

Summary of Water Quality Economic Evaluation for Braddock Run

This paper describes how economic impacts will be estimated for the stream restoration, water quality, and fish habitat improvement measures in the Braddock Run Watershed Project located west of Cumberland in Allegany County, Maryland.

Economic Values: Willingness to Pay and Travel Cost Estimates

According to *Economic and Environmental Principles and Guidelines for Water and Related Land Resources Implementation Studies* (P&G), benefits generated from recreation opportunities created by a project are measured in terms of willingness to pay (WTP), which is defined as the amount of money a person is willing to pay (in addition to travel and supply expenses) to participate in an activity. This is sometimes referred to as consumer surplus.

Payments toward equipment, food, transportation, or lodging connected with the recreation activity are called travel costs. These cannot be used as direct estimates of WTP because these payments are not specifically for site use. Under certain circumstances they can be accounted for. Their appropriateness for use in this project will be discussed later on.

Three studies were identified that estimated economic values for trout fishing in Maryland. All three provided an estimate of net WTP per day. One specific to Maryland provided estimates for regions within Maryland as well as Maryland as a whole. Two of these studies also identified travel costs for trout fishing in Maryland. Both net WTP and travel cost values from these studies relevant to the project area are summarized in the following table. Sections of the reports from which these values were taken are also attached.

Values for Trout Fishing (\$/day).

Source	Fedler	Fedler	USFWS, Boyle et al.	AFS
Year	1987	1987	1996	1980
Geographic Area	Allegany & Garrett Counties	All Maryland	All Maryland	All Maryland
Net WTP	\$20.18	\$17.25	\$10.00 ¹	\$13.00
Travel Cost	\$25.65	\$22.06	\$26.31 ²	N/A
Total	\$45.83	\$39.31	\$36.31	N/A

¹ Net WTP (\$10) value was estimated for all of USFWS Region 5, which includes CT, DE, MA, MD, ME, NH, NJ, NY, PA, RI, VA, VT, WV, and included bass and trout. This estimate has a ninety percent confidence interval of \$5.53 to \$14.47.

² Total freshwater expenditures (Table 16) divided by total freshwater days of fishing, all types of fish (Table 6).

The values above were indexed to year 2000 using the Consumer Price Index (CPI – U) and are displayed in the table below. All further economic values in this paper will refer to these updated values unless otherwise noted.

Values for Trout Fishing (\$/day) Updated to 2000.

Source	Fedler	Fedler	USFWS, Boyle et al.	AFS
Year	2000	2000	2000	2000
Geographic Area	Allegany & Garrett Counties	All Maryland	All Maryland	All Maryland
Net WTP	\$30.59	\$26.15	\$10.98	\$27.17
Travel Cost	\$38.88	\$33.44	\$28.88	N/A
Total	\$69.47	\$59.59	\$39.86	N/A

After adjusting for inflation, net WTP per day estimates for all Maryland as a whole are (from highest to lowest) \$27.17, \$26.15, and \$10.98. While the first two estimates appear comparable, the third one appears low relative to these. The \$10.98 figure is a multi-state regional estimate covering 13 states, and includes bass fishing. It is not known whether or not this explains why it differs with the other two estimates by the amount it does.

Fedler (1987) was the only study to estimate values on a multi-county regional basis within Maryland. The net WTP for the area of Allegany and Garrett counties within Maryland (referred to in the study as Region 1) was \$30.59, the highest WTP of all the regions in Maryland.

Travel cost estimates for Maryland as a whole from the two studies that provided them are \$33.44 and \$28.88 per day. These estimates appear comparable. The travel cost estimate for Region 1 is \$38.88 per day, again slightly higher than the rest of the state.

Estimating Average Usage (Number of Trips and Days, per Mile of Stream)

Fedler (1987) estimated that there were about 467,600 trips made for trout fishing in Maryland in 1987. The mean days per trip during the survey respondents' last fishing trip for Maryland as a whole was 1.54. This equates to approximately 720,104 trout fishing days in 1987 (1.54 days/trip x 467,600 trips) statewide.

Fedler's data was collected from a sample of 2,148 anglers who bought trout stamps in 1987, of which 95% were Maryland residents. The USFWS (1998) reported that in 1996 there were about 967,000 days of trout fishing in Maryland, 842,000 of those days by Maryland residents. 842,000 seems comparable to 720,104, given the difference in time periods (1986 and 1996, respectively). Fedler indicated that trout fishing was growing in popularity during his study and that 467,600 days was probably a conservative estimate.

