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ECONOMIC INFORMATION IN U.S. FISHERIES POLICY: GAPS BETWEEN THEORY, INFORMATION AND CAPABILITY

by

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ABSTRACT

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Fisheries management agencies in the United States are increasingly being called upon to incorporate economic and social information into fisheries management decisions. This increased "people orientation" of fisheries management is limited by two factors. First, the base of empirical studies on which to draw for the needed information frequently contains results which are only partially applicable to the policy decision. Second, fisheries management agencies in most cases do not employ economists or other social scientists at the policy making level who are involved in the design of management policies which provide appropriate economic incentives and incorporate the limited information which is available.

Empirical results are limited for two reasons. First, there has been rapid improvement in theoretical and quantitative models for estimation of the net economic value or welfare of fisheries resources (consumer surplus, producers surplus, etc.). As a result, there has not been sufficient time for the accumulation of empirical information about fishery resource values based on consistent theory and estimation methods. Second, there is a bias in U.S. funding of research toward the development of new theoretical and quantitative tools to the neglect of obtaining the needed empirical estimates on which to base management decisions.

Resource management agencies in the U.S. fail to employ economists at the policy making level for two reasons. First, resource management agency heads have not made the transition from the "management of fish" to the "management of people." Second, they are not aware of the contributions that economists make to the policy frameworks of other areas such as agriculture. The major focus of this paper is on discussion of the gaps between theory and resulting empirical knowledge, with a more limited focus on how the lack of economists at the policy making level limits the types of policies in place for U.S. fisheries. There are two major requirements if economics and other social sciences are to take their proper role in fisheries management. First, increased support for the data base and the social science research base is required. Second, economists and other social scientists must become integral parts of the fisheries management policy process.

ECONOMIC INFORMATION IN U.S. FISHERIES POLICY: GAPS BETWEEN THEORY, INFORMATION AND CAPABILITY

Introduction

Fisheries management agencies in the United States are increasingly being called upon to incorporate economic and social information into fisheries management decisions. This call comes in part from an increased desire by policy makers to base policy decisions on the economic contribution of the various fisheries being managed, and on the potential economic contribution of alternative management strategies to the values generated by the fisheries. Many of these concerns involve enterprises beyond the fishery. Toxic emissions, for example, have major implications for fisheries, but must be complied with by manufacturing and other industrial enterprises which are outside the usual scope of fisheries managers.

In addition, over-exploitation of many fisheries as a result of increased pressure by commercial and recreational interests has shown the failure of management policies which "manage for fish" rather than "manage for people." In recent experience, every new seafood fad in the U.S. has resulted in the depletion of one or more fish stocks. The blackened redfish case is a recent striking example. Numerous other examples are emerging along the east coast of the USA. Fresh fish counters in the USA now contain many wild-caught seafood species that were ignored five years ago. Calls for new tools of management to prevent over exploitation of fisheries and address the needs of commercial and recreational anglers are increasingly heard. These tools are largely within purview of the social scientist, and not of the biologist/manager.

The increased implementation of a "people orientation" in fisheries management is limited by two factors. First, the base of economic theory and empirical studies from which to draw the needed information frequently contains results which are only partially applicable to the policy decision. Rapid development of new theoretical concepts and a lag in empirical studies using these concepts means our empirical information base is not adequate. Second, fisheries management agencies in most cases do not employ economists or other social scientists at the policy making level. For people oriented policies, economists and other social scientists must be involved in the design of management policies with appropriate economic incentives which incorporate the limited information which is available.

What we face in the USA is a diminishing data base of fisheries information, a limited number of studies of the recreational demand for particular fisheries, and very limited experience with economic based management strategies. The primary objective of this paper is to examine the gaps between economic theory and the resulting empirical knowledge base needed to evaluate fisheries and to develop appropriate economic based policies to manage fisheries. A second objective is to show by implication how economists and other social scientists can contribute to fisheries management policy. An implicit final objective is to show how the lack of economists and other social scientists at the policy making level limits the types of policies in place for U.S. fisheries. There are two major requirements if economics and other social sciences are to take their proper role in fisheries management. First, increased support for the data base and the social science research base is required. Second, economists and other social scientists must become integral parts of the fisheries management policy process.

Barriers to Improved Information and Policies

The empirical information base is limited for two reasons. First, there has been rapid improvement in theoretical and quantitative models for estimation of the net economic value or welfare of fisheries resources (consumer surplus, producers surplus, etc.). The travel cost approach has been improved significantly since it was first suggested by Hotelling (1949), both in terms of theoretical specification and of empirical estimation (see Table 1 for definitions of terms). In addition, the contingent valuation (CV) approach is a more recent approach which provides the potential to estimate existence and option values of recreational resources as well as user values. Likewise, the status of economic policy tools such as taxes, subsidies and transferable quotas is largely one of textbook models with few specific applications to particular problems or settings. The experimental use and study of Individual Transferable Quotas (ITQs) is a notable exception. There has not been sufficient time for the accumulation of the necessary broad empirical information base about fishery resource values or the effectiveness of economic management tools based on consistent theory and empirical methods.

