Chapter Two: Natural Resource Valuation

Water resources provide a wealth of benefits. These benefits can be seen through a variety of ways; as a source of energy and power; as recreational opportunities; or simply as places of aesthetic beauty. However the resource is put to use, the benefits it provides contain value.

When energy production considered, this value could be measured by the value of the amount of hydroelectric power a dam provides. But determining the value that a trail up a mountain provides, or the value of a recreational fishery proves to be much more difficult.

Natural Resources Valuation Theory

Valuations of natural resources become necessary when environmental management decisions are made (Freeman, 1993). Because environmental management decisions or policies potentially lead to changes in the environment, valuations can provide insight into whether or not the proposed changes will be beneficial or detrimental to the environment and to the economy. Natural resources which provide recreational opportunities pose a special type of valuation problem. 'Valuation' of recreational natural resources could then be described as an attempt "to estimate the economic value, in dollar terms, that members of society receive from uses of natural resources that cannot be efficiently allocated through markets due to their public good characteristics…" (Loomis, 2002: 339).

The valuation of recreational natural resources such as a trail, a white-water river or a fishery is hard because they are not goods which are purchased or sold in a market. Markets for natural resources do not exist largely for the reason that they tend to be public goods (Hanemann, 1994). A public good is a

service that is available to any individual who wishes to use it. A pure public good has collectively held property rights (Mitchell and Carson, 1989).

Different individuals may hold different types of value for a resource as well. Those individuals who use a river for fishing hold a different type of value than those who use the river simply as a site of aesthetic beauty. An 'economic value' would be the amount of money a person is willing to pay in order to use, or get something (Johnson and Johnson, 1990). In the context of this study, this 'thing' would be a recreational fishing opportunity. If a one-time license is required to fish on a river, the cost of that license would be the economic value. Benefits can also arise from both use and non-use (existence). The benefits one receives from paying for a license to fish a river are different from the benefits one might hold from the simple peace of mind that the river itself exists.

Several methods are available to perform the actual valuation of a natural resource. The contingent valuation method and the travel cost method are two effective and commonly used ways to estimate the value of a natural resource. This thesis details the application of these two methods to estimate the value of the Kennebec River recreational fishery. As these methods have been applied to the valuation of a recreational fishery in this study, their theoretical discussion will be focused on fishery valuation.

The Contingent Valuation Method

One way to estimate the value a fishery holds is through the contingent valuation method. The contingent valuation method (CVM) is aimed at the elicitation of the willingness to pay (WTP) of respondents through the use of survey questions. These survey questions target respondents' preferences for public goods by determining the amount a respondent would pay for a certain

measure of these goods, or improvements in the quality of them (Mitchell and Carson, 1989). Stated in a different way, responses to WTP questions reveal the "satisfaction which consumers expect to derive from additional amounts of the various commodities and services" (Crutchfield, 1962).

When created and implemented properly, the results from CVM surveys can provide invaluable information regarding the value and demand for a good that is not bought, sold or traded in a market (Cameron, 1992). Access to recreational fisheries is rarely a market-priced good, so the CVM can be a very effective part of the valuation of a fishery, so long as it is administered effectively.

A contingent valuation survey has several parts: a description of the good being valued, questions aimed to determine the respondent's willingness to pay for the good, and finally questions regarding the respondent's personal characteristics and demographics (Mitchell and Carson, 1989). Each part of the survey is important. One author notes that the degree of success of a CVM survey "depends on the skill with which the survey is designed and implemented" (Hanemann, 1994: 20).

The first part of the CVM is a detailed description of the good being valued. It is very important that the good being valued is described in a way that will allow the respondent to give a well-informed response. The CVM is only effective when the respondent is asked to value "something concrete" (Hanemann, 1994: 22).

Therefore, when valuing a fishing day, it is necessary to describe the type(s) of fish being targeted, the means by which the fish will be sought after, how long the fishing day will be, what is provided during the trip, and a

description of the geographical location where the fishing trip will take place. The more information regarding the fishing trip the respondent has, the better informed they will be to express the value they hold for the trip. The vaguer the description of the good and payment mechanism are, the more likely respondents are to find the valuation question more symbolic and less tangible (Hanemann, 1994).

After a description of the good to be valued are the actual willingness-to-pay questions. The description of the good serves as a simulated (or, 'hypothetical') market in which the value of the good is determined. The respondent may be asked the maximum they would pay for a good or whether or not they would pay for an increase of a certain amount (Loomis 1998). Responses to these questions are in dollar amounts.

There are other issues to consider in the making of a CVM survey besides product definition as well. The target population and data collection technique are issues that add to the complexity of the contingent valuation method (Young, 2005). When conducting a CVM survey aimed at valuing a recreational fishery (through WTP questions of fishing days), the ideal respondents would be individuals who use the fishery themselves, those who would conceivably use the fishery, or those who frequent a similar fishery. Fishing license holders would be a likely set of individuals who would fit this criterion.

