. For purposes of this more technical discussion, it may be noted that the spatial extent assumption affects the choice of an upper limit of integration in the computation of average willingness to pay. This is because average willingness to pay is computed by integrating the estimated demand functions derived from the travel cost model.

The third estimate in Table 2, Duffield (1981) is based on Hagmann's data base and is for $202,000 to $310,000 per year in 1979 dollars or $373,000 to $571,000 per year in 1990 dollars. This estimate is much lower than the other two because of a much lower estimated value per day, which is only $3.22 to $3.82 in 1979 dollars for upper Clark Fork basin waters. The main reason for these low values is that Hagmann's study was not designed for use with a travel cost model. As a result, some very conservative assumptions were used concerning the spatial extent of the market and multiple destination trips. Specifically, the models were estimated on a data base limited to observed trips by Montana residents. As a result, the observed maximum one way travel distance across sites averaged only about 180 miles. Only a share (about 60 percent) of nonresident use was included in the total value estimate, but nonresidents were assumed to have the same values as computed for residents only.

The observed spatial extent of the market in the 1985 data base is much larger. In that study the maximum observed travel distance was around 2500 miles, because nonresidents were included and observed to have taken primary destination main purpose trips to Clark Fork Basin waters. This has a large effect on the estimated values because it justifies a much higher truncation level for the integration procedure. Higher average values are associated with the more distant origin zones.

There are a number of other differences between the 1981 and 1987 studies as tabulated in Table A1. An important difference is in the travel cost per mile which was about 7 cents per mile in 1981

Table A1. Comparison of 1981 and 1987 Travel Cost Model Studies.

	1981[1]	1987[2]
Year Data Collected	78-79	1985
Basis of Demand Model	Resident Use Only	Resident and Nonresident Use
Model Type	Single Site	Regional
Exclusion of Multiple Destination Trips	Approximate	Yes
Specification of Price Variable	Distance	Distance
User Groups	All	Anglers Only
Functional Form	Semi-log Double-log Linear	Double-log
Substitute Variable	Yes	No
Spatial Extent of Market (One Way Distance in Miles)	150-475	2445-2730
Upper limit of Integration	Max Distance	Max Dist.[3]
Travel cost value	7 cents/mile	13 to 27 cents/mile

[1] J. Duffield, A Preliminary Estimate of the Value of Recreational Use on the Upper Clark Fork and Its Tributaries (1981).
[2] J. Duffield, J. Loomis and R. Brooks, The Net Economic Value of Fishing in Montana (August, 1987).
[3] Maximum distance plus the observed origin-destination distance.

but 27 cents per mile in 1987 for reported costs.

There are also similarities between the studies as listed in Table A1. For example, both the 1981 and 1987 studies used basic zonal types of travel cost models where per capita trips are the dependent variable. Additionally, the log-linear specification was used for the 1987 study and for some sites in the 1981 study. It is interesting to note that for the log-linear models, the key estimated parameter in both studies (which is the coefficient on travel cost) was very similar in magnitude (about -1.6 to -1.8) for the 1987 study and the major sites in the 1981 study.

This shows a very important consistency between the studies. For example, one can compute the value per trip using the 1987 model but with the 1981 travel cost per mile (7.4 cents), 1981 upper limit of integration (150 miles for the conservative estimate), and the 1981 origin zones and populations. This yields an estimated value per day of $3.37 (for the Clark Fork River segment above Missoula) which is quite similar to the 1981 average of $3.22 for this limit of integration.

This indicates that both studies show a similar response of recreational use to higher travel costs and (by inference) to price. The differences in estimated values are almost entirely due to the spatial extent of the market and the value for travel cost. The travel cost per mile and the spatial extent of the market used in the 1987 and current studies are the appropriate ones to use rather than the 1981 numbers. This has been adequately discussed previously. Basically, one should have greater faith in a data base that is collected for and explicitly designed for use in travel cost modeling. The 1987 data base permits estimation of actual respondent travel costs and takes account of the multiple destination trip problem.

The conclusion from this discussion of the 1981, 1987 and current travel cost models is as follows. Differences in estimates from these models can be explained by differences in key assumptions and parameters. The fact that there is consistency between the estimated values when similar assumptions and parameters are used provides a measure of validation for the estimated values.

APPENDIX B. VALIDATION AND PRECISION

One approach to validating recreation value estimates is to compare estimates across several different models. In this section, estimates from the Montana Bioeconomics project TCM and CVM studies for stream fisheries are compared.

In addition to the TCM estimates developed in 1987, a CVM study of the value of recreation was undertaken in 1986-1988 on 17 of the better ("blue ribbon") trout fishing waters in the state (Duffield and Allen 1988). As it turned out, an insufficient sample was obtained to provide CVM estimates for the upper Clark Fork mainstem, but CVM estimates were obtained for Rock Creek, the Bitterroot, the Blackfoot and the middle Clark Fork (Bitterroot confluence to Paradise).

