Concepts of Value for Marine Recreational Fishing

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Recreation is an important use of marine fisheries resources. U. S. fishermen spent more than 536 million days[1] engaged in saltwater or searun fishing in 1975 (U. S. Fish and Wildlife Service). Public decision makers concerned with the management of these resources face critical decisions that will influence recreational fishing.

The benefit-cost criterion is one guide for making these decisions. This paper focuses on procedures for estimating changes in marine recreational fishing benefits under resource management options. The theoretical basis for such estimation is clear and there are a number of good studies to guide the research. With benefit-cost analysis it is appropriate to use the maximum willingness of users to pay to measure gains in benefits, and minimum desired compensation to measure losses. Thus when benefits exceed costs it is possible for those who gain to compensate those who lose, such that no person is worse off and some are better off. These same concepts are applied to market goods such as commercially-caught fish, thus making it possible to evaluate changes in benefits resulting from an option that reduces the commercial catch of salmon; but increases the catch by sportsmen.

The value of marine recreational fishing experiences depends heavily on their quality and location with respect to users and substitute opportunities. Management options are likely to influence the quality of opportunities in a particular area such as a bay or sound. Thus it is not appropriate to estimate average values for an activity or a large geographic area, but rather values associated with a particular area.

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Willingness of users to pay is the appropriate measure of increase in benefits directly associated with an option (e.g., fishing benefits stemming from an increased stock of fish). Willingness to pay for recreation at an area is ordinarily approximated by an area under the demand curve for use of that area. This includes the actual user fees, if any, plus an approximation of the additional amount that consumers are willing to pay (consumers' surplus) rather than go without using the area. This approximation is likely to be satisfactory for recreation because extracting the full willingness to pay for each unit of the good from consumers would not raise expenditures sufficiently to shift the demand curve (i.e., there would be a small income effect). Willig provides formulae for identifying the error in that approximation.

Willingness to Sell

For evaluation of benefits lost by elimination of existing resources (e.g., fishing benefits lost when a bay becomes severely polluted), it is appropriate to measure the lost benefits in terms of willingness of users to sell, i.e., the minimum compensation required to ensure that present users would be not better nor worse off after receiving this compensation than they would be without the option being undertaken. Willingness to sell, like willingness to pay, may be approximated by an area under the demand curve. As with willingness to pay, explicit bounds may be set on the approximation using the formulae presented by Willig.

Empirical evidence obtained from surveys of recreationists

(Hammack and Brown) indicates that willingness to sell exceeds willingness to pay by amounts far in excess of the expected difference. The precise explanation for the wide difference is not yet known, but weakness in the survey instruments seems likely. While accurate measurement of willingness to sell presents numerous difficulties, there is no question that it is the proper measure of lost benefits. From a practical standpoint, it is at present best to present willingness to pay as the lower bound estimate of lost benefits from destroyed resources with the recognition that with especially desirable or unique resources this may be a significant underestimate of the lost value.

In the absence of market prices for marine recreational fishing, demand is estimated from user behavior (the travel-cost-based approach) or their responses to questions (the survey-based approach). Dwyer, Kelly, and Bowes provide detailed procedures for use of these approaches and discuss the relative merits of each.

The Travel-Cost-Based Method

The travel-cost-based method makes use of a model for predicting use of an area that can be summarized by:

$$(1) \quad V_{ij} = f(C_{ij}, T_{ij}, P_j, \phi_i, D_i, Q_j, C_{ik}, T_{ik}, Q_k)$$

Where:

V_{ij} = the number of trips from origin i to area j

C_{ij} = travel cost between the origin i and area j

T_{ij} = travel time from origin i to area j

P_j = the entry fee for use of area j

ϕ_i = the population of origin i

D_i = characteristics of individuals at origin i

Q_j = the quality or characteristics of area j

C_{ik} = the vector of travel costs to all substitute sites ($k \neq j$) available to users from origin i

T_{ik} = the vector of travel times from origin i to substitute areas ($k \neq j$)

Q_k = the vectors of quality characteristics of substitute areas ($k \neq j$)

The model should include those factors that are expected to explain use, particularly the variables likely to be influenced by management options. Estimates of the parameters are based on trips from various origins (i) to an area (j). The wide range of costs and substitutes facing individuals at different distances from an area as well as varying populations at each origin provide considerable information about the influence of these variables on participation. In order to estimate the influence of the quality characteristics, Q_j, it is preferable to jointly estimate the model for a number of areas that have different levels of Q. The model can be used to estimate visitation expected under new or modified conditions, provided that estimates of the relevant variables are available.