The data collection technique could be via mail survey, personal interview or telephone interview. Each has associated costs and accuracy tradeoffs (Young, 2005). Personal interviews are considered the most preferable (Mitchell and Carson, 1989; Young, 2005), but are very time consuming and expensive to conduct.

Following the willingness-to-pay questions are questions aimed at the respondent's demographic characteristics (Mitchell and Carson, 1989). These questions usually focus on socioeconomic factors such as income, education, age or state of residence (Young, 2005). Responses to demographic questions can then be used in regression analysis, estimating a valuation equation of the good, or a trip generating function for the fishing site.

Once the survey has been completed and responses compiled, total benefits estimates can be made. The contingent values are collected and individual demand curves can be made for the good. Then, a vertical summation of these demand curves can be made to aggregate the total value of the good (Mitchell and Carson, 1989). In the case of responses to WTP questions regarding fishing activity, aggregate benefits can be estimated by the summation of individual WTP responses for a day of fishing.

One great advantage of the contingent valuation method is its flexibility in creation of hypothetical markets (Mitchell and Carson, 1989). The WTP questions of a CVM survey can be created so that the good being valued can hold a seemingly infinite number of characteristics, all of which could affect the value each respondent reports. In this light, the WTP questions that pertain to a fishing day can be modified to nearly any fish species, fishing conditions, fishing length or fishing type.

Another advantage of the contingent valuation method lies in its ability to capture the existence values of respondents (Mitchell and Carson, 1989). In comparison to valuation methods that capture strictly those goods that are bought in a market, WTP questions elicit the respondent's true total amount they are willing to pay to use the good (fish for a day), and thus represent their

true total value of the good. WTP questions are hypothetical in construction, so they obtain values that include respondent's existence values of the good (fishery).

The contingent valuation method provides a way for researchers to capture respondents' values of non-market goods, such as the value of recreational natural resources. A detailed description of the good to be valued will result in responses that can be used in total value estimates. The willingness-to-pay questions for a fishing day can be used to estimate benefits for the entire recreational fishery.

The Travel Cost Method

Another method of natural resource valuation is the travel cost method. The travel-cost method (TCM) uses estimates of "market expenditures for transportation and other trip-related items to infer a demand function for recreation" (Johnson and Johnson, 1990). By using information on how much visitors pay to get to a recreational site, the value of the recreational resource can be inferred (Tietenberg, 2000). The sum of these trip-related items is then considered to be the total value the individual places on the recreational opportunity.

A basic travel cost model creates a demand schedule for the recreational opportunity (Young, 2005). By combining total trip expenditures with the quantity of trips taken per time period, an individual demand schedule, and consequently a total demand curve, can be estimated. One extension of the TCM interprets the travel costs associated with a recreational site as equivalent to an entry fee to the location (Cameron, 1992). The foundation of the demand schedule created by the TCM is that consumers respond to higher travel costs

as they would to increased entrance fees (Young, 2005). That is, the method assumes that increased travel costs lead to decreased use of the resource.

Travel costs associated with a fishing day could come from a variety of sources. The cost of transportation to the fishery can be quite substantial. Some individuals might drive their own vehicle while others may have to take a bus or even a plane to reach some fishing destinations. The costs of food and beverages consumed during the fishing day should be considered, as should any lodging fees that the anglers pay for while visiting the fishery.

Another substantial part of the costs of a fishing trip can be the fees that are spent on the use of a fishing guide; this is included in the travel cost method as well. Any bait bought for the trip, boat rentals, shuttle services or fuel for the boat should all be considered in the travel cost method of valuation. In essence, the TCM captures all actual monetary expenditures that occur *en route* to the fishing site and *during* the fishing trip. On the survey, a space for 'other' purchases should be included as well.

One advantage of the travel cost method is that the reported expenditures are site-specific (Hufschmidt et al., 1983). Just as the hypothetical markets created in contingent valuation surveys can target a specific type of fishing, travel cost method surveys can be aimed at a specific fishing site. It was mentioned above that the values reported in response to WTP questions capture respondents' existence values for the recreation; travel cost method questions do not capture these values. Instead, they measure the actual economic benefits (expressed as dollar-amount expenditures) that are derived from the recreational site, and do not measure any value of the 'recreation' in general (Hufschmidt et al., 1983).

Once expenditure data has been collected for all the possible fees associated with visiting the recreation site, a trip generating function can be constructed. This trip generating function takes into account the total cost of travel to the recreational site, the total travel time to reach the recreation site, as well as a set of socioeconomic traits, like those described in the contingent valuation method (Young, 2005).

