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APPENDIX A

ASSESSMENT OF METHODS FOR VALUING THE POTENTIAL LOSS OF FISH POPULATIONS IN THE SWAN RIVER DRAINAGE

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LITERATURE REVIEW OF

METHODOLOGIES TO EVALUATE RECREATION

ASSOCIATED WITH FISH IN THE SWAN RIVER DRAINAGE

I. INTRODUCTION

Our task in this study is to estimate the value of the loss to society associated with the likely reduction of fish populations when small hydroelectric projects are constructed on tributaries of the Swan River. The most useful techniques for such an estimation have been developed by economists, and reported in numerous professional journals. In this appendix we describe eight techniques and assess the ability of each estimate the value of a partial loss of a fish population. The eight techniques we assess are gross expenditure, travel cost, own-price-quality travel cost, demand-system travel cost, gravity model, hedonic travel cost, household-production-function, and contingent valuation.

II. DISCUSSION OF AVAILABLE ANALYTICAL TECHNIQUES

A. GROSS EXPENDITURE

The gross-expenditure method infers the value of a recreation site from the total of all expenses related to trips to the site. Expenses would include meals, lodging, equipment, clothing, ammunition, bait, guide services, rentals, and transportation. The value of a day spent by a user at a site is the total of all the expenditures made over the day. Thus, the annual value of a site would be the sum of all the expenditures for all the trips made by all users to the site.

The technique looks at gross expenditures, that is, all expenditures made on a trip to a recreation site. Included are purchases of goods not directly related to the value of the site. For example, a user not only purchases access to some Site A, but he also buys a steak dinner and sleeps in a hotel with a pool. All the costs of these other goods (the dinner and lodging) are mistakenly lumped together with the value of the site. A user might like Site B 20 dollars more than Site A, yet spend 30 dollars more on Site A trips than on Site B trips because of the great restaurant and motel near Site A. It is the restaurant, not the quality of Site A, which drives the gross expenditures. We could not conclude that the recreation provided at the site is superior at Site A, even though gross expenditures were greater.

The gross-expenditures method is a poor tool for valuing outdoor recreation sites. Too much of the variation in gross expenditures is related to the purchase of other goods not directly related to the site. There is no reason to believe that sites that are the destination of more expensive trips are necessarily more valuable.

B. TRAVEL COST

One component of gross expenditures, the travel cost to a recreation site, can help evaluate the site. The travel cost from residence to the site is part of the cost of using the amenities the site offers. In fact, travel cost is part of the cost of all of our daily purchases, such as vegetables, clothes, and movies. For typical consumer goods, however, the distance traveled tends to be small, especially relative to the purchase price of the good once at the destination. Thus, we tend to ignore travel cost when thinking about the price of traditional goods, even though it is non-zero. For outdoor recreation sites, though, the purchase price is usually zero or very small, whereas the distance traveled can be quite large. For outdoor recreation, one can often ignore purchase price and instead focus on travel cost as the price of a site.

In a given season, people will continue to travel to a site until the value of one more trip is no longer greater than the price. The same principle applies to all other goods purchased in the market: people continue to buy more of something until the value to them of the last (marginal) unit purchased is equal to its market price. Stated another way, people try to spend the dollars they have (their budget) on the mix of goods and services they think will make them as happy as possible. The extra relative happiness they receive from the last good purchased is reflected in the relative price of that good. Thus, the value to a user of last trip he makes to a site is equal to the price of that site, which is equal to the cost of traveling to that site.

Note the emphasis on "last" trip (economists call this the "marginal" trip). What about the value of previous ("inframarginal") trips? The inframarginal trips are generally worth more than the marginal trip. For example, the last ten gallons of water someone purchases on a given day might be worth only 1/2 cent, the price of the water. But she might have purchased a total of 75 gallons. If we restricted her consumption to 20 gallons, the 20th gallon would likely be worth more than 1/2 cent. If we restrict her to 1 gallon, she is likely to be willing to spend a great deal more than 1/2 cent per gallon to be allowed 2 gallons. For almost all consumption goods, people value an extra unit of the good less and less the more of the good they have. Thus, a fisherman's sixteenth trip to a fishing hole is not worth as much to him as his first trip was.