Table B1 provides a listing of TCM and CVM estimates. Note that one would not expect the TCM and CVM estimates to be identical. The TCM estimate of recreational value is measured as the area under an ordinary demand curve while CVM is measuring the area under a so-called "compensated" demand curve. However, any differences are likely to be small for goods like recreation. Accordingly, we expect TCM and CVM to be not exactly equal, but generally close.

The TCM estimates are for 17 Montana rivers as derived from the model in Table 3 and using a 500 dollar upper limit of integration and reported travel costs. The CVM estimates are from a data base described in Duffield and Allen (1988) (see Table B1). These estimates are based on responses by Montana licensed anglers to dichotomous choice or close-ended contingent valuation questions of the form "Would you still have made this trip if your expenses had been <u>(dollar amount)</u> more?" where the dollar bid amount varied from $5 to $500 across respondents.

There is also an upper limit of integration choice for this type of model for the type of welfare measure reported here. The basic output of a dichotomous choice CVM model is not an economic demand function but the frequency distribution of willingness to pay. The welfare measure for CVM used in Table B1 is a truncated mean with the truncation point at the highest offer bid amount of $500. The statistical definition of this truncated mean, which is a widely used welfare measure for these types of models, is provided in the Table B1.

Table B2 provides a comparison of TCM and CVM estimates for different truncation points. For the TCM estimates in Table B2, the upper limit of integration is the maximum observed distance with the same CVM estimates as Table B1. Note that the TCM and CVM estimates in Tables B1 and B2 are based on two totally different data bases and two very different methods of analysis. The TCM estimates are based on observed behavior while the CVM

Table B1. Comparison of Estimated Net Economic Value Per Trip Based on Contingent Valuation Method and Travel Cost Model (Truncated at $500 Travel Cost) Welfare Estimate Means.

River	CVM Mean[1]	TCM Mean[2]	T-Stat.[3]
Beaverhead (Standard Error)	166.32 (34.06)	146.32 (7.45)	.573
Big Hole	200.81 (30.89)	114.60 (7.61)	2.710
Bitterroot	91.27 (24.97)	55.11 (6.88)	1.396
Blackfoot	140.29 (31.43)	78.82 (6.28)	1.921
Boulder	163.50 (46.89)	162.29 (14.59)	.024
Bighorn	163.49 (25.27)	142.02 (8.37)	.806
Clark Fork[4]	74.22 (21.18)	52.96 (4.68)	.980
Flathead	175.97 (51.59)	28.27 (3.76)	2.855
Gallatin	156.85 (31.40)	101.51 (9.83)	1.682
Kootenai	118.07 (35.18)	90.88 (6.63)	.759
Madison	192.03 (30.30)	134.42 (8.92)	1.824
Missouri	47.87 (11.34)	88.58 (6.64)	3.100
Rock Creek	121.89 (29.92)	134.15 (12.34)	.379
Smith	179.15 (65.14)	68.23 (5.11)	1.697
Stillwater	92.72 (25.61)	119.46 (12.46)	.925
Upper Yellowstone	162.51 (32.25)	94.92 (8.23)	2.031
Middle Yellowstone	67.87 (23.42)	40.41 (4.68)	1.149

Notes on following page.

Table B1. (Continued)

1 CVM standard errors were bootstrapped as suggested by Duffield and Patterson (1991) with 200 repetitions. The CVM data base and models are discussed in Duffield and Allen, "Angler Preference Study Final Economics Report" (1988).

2 TCM standard errors were bootstrapped following the procedures of Adamowitz, Fletcher and Graham-Tomasi, "Functional Form and the Statistical Properties of Welfare Measures." American Journal of Agricultural Economics 71:414-421 (1989) using a predicted intercept and 200 iterations. The complete model is provided in Table 3.

3 T-Statistics are calculated as $$T=\frac{\overline{X}_{CVM}-\overline{X}_{TCM}}{\sqrt{VAR_{CVM}+VAR_{TCM}}}$$

4 Bitterroot River to Paradise

Table B2. Comparison of Estimated Net Economic Value Per Trip Based on Contingent Valuation Method and Travel Cost Model (Truncated at the Maximum Observed Travel Distance to a River) Welfare Means.

River	CVM Mean[1]	TCM Mean[2]	T-Stat.[3]
Beaverhead	166.32 (34.06)	191.71 (11.30)	.732
Big Hole	200.81 (30.89)	149.33 (11.35)	1.546
Bitterroot	91.27 (24.97)	75.37 (10.63)	.539
Blackfoot	140.29 (31.43)	103.74 (9.54)	1.087
Boulder[4]	163.50 (46.89)	244.32 (26.59)	1.538
Bighorn	163.49 (25.27)	191.59 (13.32)	1.023
Clark Fork	74.22 (21.18)	64.10 (6.36)	.434
Flathead[4]	175.97 (51.59)	32.42 (4.68)	2.763
Gallatin	156.85 (31.40)	139.68 (15.37)	.428
Kootenai[4]	118.07 (35.18)	117.24 (9.80)	.004
Madison	192.03 (30.30)	186.49 (14.43)	.108
Missouri	47.87 (11.34)	113.05 (9.63)	4.437
Rock Creek[4]	121.89 (29.92)	197.09 (22.35)	2.089
Smith[4]	179.15 (65.14)	73.18 (5.72)	1.613
Stillwater	92.72 (25.61)	159.10 (18.87)	2.136
Upper Yellowstone	162.51 (32.25)	123.90 (11.89)	1.088
Middle Yellowstone	67.87 (23.42)	51.19 (6.62)	.653

Notes are on following page.