Based on his sample data, Fedler (1987) estimated the number of trout fishing trips made during 1987 to each of the four Maryland regions that were identified in his study. These estimates are presented in the table below.

Study Area	Counties in the Study Area	Trout Fishing Trips (1987)
Region 1	Allegany, Garrett	128,192
Region 2	Frederick, Washington	116,155
Region 3	Baltimore, Carroll, Cecil, Harford	121,445
Region 4	Anne Arundel, Howard, Montgomery, Prince George's	56,736
	Total (all regions)	422,528

For the purposes of this project, it is assumed that trips to Region 1 account for about 30.3 percent of all trout fishing trips in Maryland ($128,192 \div 422,528$). If the actual total number of trips per year statewide is 467,600, the estimated number of trips to Allegany and Garrett Counties should be about 141,683 ($.303 \times 467,600$). From data cited in MDE (1994), it appears this region contains about 30% of the total miles of trout stream in Maryland.

Not all trout fishing trips are to rivers or streams. A certain percentage of these trips are to impoundments, which include ponds, lakes and reservoirs. Fedler surveyed anglers about what percentage of their fishing trips were to impoundments and/or streams or rivers. The mean percentage of trips to rivers and streams was 63.3, so this percentage was multiplied by the annual number of trips estimated to Allegany and Garrett counties to arrive at 89,685 trips ($.633 \times 141,683$).

Survey results indicated that the mean days per trip for respondents' last fishing trip to Allegany and Garrett counties was 1.89. This is used to convert the number of trips to the number of days, 169,505 ($1.89 \text{ days/trip} \times 89,685 \text{ trips}$).

From data cited in the MDE Water Quality Inventory, it was estimated that there are approximately 463 miles of trout stream in Maryland. Using Youghiogeny and North Branch Potomac basins as a proxy for Region 1, Allegany and Garrett counties have approximately 147 miles of trout stream. Dividing 169,505 days by 147 miles gives an estimate of the average annual number of fishing days per mile of trout stream (1,153) for Region 1.

Using this estimate and the indexed WTP value per day for Region 1 above, it is estimated that the average value of a mile of trout stream in Western Maryland is approximately \$35,270 per year ($1,153 \text{ days/mile} \times \$30.59/\text{day}$).

With this figure as a benchmark average for Western Maryland, it should be possible to estimate the economic impacts due to the water quality, fish habitat improvement, and stream restoration measures that will be implemented in Braddock Run. For instance, if 12 miles of new trout stream are effectively created by project actions, the annual value created would be about \$423,240, assuming that the new miles of stream created are fished at at least the regional average rate.

Use of Travel Expenditures in Benefit Calculations

Boyle et al (1998) discussed the appropriateness of using trip expenditures to estimate economic benefits of projects. They indicate that it would be appropriate to count trip expenditures for projects that are regional or local in nature. For the Braddock Run Watershed Project, regional impacts will be accounted for, so travel costs may be acceptable to include in the calculation of economic impacts. Fedler (1987) points out that not all travel expenditures estimated in his study will occur within Region 1, so it may be appropriate to count a portion of them for the project area.

Increased Usage Estimates

It is assumed that more anglers will eventually travel to the additional miles of trout stream created by the project, or travel more frequently to existing streams enhanced by the project. The economic benefits from the travel expenditures of these additional anglers will probably not accrue to the region for some time, until it is publicly perceived that there are enhanced fishing opportunities in or downstream of the project area.

Due to this time lag, economic benefits of the measures that improve fishery habitat in the Braddock Run project will be lagged over the project evaluation period a sufficient amount of time to account for this lag.

There is uncertainty as to how much the proposed measures of the Braddock Run Watershed Plan will impact the number of days of fishing in the area. The Braddock Run mainstem is approximately 12 miles long. Most of the land that provides access to Braddock Run is privately owned. However, there are anglers who fish this area along certain points. During field inventory and reconnaissance for the project, people were observed fishing the mainstem.

Use of Survey Data

Fedler (1987) estimated that trout anglers would make on average 3 additional trips to Region 1 if the stocking rate was doubled there. This translated into 120,000 additional trips to the region and expenditures of over \$6,500,000 (in 1987 dollars). Fedler also estimated that if the miles of trophy trout waters were doubled, trout anglers would make on average 2 additional trips to the region, which would translate into approximately 80,000 additional trips to the region.

If it is assumed that the Braddock Run project will effectively create twelve additional miles of trout stream, this would increase the total miles of trout stream in the region by about 8 percent. Multiplying this proportion by the additional trips that would be created by doubling the miles of trout stream gives an estimate of 6,400 additional trips to the region per year. Converting this to days and multiplying the indexed average per day WTP by this figure yields approximately \$370,017 per year. It should be noted that the survey respondents were not asked if they would decrease fishing trips to other regions in the state as a result of their increased trips to Region 1.