The critical issue in determining the value of a site is estimating how much more than the marginal trip the inframarginal trips are worth. The net value of a site is the difference between the benefits it provides and what users pay to get those benefits. What they pay is travel cost, which we assume does not depend on the number of trips made (i.e., the cost of marginal and inframarginal trips are equal). For every inframarginal trip, users get benefits beyond the value of travel costs. The sum of these extra benefits to all users is the net value of a site.

How does one measure the value of inframarginal trips? Looking at the behavior of a single individual facing a single price for trips, it is impossible to measure the value of inframarginal trips. All we know is that the inframarginal trips were worth taking (that they were at least as valuable as the travel cost to the site). We could ask a person about the additional value of these earlier trips, but such valuations are unreliable. Economists prefer to observe actual behavior rather than answers to hypothetical questions. (We discuss this later in the section on Contingent Valuation.) The travel-cost method developed by Hotelling (1949) and Clawson (1959) infers the value of inframarginal trips by observing the number of trips made to a site by people who live different distances from the site. Because they live different distances, they face different prices (travel costs) for use of the site. If we assume the people are otherwise alike (a strong assumption), then the different number of trips people take result entirely from the different prices (distances) they face. We can infer the value of the inframarginal trips for a person close to the site by looking at the value persons far from the site place upon their own marginal trips. For example, if people from 100 miles away go to a site once, the first trip (at $.20 per mile) is worth $40 (2 x 100 x .20). If people 90 miles away go to the site twice, the second trip is worth $36. If people take a third trip when they are only 80 miles away the third trip is worth $32. Figure 1 shows this relationship. The inframarginal value of trips can be measured by looking at the marginal value (which is observable) of users who took fewer trips.

INSERT FIGURE 1

The value of a given site to a user is the amount above the travel cost she will pay for each trip. The net value of the marginal trip is zero. For example, if one took the above site away from the people who lived 100 miles away, they would lose a trip which they value at $40, but they would save $40 of expenses. The net loss to these people is zero. If one takes the same site away from the people who live 80 miles away, they would lose three trips. The first trip they would value at $40, the second at $36, and the third at $32. On the other hand, they would save the travel expenses of three trips. The net loss would be $12 (($40 + $36 + $40) - (3 x $40)). Twelve dollars is what the users 80 miles away would pay for the all or nothing privilege of having the site exist. This net value is the <u>consumer surplus</u> of trips to the site--it is an appropriate measure of the value of a site. The sum of the consumer surpluses for all users gives an estimate of the net value of the site.

The travel-cost approach has several problems, some of them stemming from its underlying assumptions. First, to evaluate inframarginal trips the approach assumes that people at different distances from the site are similar. If this assumption is violated, then it is no longer possible to assume that everyone values the first trip the same. The price of the marginal trip for the people who take only one trip would no longer be an appropriate measure of the value of the first trip of people who take more trips.

A second problem can arise from the assumption that travel costs are incurred solely to arrive at the site. If people visit multiple sites, then part of the reason for making the travel expenditure is to enjoy the other sites. Attributing the entire travel cost to the target site would overstate what the person is willing to spend for the marginal trip to it. Also, since people from farther away are more likely to engage in multiple-purpose trips, it is possible to overvalue the first few trips users make and thus overestimate the consumer surplus of trips--the value of the site. Ideally, the analysis should be limited to single-purpose trips.

A third problem of the travel-cost approach is that it is difficult to determine travel cost per mile. Some users may look at their travel choices solely in terms of the out-of-pocket costs of the trip--the extra gasoline. Others may include maintenance and insurance costs. Others could value a mile driven at the same costs of renting a car. Some may also value the time spent traveling. Thus, the possible values for a mile driven could range from a few cents a mile to a dollar or two, depending upon the definition of travel cost. The estimated value of the site will vary in proportion to the value chosen for travel cost per mile.

(Note that other techniques we will describe are also plagued by these three problems. Revealed-preference techniques (such as the own-price-quality, demand-system, and hedonic travel-cost models) all are built on the travel-cost model. The household production function and gravity models also depend upon these same travel-expenditure assumptions to infer values.)

A fourth problem with the simple travel-cost model is that it measures the all-or-nothing value of a single site. For example, using travel cost one could estimate the total recreational value of the Swan River drainage. This would certainly serve as an upper bound of the value of a loss in fish population in the drainage. But the Swan River drainage, even with the reduced fish population, would nonetheless continue to provide recreational services. The total value of all recreation services in the drainage may grossly overestimate the partial loss of service that results from the reduced number of fish. The simple travel-cost technique is designed to value sites, not changes in the sites. As a measure of the value of fish, it is a biased upper bound.