An estimated model can be used to derive an aggregate demand curve for each existing area within the region of study by increasing the user fee, P_j, and solving for expected use from the origins.

Significant advances in travel-cost-based methodology include the extensions by Burt and Brewer; Cesario and Knetsch; Knetsch, Brown, and Hansen; and Cicchetti, Fisher, and Smith. These recent models incorporate regional estimation procedures that provide analytical frameworks

which take explicit account of alternative recreation opportunities. That is, they jointly estimate the demand for existing areas of various quality, thus allowing the prediction model to account for interaction among areas in attracting visitors. These procedures make it possible to improve significantly on the methodology used by Stevens in his early study of the influence of water quality on benefits from recreational fishing.

The Survey-Based Method

The survey-based method is used to estimate the value of a recreation experience from responses to a questionnaire or a personal interview. It is helpful to view the survey method as having two stages, although they may be combined. An initial survey is aimed at developing a model to predict an individual's willingness to pay for use of an area. Explanatory variables should include those factors that are expected to be altered by the options to be evaluated.

To estimate the value of an existing area, a second survey is aimed at a larger sample in order to identify the user population and values of the explanatory variables. Using the results of this survey and the equation which explains individual willingness to pay, the valuation of each user is calculated and summed to estimate total willingness to pay. Evaluation of a quality change relies upon the estimation of willingness to pay over a wide enough cross section of quality levels to identify the influence of such a change on the willingness of users to pay. Another survey-based approach to evaluating proposed situations is to pose hypothetical conditions to users and determine their willingness

to pay under those conditions. Cicchetti and Smith used this approach to evaluate the impact of alternative levels of congestion on the willingness of users to pay for a wilderness experience.

Past applications of the survey-based method to recreation (Davis 1963, 1964; Hammack and Brown; and McConnell) developed equations to predict an individual's willingness to pay for a visit or season that can be summarized by:

$$(2) \quad WTP = g(Q_j, D_j)$$

Where: WTP = an individual's willingness to pay for visit or season of use

Q_j = the quality or characteristics of area j

D_j = the characteristics of the users of j

Variables reflecting travel-cost, travel time, and alternatives ordinarily included in the travel-cost-based model are not included in the survey-based model. It is assumed that they are reflected in user responses.

Quality Variables

A number of factors are likely to influence the quality of the fishing experience and many of them may be influenced by management options. Therefore in applying the travel-cost-based and survey-based methods to the evaluation of marine recreational fishing it is critical that quality (Q_j in expressions 1 and 2) be given special attention. Stevens found that success ratio at a particular site was a significant determinant of angler participation rates for salmon and steelhead fishing. Brown, Charbonneau, and Hay (1978b) found that number of fish caught was a significant variable in equations for explaining the willingness

of users to pay for a number of types of fishing. McConnell and Norton posed additional quality variables to include crowdedness or congestion in the fishing area, services provided by charter industries, composition of the catch, size of fish caught, and weather or sea conditions. The various approaches to reflecting congestion and quality in recreation benefit estimation models are summarized by Ravenscraft and Dwyer (1978a, 1978b).

An expression such as the following might be advanced to explain the quality of marine recreational fishing:

$$(3) \quad Q_j = q(H_j, C_j, W_j, O_j)$$

Where: H_j = the harvest of fish, in numbers, species, total weight, total length, etc.

C_j = the crowding at area j in numbers of boats or or fishermen per unit of area, number of encounters between fishermen, etc.