\$370,017/year is roughly comparable to the figure estimated above using average usage (\$423,240/year). The fishing days per mile estimated by this alternative method would be 1,008 (6,400 trips x 1.89 days/trip ÷ 12 miles) compared to the average usage estimated at 1,153 above.

Increased Fishing Days

These figures are based on the 1987 estimate of the number of trout fishing days, 720,104, which is about 15 percent lower than the 1996 estimate, 842,000. If the number of trout fishing days in Maryland as a whole has increased, it would be reasonable to assume that both of the benefits estimates are low for recent years. According to Pullis (1999) days of trout fishing nationwide have increased by seven percent from 1991 to 1996. Total Maryland freshwater fishing days increased almost 10 percent between 1991 and 1996 USFWS (1993). Given this it may be appropriate to adjust benefits upward by about 10 percent, which would translate into annual benefits of \$407,019/year and \$465,564/year.

However, both estimates assume that the additional miles of trout stream created will be utilized in addition to the miles already available. This assumption probably produces an overestimate of benefits.

Summary of Calculations

Regional Annual Average Usage

- Number of trout fishing trips to Allegany and Garrett counties per year

$$128,192 \text{ trips to Region 1} \div 422,528 \text{ trips to all Regions} = .303$$

$$.303 \times 467,600 \text{ total actual trips statewide} = 141,683 \text{ trips to Region 1}$$

- Number of trips to rivers and streams in Region 1

$$.633 \times 141,683 \text{ trips} = 89,685 \text{ trips to rivers and streams/year}$$

- Number of days of trout fishing

$$1.89 \text{ days/trip} \times 89,685 \text{ trips/year} = 169,505 \text{ days/year}$$

- Average number of trout fishing days per mile of trout stream

$$169,505 \text{ days/year} \div 147 \text{ miles} = 1,153 \text{ days/mile/year}$$

- Estimated average value per mile of trout stream

$$1,153 \text{ days/mile/year} \times \$30.59/\text{day} = \$35,270/\text{mile/year}$$

Survey Response Data

- Estimate percent increase in trout stream miles

$$12 \text{ new miles} \div 147 \text{ miles existing} = .08 \text{ increase}$$

- Actual new trips created per year

$$80,000 \text{ trips/year} \times .08 = 6,400 \text{ trips/year}$$

- New days created per year

$$6,400 \text{ trips/year} \times 1.89 \text{ days/trip} = 12,096 \text{ days/year}$$

- Total value created per year

$$12,096 \text{ days/year} \times \$30.59/\text{day} = \$370,017/\text{year}$$

Note: this figure can be expressed in terms of miles of new trout stream: \$30,835/mile/year for comparison with the estimate above.

References

American Fisheries Society. 1993. "Sourcebook for Investigation and Valuation of Fish Kills." American Fisheries Society Special Publication 24 (supplement). Bethesda, Maryland.

American Fisheries Society. 1992. "Investigation and Valuation of Fish Kills." American Fisheries Society Special Publication 24. Bethesda, Maryland.

Boyle, Kevin J., B. Roach, and D.G. Waddington. 1998. "1996 Net Economic Values for Bass, Trout and Walleye Fishing, Deer, Elk and Moose Hunting, and Wildlife Watching." Prepared for U.S. Fish and Wildlife Service.

Fedler, Anthony J. 1987. "Trout Fishing in Maryland, An Examination of Angler Characteristics, Behaviors and Economic Values." Prepared for Maryland Department of Natural Resources. Annapolis, MD.

Maryland Department of the Environment. 1994. "Maryland Water Quality Inventory, 1991-1993." Baltimore, Maryland.

Pullis, G., Andrew Laughland. 1999. "Trout Fishing in the U.S. Addendum to the 1996 National Survey of Fishing, Hunting and Wildlife Associated Recreation."

U.S. Department of the Interior, Fish and Wildlife Service, and U.S. Department of Commerce, Bureau of the Census. 1998. "1996 National Survey of Fishing, Hunting, and Wildlife-Associated Recreation."

U.S. Department of the Interior, Fish and Wildlife Service, and U.S. Department of Commerce, Bureau of the Census. 1993. "1991 National Survey of Fishing, Hunting, and Wildlife-Associated Recreation."

U.S. Water Resources Council. 1983. "Economic and Environmental Principles and Guidelines for Water and Related Land Resources Implementation Studies."