C. OWN-PRICE-QUALITY TRAVEL COST

The own-price-quality travel-cost model was first developed by Vaughn and Russell (1983). The model is an extension of the simple travel-cost model to include quality of the site. With the own-price-quality model, the number of trips (Q_i) to a specific site is assumed to depend only on the price of getting to that site (P_i) and its quality (Z_i):

$$Q_i = f_i(P_i, Z_i)$$

$$Q_j = f_j(P_j, Z_j).$$

The model is appropriate if people have only one site to choose from in their region and if sites in different regions have different qualities. In a world with substitutions, however, we expect the prices and qualities of alternative sites to affect the number of trips a person would make to a specific type of site. The own-price-quality model assumes these substitute sites have no effect. In other words, each site draws consumers independently of all other sites. People living in residential areas close to a multitude of possible recreation sites will be very busy recreating: going to one site has no effect on their demand for recreation at any other site.

An advantage of the own-price-quality model is that it requires only a minimal amount of data. If one can reasonably assume that alternative sites are of little importance, the approach offers an easy methodology to evaluate quality. The quality parameters simply shift the demand for trips. The value of the quality improvement is just the added consumer surplus (see the shaded area in Figure 2) above the travel cost, summed for all users.

INSERT FIGURE 2

D. DEMAND-SYSTEM TRAVEL COST

The demand-system travel-cost model has been applied by Burt and Brewer (1981) and by Cichetti, Fisher, and Smith (1972). It looks at systems of sites instead of individual sites. Types of sites are ranked according to objective characteristics such as size, elevation, water resources, and other physical attributes.

The number of trips the consumer makes to each type of site is then compared not only to the cost of that site (the travel cost), but also to the cost of alternative sites. For example, the number (quantity) of trips a consumer makes to some site i (Q_i) depends upon the travel cost to (price of) of that site (P_i), as well as the price of substitute sites (P_k). We represent this relationship as:

$$Q_i = f_i(P_i, P_k, W)$$

$$Q_k = f_k(P_i, P_k, W),$$

where W represents demographic differences among users that might influence their desire to visit the site (such as their age, sex, or income).

The demand-system approach offers two improvements over the simple travel-cost method. First, the demand system, by taking account of substitutes explicitly, does a better job of measuring the value of any single site. Clearly, the demand for a nice, medium-sized lake will be different if the lake is located in Minnesota or Arizona (where there may be thousands or only a handful of substitutes). Secondly, the demand system offers a chance to value changes in the nature of the site. As long as one is considering changing an existing site, say i, to physically resemble another existing site, say k, the value of the change can be measured by the demand system.

Figure 3 shows how, in concept, such a measure would be made. The first graph shows demand for site type i, the second for site type k. Assume in this example that type k is higher

INSERT FIGURE 3 HERE

quality. If we change a type-i site to resemble a type-k site, we expect two major effects. First, there is now one less type-i site and one more type-k site. Some people will now have to travel farther to find a type-i site (because the one they used to go to is now type-k) and some people will now have shorter trips to find a type-k site (for similar reasons). The horizontal dotted lines shows the effect on a hypothetical marginal travel cost: the cost curve increases (rises) for the type-i site, and decreases (lowers) for the type-k site. Secondly, substitution occurs because the price of the type-k site has dropped relative to the price of the type-i site: the demand curve moves in for the type-i site, and moves out for the type-k site. Consumer surplus (the area in the triangle made by y-axis and the new demand and cost curves) decreases at the type-i site and increases at the type-k site. The net gain in consumer surplus is the value of the increase in quality from type-i to type-k.

The demand-system travel-cost method could be used to value change in fish population if it is possible to identify types of existing sites which resemble the transformed site, and if data are available about use of a wide variety of sites.

E. GRAVITY MODEL

The travel-cost model was developed to evaluate sites; the gravity model was developed for transportation engineers to predict travel burdens on highway networks. In principle, the two models are identical. The sophisticated gravity model uses a person's demand for trips to predict the number of trips she will take and where she will go.

The simplest gravity model predicts trips in terms of the quality of the site (Z) and the cost of getting to site j from residential location i (the travel-cost function, $f(C_{ij})$):

$$T_{ij} = KZf(C_{ij})$$

where T_{ij} is the number of trips per capita and K is a constant. Note the similarity between this model and the own-price-quality model. An implicit assumption of the model is that the number of trips from each residence i to each site j is not affected by any other possible sites.