Second, there is a bias in USA funding of research toward the development of new theoretical and quantitative tools to the neglect of obtaining the needed empirical estimates on which to base management decisions. While the development of new theoretical approaches has been highly productive, balance is needed between the theoretical and empirical if the information base for policy is to be adequate.

Rapid Development of Theory

The economic theories underlying the evaluation and management of natural resources are relatively new. As a result, the core models have changed substantially as economists have attempted to resolve core evaluation and management issues. The development and implementation of new tools to evaluate and manage recreational and commercial fisheries are discussed. The economic evaluation literature is discussed first followed by a discussion of the status in using economic policy tools in fisheries management.

In the economic management of fisheries, there are two elements of the information base which are essential. First, information is needed about how various fisheries are valued for recreational and commercial purposes. For commercial fisheries which sell their product in economic markets, standard market economic tools are usually sufficient if adequate data exists and major externalities are not present. To obtain this information for recreational fisheries, one needs an adequate data base on the recreational behavior of people and reliable estimates from this data base on how people value various recreational sites. Second, studies of the response of commercial and recreational anglers to alternative tools or techniques for the management of a fishery are required. In this section, I focus first on the evolution of tools to estimate the economic value of recreational fisheries, followed by an evaluation of our ability to use economic tools to manage fisheries.

Economic Valuation of Recreational Fisheries

The major national source of data for recreational fishing behavior in the USA is the National Survey of Fishing, Hunting, and Wildlife Associated Recreation published every five years by the U.S. Fish and Wildlife Service. Most recreational studies, however, are based on special data surveys for the particular fishery being studied.

Hotelling (1949) made the original suggestion for the travel cost method (see Table 1). Dwyer et al. (1977) review early development of the travel cost method which involved estimation of the equation

(1) Trips/visits = f(trip cost, population of zone, proximity of substitute sites, site quality).

These early models were estimated using zonal or area data on number of visits from predefined zones and characteristics of each zone from which visits were made. As researchers began to collect data on individual recreational behavior, they began estimating travel cost models using this individual based data. Most of these estimates were biased in one or more ways, through use of continuous estimation methods on truncated data sets, use of data which did not sample the complete population of potential users of a site, and omission of the value of travel time. Sorg and Loomis (1984), Walsh, Johnson and McKean (1988) and Smith, Palmquist and Jakus (1989) have developed procedures to adjust these biased estimates to a more comparable basis.

However, comparison with more recent studies using unbiased procedures suggest that these adjustments are not adequate. Table 2 provides the estimates of economic value per day from AFS (forthcoming 1992a). Nearly all of the travel cost (TCM) estimates were made using ordinary least squares and adjusted using Sorg and Loomis. Two exceptions are the Ohio estimates for walleye and yellow perch, which were estimated using a truncated least squares or conditional maximum likelihood estimator. The comparable estimates from ordinary least squares were about $25 per day, or five times greater (Hushak et al. 1988). The Sorg and Loomis correction is about 20 percent.

Perhaps the most important development was the derivation and standardization of censored and truncated econometric procedures (Maddala 1983). These procedures permitted joint accounting for changes in participation rates and for changes in the frequency of participation as trip costs changed. There were important theoretical developments as well. In what follows, I limit discussion to developments within the travel cost literature, excluding discussion of contingent valuation methods.

Bockstael, Hanemann and Strand (no date) and Bockstael, Strand and Hanemann (1987) developed models which distinguish between those who can substitute work and leisure time and those who cannot. Kealy and Bishop (1986) specified their model in terms of recreation days rather than trips or visits in order to account for trips of varying duration. McConnell and Strand (1981) and Smith, Desvousages and McGivney (1983) provide techniques for estimating the value placed on human time during recreation trips. Pollak and Wales (1980, 1981) provided models for the incorporation of demographic characteristics of recreators into demand models. The repackaging model of Wilman (1987) specifies a procedure where trips of differing characteristics can be grouped into subsets of trips, and then demand functions for each type of trip with substitution between types of trips are estimated.