One example of a basic trip generating function is presented below:

$$Trips_i = \beta_0 + \beta_1(TC_i) + \beta_2(TravTime_i) + \ldots + \beta_n(X_{ni}) + \varepsilon$$

where $Trips_i$ are the amount of trips person i takes to the recreation site, TC_i is the round trip cost of travel to the site by person i, $TravTime_i$ is the time required to reach the site by person I, X_{ni} is a vector of the socioeconomic characteristics of person I, ε is an error term and the βs are the coefficients to be estimated (Young, 2005).

The travel cost method provides insight into the actual market expenditures that arise from visiting a recreational site. By measuring these market expenditures, a value can be estimated for a good that does not have a specific market price, such as a recreational fishery. The sum of all expenditures incurred for the use of the fishery for one fishing day can be used as an estimate of the value a respondent places on using the fishery. Expenditures involved with a fishing day can come from an abundance of sources, so it is important to capture as many of these costs as possible. This ensures an accurate estimate of the value of the fishing day.

Fisheries Valuations

The valuation techniques described above can be used separately or in conjunction to reach an estimate of the value of a recreational fishery. Through personal interviews, mail surveys or telephone interviews, these valuation methods can reach respondents who may have used the fishery in question, or a similar fishery. When the studies are conducted in effective manners, the resulting value estimates can be very credible. It should be emphasized that the use of the above valuation methods are used to value 'fishing,' not 'fish' (Crutchfield, 1962). Following are a sample of fishery valuation case studies.

In the fall of 1999, a mail survey was used to estimate the recreational value per angling day of a sample of rivers and lakes found across Denmark, Finland, Iceland, Norway and Sweden (Roth et al., 2001). Relevant fish species in this study include Atlantic salmon, sea trout and brown trout. The contingent valuation method was used to estimate recreational anglers' willingness-to-pay (WTP) for present fishing activities, new hypothetical fishing options, and for the protection of the aquatic environment for conservation of natural fish stocks (Roth et al., 2001).

In the survey, respondents were asked to itemize their fishing expenses in the previous year. There were also asked a series of CVM questions which were designed to address the estimates described above. The results from this mail survey showed that the estimates of actual expenditures and WTP responses were very close in terms of the recreational angling value (Navrud, 2001).

Contingent valuation of the recreational value to fish for salmon and sea trout in the River Gaula estimated one angling day at $35.31 per person. A similar estimate for brown trout in Lake Lauvann was between $8.36 and

$11.33. A travel cost estimate of the value per angling day, targeting Atlantic salmon in the River Vikedals Elv was estimated to be between $16.39 and $22.55. A contingent valuation estimate for the same fishery was between $15.51 and $22.22. All amounts are in 1994 U.S. dollars.

Another study, conducted by Vaughan and Russell (1982) used travel cost estimates and average willingness-to-pay responses to value a day of recreational fishing differentiated by fish species. In their study, fish species were separated into three categories: coldwater game fish, warm-water game fish and rough fish. One-day estimates of total travel cost and willingness-to-pay were then found for both trout and catfish (Vaughan and Russell, 1982).

A mail survey, conducted in 1979, produced cross-sectional data from recreational fishing sites in the United States. The authors researched values of different fish species under the hypothesis that anglers value some species more highly than others (Vaughan and Russell, 1982). This hypothesis was tested, as value estimates for a day of fishing for trout (a coldwater game fish) were compared with those estimates of fishing for catfish (a rough fish).

The travel cost estimates for one fishing day were estimated at $15.60 for trout and $10.62 for catfish. Using the contingent valuation method, mean estimates for the value of a fishing day were $21.00 for trout and $15.00. Vaughan and Russell extend their analysis and also note that an increase of one fish per angler above the mean catch rate resulted in a raise in willingness-to-pay by $0.46. All amounts listed are in 1982 U.S. dollars.

A study conducted by Boyle (1989) experimented with varying amounts of information to respondents. A mail survey targeted at trout fishing in southern Wisconsin streams was sent out. Three versions of the survey were

sent, each with a different amount of information given regarding the fishery. The first version gave a basic description of the fishery to be valued; the second gave this basic description as well as information about current stocking efforts; the final version gave the information of the first two, as well as the cost of the stocking program (Boyle, 1989).

In essence, the study tested a hypothesis that changing commodity specifications would result in different reported values of willingness-to-pay. Results from the study determined mean willingness-to-pay for use of the fishery. Boyle reported mean willingness-to-pay values of $11.86 for the first group of survey respondents, $10.56 for the second and $10.17 for the third. Using these amounts, he concluded that changing commodity specification did not affect estimated mean values, but did affect the precision of the contingent values (Boyle, 1989). All amounts are in 1989 U.S. dollars.