Another common gravity model predicts trips in terms of the relative quality of each site to all other sites. Total trips are assumed exogenous (i.e., they are not derived by the model, but are inputs to it). The model merely allocates the total across the available sites (m sites):

$$T_{ij} = KZf(C_{ij}) / \sum_{n=1}^{m} (Z_n f(C_{in}))$$

The model is more realistic in its handling of the interrelationship across sites because it explicitly acknowledges the relevance of substitutes. That benefit is offset by its assumption that total trips are exogenous; one would expect that total trips would depend on the opportunities facing residents at i.

The most general gravity model resembles the advanced travel-cost models (demand-system and hedonic travel cost). The trips function has the following form:

$$T_{ij} = Kg(mZ_n f(C_{in})) \cdot h(Z_j)f(C_{ij}) / \sum_{n=1}^{m} (Z_n)f(C_{in}).$$

where f( ) is the travel-cost function, g( ) is a function for total trip opportunities, and h( ) is the site-characteristic function. The division of trips across sites depends upon both the site's characteristics and the travel cost relative to those of other sites.

The exact functional form assumed for $f(C_{ij})$ and h(Z) determines the shape of the underlying demand curve. Though users of the gravity model tend to assume reasonable functional forms, they often restrict themselves to unnecessarily rigid specifications. They also have failed to construct adequate submodels of the role of site characteristics h(Z). For example, Cesario and Knetsch (1976) use an attractiveness index which they define subjectively based on the popularity of the site. They did not estimate the correlation between attractiveness and objective characteristics. Further, there is a possibility that attractiveness may reflect site access, a variable supposedly captured by the travel-cost function $f(C_{ij})$. Finally, most users of the gravity model appear to be unaware that the specification of the gravity model implies a particular underlying demand function. For example, Sutherland (1982), estimates both a demand function and an inconsistent-trip generation function in the same analysis. The trip generation function recognizes substitute sites whereas the demand function does not. The estimated shapes of both functions are inconsistent with each other. The true tastes which generated the trip function could not have also produced the estimated demand function.

The primary use of the gravity model is to estimate trip generation for the purposes of transportation planning. For valuing recreation, those trips must still be transformed into a demand function for recreation. Consequently, it is generally preferable to estimate the demand-for-trip model directly.

F. HEDONIC TRAVEL COST

The hedonic travel-cost method, developed by Brown and Mendelsohn (1980), combines the hedonic procedure now familiar in the literature of urban and labor economics with the traditional Hotelling-Clawson travel-cost method. Recreation sites are viewed as bundles of homogeneous characteristics. For each trip the price or cost of purchasing a bundle for a trip is the marginal travel cost from an origin to the recreation site. By examining the variety of purchases of a group of people from a single origin, one can to estimate the marginal expenditures necessary to purchase additional units of each characteristic.

Armed with these "prices" of characteristics, one can estimate the demand for each by comparing origin residence zones which have varying access to sites.

The initial step of the technique is to estimate the price people must pay to obtain more of each characteristic. By regressing travel costs upon the bundle of characteristics people can purchase at each site, it is possible to estimate these marginal prices for each characteristic. Thus, for the set of plausible sites facing each residence area (each origin), one performs the following regression:

$$V = f(Z_1, Z_2, \ldots, Z_n)$$

where V is travel cost and Z_i is the level of each characteristic. As discussed in the travel-cost section, the travel cost is the total cost of traveling from the residence to the site. It includes time cost, out-of-pocket expenses, and wear-and-tear on the vehicle. The exact dollar value per mile to place on travel cost is somewhat uncertain making the final dollar values of site characteristics uncertain as well. The probable value, in 1982 dollars, is about $.25/mile.

Every characteristic of importance should be included in the analysis. Data limitations, however, often force the analyst to choose from a more limited set. In the case of Montana fishing sites, it is probably adequate to choose three variables: fish density, fish size, and scenic quality. Fish density--the availability of fish--can be conveniently measured in average catch per unit effort (e.g., catch per ten days fishing). Because this measure is supposed to reflect the quality of the site and not the skills of the fisherman, catch rates should be averaged across all the sampled fishermen at each site. To value specific types of fish, separate estimates of fish density must be made for each species. The same is true of fish size (average size of catch). Scenic quality is more difficult to measure objectively. In practice, it might be sufficient to identify whether a site has below-average, average, or above-average scenery.