Table B2. (Continued)

1 CVM standard errors were bootstrapped as suggested by Duffield and Patterson (1991) with 200 repetitions. The CVM data base and models are discussed in Duffield and Allen (1988).

2 TCM standard errors were bootstrapped as by Adamowitz et al. (1989) using a predicted intercept and 200 iterations. The complete model is provided in Table 3.

3 T-Statistics are calculated as $T = \frac{\overline{X}_{CVM} - \overline{X}_{TCM}}{\sqrt{VAR_{CVM} + VAR_{TCM}}}$

4 CVM sample less than 80 observations.

requires response to hypothetical questions.

The basic finding is that the valuation estimates are similar across sites. This can be seen in two ways. First, the estimates for each site in Table B1 and B2 are compared for significant differences given the estimated standard errors for each point estimate. For Table B1, for nine of the seventeen sites, the point estimates from the two models are not significantly different at the 90 percent level. This indicates that there is some degree of comparability across the two very different methods. In Table B2, the agreement is even closer with only four significantly different estimates by site and with 13 of 17 not significantly different.

Estimates were also compared another way by computing Pearson and Spearman correlation coefficients that measure the degree of correlation between the two measures. For example, if the TCM and CVM were identical for every site, the correlation coefficient would take a value of 1.0. If there was no similarity, it would take a value of zero. For the seventeen river sample of Table B1, the correlation from both measures is about .40, which is not quite significant at the 10 percent level (Table B3). However, when sites for which the CVM samples were less than 80 observations are excluded, the correlations are quite high and also highly significant with a Pearson correlation of .65 and a Spearman of .71 (Table B3).

The conclusion is that the strong correlation shown by the Pearson coefficient indicates that the two methods result in estimates that are similar in magnitude for a given site. The Spearman coefficient indicates that the two methods provide a similar ranking of sites from most to least valuable.

The finding of increased correlation when sites with small CVM samples are excluded is encouraging as to the consistency of the methods. This is because site estimates based on small samples are less precise. If the correlation is higher for the more precisely estimated values, this suggests that the underlying methods are sound and that the estimates could be improved by using larger sample sizes.

Other studies have also found some agreement between TCM and CVM estimates. For example, this is a finding of the extensive review of outdoor recreation valuation commissioned by the U.S. Forest Service in 1988 and previously discussed. There have been quite a number of such comparisons which tends to validate the methods.

Precision of the estimates reported in Table 4 and Tables B1 and B2 is described by the standard error statistic reported in these tables. For the recreation value estimates in Table 4, for example, one can be 95 percent sure that the "true recreational value" is within plus or minus 1.96 times the standard error.

Table B3. Correlations of Contingent Valuation and Travel Cost Model[1] Estimates of Net Economic Value Per Trip for Seventeen Montana Rivers.

	Correlation Coefficient	
Sample	Pearson	Spearman
A. Seventeen Montana Rivers (Table B1)		
	.388 (P=.124)	.400 (P=.112)
B. Thirteen Montana Rivers (Excludes Rivers with CVM Samples Less than 80 Observations)		
	.652 (P=.016)	.714 (P=.006)

1 Both models use $500 as the upper limit to willingness to pay.

This range is referred to as the "95 percent confidence interval".

It was necessary to compute estimated standard errors for the valuation estimates. It is impossible to derive analytical standard errors for a measure like the CVM truncated mean (which requires numerical methods to compute). The TCM standard errors would be very difficult to derive analytically. Accordingly, in both cases I used a statistical procedure called "bootstrapping" which involves repeated draws (200 iterations were used in this case) from the statistical distributions appropriate for each case. This is very computationally intensive (requires a lot of computer time), but is a well-accepted procedure. A detailed discussion of bootstrapping is provided in Duffield and Patterson (1991).

The 95 percent confidence interval for the recreational trip value estimates for the upper Clark Fork as shown in Table 4 can be briefly discussed. For the $500 upper limit of integration, the point estimates for both the upper Clark Fork tributaries and the mainstem river are about $44 dollars per trip. Given the standard errors, the 95 percent confidence intervals for these two waters are very similar at $37 to $51 and $36 to $53 respectively. By contrast, the values for Rock Creek are significantly higher, with a 95 percent confidence interval of $110 to $158 per trip.

One can conclude that the recreational values per trip estimated for fishing on the Upper Clark are relatively precise, with 95 percent confidence intervals that are no larger than only about plus or minus 15 percent of the mean estimate.