W_j = weather conditions, average or maximum temperature, cloud cover, etc.

O_j = sea conditions, wave heights and tides.

Catch rate, H_j, may be influenced by a number of variables, including the stock of fish, number of fishermen, fishing regulations, angler skill, information made available to fishermen, and weather and sea conditions. The skill variable, often measured in terms of experience with the area or activity has been a significant variable in models for evaluating forest recreation (Davis 1963), hunting in Maine (Davis 1964), waterfowl hunting (Hammack and Brown) and beach use (McConnell).

The following expression might be proposed to explain catch rate:

(4) $H_j = h(S_j, N_j, R_j, L_j, W_j, O_j)$

Where: S_j = the stock of fish at area j

N_j = the number of fishermen at area j

R_j = fishing regulations for area j

L_j = angler skill

W_j and O_j are defined above

Continuing Research Efforts

Significant improvements continue to be made in the procedures for estimating the willingness of users to pay for recreation opportunities. Major improvements in the travel-cost-based method have included better procedures for building in substitutes, quality, and travel time, and applying the model to new types of situations. The survey-based method has received less attention, but in recent years there has been increased efforts to apply it to fish and wildlife resources and the evaluation of congestion. Much of the recent work on the survey method has been conducted or sponsored by the U. S. Fish and Wildlife Service (Charbonneau and Hay; Brown, Charbonneau, and Hay 1978b). An interesting and potentially useful component of that effort has been directed toward the hedonic pricing approach.

Lancaster proposed an approach to consumer theory that focuses on consumer satisfaction derived from attributes associated with particular goods, rather than the goods themselves. This perspective, which is the basis of hedonic pricing, has intuitive appeal for evaluating changes in the quality attribute of marine recreational fishing.

Hedonic prices for quality are implicit prices of an area's

attributes revealed through recreation expenditures by a cross section of individuals using areas with a range of qualities. The basis for deriving the prices is the presumption that differences in quality will be reflected by differences in user expenditures. In principle, if over all areas there is enough variation in each characteristic of interest, then it is possible to estimate the willingness to pay for a marginal change in those characteristics.

With hedonic pricing the first task is to establish an empirical hedonic price function linking observed expenditures and area characteristics and use. Second, implicit prices (marginal willingness to pay) are estimated for each user from the quality derivatives of the hedonic price function. Finally, the individual's quality demand function for an area is evaluated by empirically relating an individual's implicit prices and chosen area characteristics and use level. Benefits associated with changes in quality are then evaluated as changes in the areas under each individual's demand curve for quality.

The method is not greatly different than a travel-cost-based approach with quality characteristics included as explanatory variables. This is especially true when travel is a major component of user costs or there is very little variation in other expenditures possible. The experience with using the method for recreation evaluation is at present limited and tentative. The reader is refered to Rosen for the clearest exposition of the theory. Harrison and Rubinfeld offer a good presentation of the method applied to evaluate the costs of pollution through housing prices. There is little published work in the recreation area. Brown,

Charbonneau, and Hay (1978a) provide one example. Other work is underway.

Summary and Conclusions

Public decision managers concerned with marine resources continue to face important decisions that promise to affect recreational fishing. Benefit-cost anlaysis is one of the criteria taken into account when these decisions are evaluated. The willingness of users to pay is the appropriate concept of value for gains in benefits while willingness to accept compensation (willingness to sell) is the appropriate concept for losses. Both concepts can be estimated from a demand curve for recreation at a particular area.

The travel-cost-based and survey-based methods can be used to estimate the demand for and value of marine recreational fishing. Many of the resource management options that are to be evaluated are likely to influence the quality of marine recreational fishing, consequently it is critical that the quality of the fishing experience be reflected in the analysis.

There has been much improvement in the travel-cost-based model over the past two decades and a current resurgence of interest in using the survey-based model to evaluate fish and wildlife resources. Hedonic pricing offers a new and interesting approach to the evaluation of changes in quality.

Footnotes

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[1] Includes any portion of a day engaged in that activity.

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