Having performed this initial step for each residential site in the sample, one can calculate the price each person in the sample faces for each characteristic. This price describes how much a person is willing to pay to improve each characteristic slightly. For small changes in site characteristics, these prices provide a reasonable measure of site changes. For example, if the price of fish density were $1.25 per catch per twenty days, and mean catch per 20 days were reduced from 10 to 9, the value of the change would be $1.25 per trip. To estimate the total value of the site change, one would simply multiply the $1.25 per trip times the total number of trips to the site.

For large changes in site quality, the price becomes an increasingly inaccurate measure of the change. For major improvements (deterioration), the price overestimates (underestimates) aggregate value. Large changes affect the price of the characteristic so that it is no longer desirable to value quantity changes at a single price. For large changes in the site, it is desirable to include the effect of price changes in a measuring consumer surplus. Consumer surplus is the area under the demand curve and above the cost curve (P): the value of the recreation to consumers after travel costs have been subtracted (see Figure 4). To measure the consumer surplus of a

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large change in a site characteristic (for example, a decrease from Q_1 to Q_2) one must first estimate the demand for the relevant characteristic. The value of the change (in this case, a loss) in quality is the change in (loss of) consumer surplus (the shaded area) associated with the price change from P_1 to P_2. In this study, the relevant issue is the demand for and consumer surplus of fish density.

We can estimate demand for fish density by observing how much fish density is purchased by users who face different prices for fish density. That is, by comparing the behavior of near and far fishermen, we estimate how fishermen value access to the fishery. Removal or enhancement of a site, after all, only changes how far the fishermen must drive to obtain a site of the desired quality. The inverse demand (where the inverse demand function describes what the consumer is willing to pay for each level of characteristics) for the fish density of each species can be obtained by regressing the price of the characteristics on the level of each characteristic:

$$P_1 = g(Z_1, Z_2, \ldots, Z_n, W)$$

where W represents demographic differences among users that might influence their desire to visit a site. The equation above is for estimating P_1, the price of characteristic Z_1; an additional equation would be estimated for each additional characteristic. This regression must be done across the entire sample, including all the residential zones in the same analysis. The shape of the estimated demand function, in turn, will lead to an estimated consumer surplus for any specified change in characteristics.

The advantage of the hedonic travel-cost method is that it focuses upon valuing site characteristics such as fish density. Consequently, it is designed to value exactly the good in question. The disadvantage of the approach is that it requires substantial data about site characteristics and user behavior. Such data are generally unavailable; a specific survey must be undertaken to collect them.

G. HOUSEHOLD-PRODUCTION-FUNCTION

Whereas traditional demand theory is concerned with the demand for goods observed to be purchased in the market place, the household-production-function approach concerns itself with goods produced at home. Households are perceived as suppliers of commodities which they in turn consume. They produce these commodities by combining purchased goods, household technology, and time. For example, a hunter might combine a site, ammunition, a rifle, and time to produce a day of hunting and a kill. Note that in contrast to the travel-cost methods, the focus of the valuation is not the site but rather what the household produces at the site. The purpose of the household-production-function approach is to value household outputs such as fish caught; it cannot directly value the fish population of each species. The amount a fisherman is willing to pay for the fish he takes home is a gross measure. This gross measure is the sum of what the fisherman is willing to pay for the fish population plus what it costs him to actually catch the fish. In our analysis of fishing in the Swan River basin, the desired social measure is the net value of fish--how much each user would pay to have the fish population increased (or not decreased). The gross measure is an overestimate of willingness-to-pay since the fisherman would still have his expenditures of money and time if he did not fish at all. To arrive at a net value, one must subtract the value of time and other expenses from the gross measure of catch value.

The mechanics of the household approach are similar to those of the hedonic travel-cost method. In the first stage, a cost function is estimated. The total expenditure of the trip (the gross expenditure including total time, not just travel costs) is regressed upon all the outputs produced. For a fishing trip, the obvious outputs are days fishing and catch. One must be careful, however, to include other possible objectives such as days of solitude, outdoor experiences, culinary events, or attractive lodging, which the fisherman may also be seeking in his trip. This regression allocates the expenditure made over the set of possible outputs. The partial derivative of this estimated cost function reveals the price of each output. Given exogenous demand-shift parameters which reflect only differences in taste, the demand for the output can be estimated in a second-stage regression.