An economic valuation of the Gulkana River Chinook salmon sport fishery in Alaska was conducted by Layman, Boyce and Criddle (1996). The study used a travel cost model to measure economic benefits under then-current management policies. Also estimated was the change in benefits that would accrue from changes in the sport fishing regulations, holding Chinook populations constant (Layman et al., 1996).

Using a hypothetical travel cost method (HTCM), the authors asked respondents how many fishing trips they would make under three management conditions (Layman et al., 1996). This method is an extension of the travel cost method, in that it provides data not only on single trip expenditures, but also on estimated visits to the fishery.

The data collected by the HTCM (including hypothetical trips taken), reported that mean travel costs for current management decisions were $32.35; under a management decision to double harvest rate, the mean was $43.84; under a double-bag limit management decision, the mean was $41.59; and under a management decision to limit the season bag limit to five fish, the mean value was $51.46. All amounts are in 1996 U.S. dollars.

A study from 1993, conducted by Morey et al. used travel cost and contingent valuation methods to survey Atlantic salmon fishing license holders. The study estimated consumer's surplus for three possible resource changes to the Atlantic salmon fishery of the Penobscot River in Bangor, Maine. The first change was a complete elimination of the Atlantic salmon fishery; the second was a doubling in expected catch rate in the river; the third was a halving of the expected catch rate in the river (Morey et al., 1993).

Average cost per trip to the Penobscot River was estimated to be $137.33. Morey et al. also found through contingent valuation that elimination of the Atlantic salmon fishery on the Penobscot River would result in a mean loss if $810 per angler; a doubling of catch rates estimated a mean benefit of $511; and a halving of catch rates would result in a mean loss of $190 per angler. These values shed light into the very high consumer surpluses that arise from Atlantic salmon fisheries. All amounts are in 1993 U.S. dollars.

It has been touched upon earlier in the previous chapter that sometimes dam removal decisions require fisheries valuations. One case where this occurred was in the Pacific Northwest, along the Snake and Salmon Rivers. Construction of the Nez Perce Dam would have resulted in the blocking of migratory salmon runs up the Salmon and Snake River (Sewell and Marts,

1961). A secondary dam construction plan would have built two separate dams, but these dams would have blocked only the Snake River.

This dam removal decision process led to a benefit-cost analysis for each dam project. Substantial costs were realized when it was clear that the public held a high value for the fishery resource. Additional costs associated with the building of the two dam plan were then realized as the costs of fish preservation, the costs of substituting the two-dam plan for the Nez Perce Dam and the downstream preservation costs. Because the Nez Perce Dam would have generated more water storage, higher power capacities, the two-dam plan was considered as a reflection of the public's concern for the salmon fishery (Sewell and Marts, 1961).

It was then determined that significant costs to the fishery would arise if either dam plan was initiated. Total costs to fish and wildlife from the Nez Perce dam project were estimated at $12,540,000 and $17,600,000 for the two-dam plan (1961 U.S. Dollars). The results from this study illustrate that society places a very large value on the salmon fishery and is willing to pay a high price for fishery preservation (Sewell and Marts, 1961).

A final example is that of the valuation of the Kennebec River fishery conducted by Boyle et al. (1991). A valuation of the fishery to be created after dam removal was used in the decision-making process as part of the benefits of removal. Boyle et al. used travel cost and open-ended contingent valuation methods in a mail survey to Maine resident and non-resident fishing license holders (Freeman, 1995).

A. Myrick Freeman III used the data collected from the survey to estimate the value of the post-dam fishery (1995). Freeman determined the present

value of net benefits to be seen from removal to be $36.4 million. This value was calculated by using a $1.7 million estimate from Boyle et al. for the aggregate annual value from dam removal, and discounting this flow at 4% for 40 years (Freeman, 1995). The benefits estimates from the papers by Boyle et al. and Freeman ultimately led to the removal of the Edwards Dam in 1999.

These valuation techniques can be applied to many different types of natural resource goods. Cocheba and Langford (1978) give an analysis of the economic benefits that arise from hunting waterfowl. Grijalva et al. (2002) used a repeat-nested logit model to estimate the economic losses rock climbers would experience if a potential rule change by the U.S. Forest Service went into place. A study by Ajzen and Driver (1992) researched the willingness-to-pay of college students to spend time at the beach, go jogging or running, mountain climbing, boating and biking.

This chapter has presented an overview of natural resource valuation theory, as well as a description of two commonly used valuation techniques, the contingent valuation method and the travel cost method. The case studies presented in the final section describe some applications of these methods to the valuation of recreational fisheries. The Kennebec River is a special case where the valuation of the fishery led to a decision to remove the Edwards Dam. A more complete story of the Edwards Dam removal and the pre-dam removal fishery valuation is presented in the following chapter.