The estimation of the demand for the outputs of the household production function are plagued by econometric difficulties. The absence of measured outputs tends to bias the estimation of the cost function. The household-production-function requires data about preferences that are hard to collect: getting a list of all the activities that provide pleasure during a recreation experience is difficult and expensive. It is also hard to distinguish between time as a cost (a lost opportunity to do something else, including work) and time as a measure of output (such as days fishing or hiking). Time spent is more likely to be integral to the experience the less is the total time available to achieve the experience. The presence of nonlinearities and joint production causes marginal prices to vary with the level of outputs purchased. The endogeneity of prices, in turn, leads to identification and selectivity bias problems in the estimation of the structual equations. All these problems confound the estimation of the household-production-function approach and prevent its useful application.

Given the difficulty of estimating the demand for the outputs of user activities, and given the policy need to estimate the demand for inputs (sites) rather than outputs, the household-production-function approach is not applicable. It is not user days which need to be valued, but fish populations. Alternative approaches such as the hedonic travel-cost method, which directly value inputs, are preferable to indirect methods that value outputs which then must be converted back to inputs.

H. CONTINGENT VALUATION

The contingent-valuation procedure, unlike the seven other methods mentioned here, does not depend on user behavior. Instead, the value of desired commodities is revealed by how a person responds to a battery of hypothetical questions. By constructing the correct set of questions, the researcher tries to get the individual to reveal the true values.

Although the contingent-valuation approach seems the most straightforward of the methods described, it is one of the most difficult of the approaches to apply. Contingent-valuation designs have six potential biases: hypothetical, strategic, payment-vehicle, starting-point, information, and interviewer bias.

Hypothetical bias refers to a random error that results from a respondent's answer not truly corresponding to observable behavior in a real situation. The problem arises because the person does not fully visualize the hypothetical setting, fails to account for all her feelings when put in such a setting, or does not wish to reveal her true values.

The strategic bias suggests the individual intentionally mis-states his preferences to force others to share his values. For example, someone who likes a certain public good has an incentive to overstate that preference in the hopes that the good's high value will ensure its continued provision.

Payment-vehicle bias reflects the fact that responses to questions of value are influenced by the method of payment and whether respondents are to pay or be paid. Payment-vehicle bias is often used to explain the large number of protest votes encountered whenever the contingent-valuation method is used. Payment-vehicle bias, by identifying who must pay, also explains the large discrepancy between what people offer to pay versus what they think they should be paid for changes in public goods. Neither answer reflects solely the value of the good; it also reflects a sense of values about how goods should be paid for.

Starting-point bias originates from willingness-to-pay questions that request specific amounts people must pay. By starting at $25 rather than $1, the survey question implies that $25 is a low bid. People sometimes respond accordingly, with the average bid rising proportionately with the starting bid.

Information bias originates from the "facts" presented in the hypothetical question. For example, if one begins by saying that air pollution is a known health hazard and ecological disaster, one obtains a different response than if one begins by stating that air pollution is a necessary by-product of our standard of living and causes little effect. The phrasing of the hypothetical situation consequently can alter the responses.

Interview bias arises from the fact that interviewers are different and can impose their values upon respondents. Untrained interviewers might rephrase questions to interpret them for the respondents. Depending upon the interpretation of the interviewer, a different set of responses would be forthcoming. If a researcher gives interviewers careful training, interview biase can be overcome.

To provide representative answers, questions must be phrased to avoid each of these potential pitfalls. Unfortunately, not enough is known about this art to assure the accuracy of any single survey instrument. At a minimum, a variety of questions should be asked. If all the responses are consistent, the survey instrument is, at least, robust. Additional comparisons between the survey method and alternative sources of information would also provide useful indicators of the validity of the method.

Although difficult to apply, the contingent-valuation method is clearly relevant to the valuation of fish population changes. By asking the correct battery of questions, it may indeed be possible to determine the value of such changes from the answers users provide.

III. CONCLUSION

To measure the net economic loss associated with the potential loss of fish population in the Swan River drainage, we propose to adopt three independent methodologies: travel cost, hedonic travel cost, and contingent valuation. The first two techniques estimate values based upon the observed opportunities and choices of users. The contigent evaluation method, in contrast, poses a set of hypothetical questions designed to elicit the true values of respondents. By adopting three separate approaches, we hope to increase the probability of making a reliable estimate and also compare the strengths and weaknesses of each methodology.

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