What is probably the most prominent approach uses a two-step hedonic model originally proposed by Rosen (1974), called the Hedonic Travel Cost Function (Smith and Palmquist 1989, Smith, Palmquist and Jakus 1989). In the first step, hedonic equations of the form

(2) Price = f(quantity/quality of recreation site amenities)

are estimated. In step 2 called the Hedonic Travel Cost Function, the hedonic price (the regression coefficient of each amenity in equation 1) is regressed on the vector of amenities

(3) HP = g(quantity/quality of recreation site amenities)

where HP is the hedonic price.

A major problem with this approach is that the coefficient of each amenity in equation 2 is regressed back on the quantity of that amenity in equation 3. Brown and Mendelsohn (1984) propose market segmentation where separate hedonic equations 2 are estimated for each market segment. The "independent" estimates of the hedonic price of each segment are then used to estimate equation 3. Kriesel (1988) attempted to use this model to estimate the marginal value of added years of expected life of shoreline property. He used the hedonic equation 2, but backed away from using step 2 because he was unable to segment his market. Smith, Palmquist and Jakus (1989) use multiple hedonic price equations 2 in generating hedonic prices for use in equation 3. Caulkins, Bishop and Bouwes (1986) address site quality issues using a multinomial logit model, a potential alternative to the hedonic travel cost model.

Jeng (1990), in her attempts to estimate the repackaging model of Wilman (1987), developed the hedonic price equation 2 for the estimation of endogenous trip prices which include endogenous on-site monetary and human time costs,

(4) Price = h(trip duration, recreator characteristics).

Since trip duration is also endogenous, it is predicted by the equation,

(5) Trip duration = h'(distance, recreator characteristics).

Since Jeng's focus (see also Hushak and Jeng 1990) was on trip duration and on respondent characteristics, her problem was to generate a trip price which incorporated on-site costs of a heterogeneous trip which varied in duration, but excluded elements of on-site costs which reflected tastes, income or other factors. This "predicted" price, as estimated from equation 4 as the predictable portion of reported trip price, was then used as the trip price in the recreation demand equation,

(6) Trips = k(price, recreator characteristics).

Jeng successfully estimated this model using data subsamples of recreators who can and cannot substitute work and leisure time as suggested by Bockstael, Strand and Hanemann (1987). However, her attempts to separate the sample into trips of varying duration (a major trip characteristic) to estimate Wilman's repackaging model were not successful because of high multicolinearity across the prices of trips of varying duration.

Estimates of economic value in the form of willingness-to-pay or consumer surplus from these models is a base for fisheries policy or management (see Table 1 for definitions of terms). They provide insights about how various fisheries are valued by recreators and other users and the potential benefits from various management strategies. However, the rapidly changing nature of the theoretical models and the necessarily preliminary nature of the estimates mean that economists are required to use them on policy decisions.

One example of the need for economic value information is the development of a strategy by the American Fisheries Society (AFS) to assist fisheries managers in assessing damages in fish-kills due to toxic substance discharges or other reasons. In 1982, AFS published a document which contained guidelines for counting dead fish in fish kills and the hatchery costs of replacing these fish. Since 1982, several states have implemented procedures for assessing damages from fish kills based on these guidelines.

These procedures are adequate where killed fish can be replaced immediately with like sized fish. However, they lack the capability of assessing damages due to lost recreational days where the fishery is allowed to rehabilitate itself through natural processes or where smaller fish are stocked and allowed to grow to the size of killed fish.

In 1989, under a grant from the U.S. Fish and Wildlife Service, the Socioeconomics section of AFS undertook a project to update the hatchery cost estimates, and also to compile the existing literature on economic values of lost recreational and commercial fishing days by state and by species (AFS-SE 1992a, 1992b).

This latter component is an attempt to compile the information base to assess fish kill damages on the basis of lost fishing days and/or lost harvest. We found a large number of studies. The compilation of results of these studies for freshwater studies is shown in Table 2. But, given the rapid change in theory and the large number of fisheries and fish species, we seldom found more than one study for any given species in a specific fishery. In addition, studies of a given species across fisheries are usually done with sufficiently different methodologies and data limitations that comparability across species is questionable.

Economic Tools for the Management of Fisheries

The current typical approach to fisheries management in the USA is of the general form of fishing seasons, daily bag limits or quotas on individual species and for individual anglers (commercial or recreational). If anglers were to respond to these tools in the way desired by the management agency, then over exploitation would not occur and fisheries would not be destroyed.

Commercial fishermen, however, are economically rational people and they harvest fish as long as the cost of harvesting an additional fish does not exceed the price they are paid for it at the dock. If each commercial fisherman owned his/her own plot of fishery and had the right to exclude others from fishing in the area as farmers do, they would take account of stock changes and implications for future harvests, and not over harvest their fishery plot.

Sport anglers, likewise, want to engage in fishing as long as the satisfaction gained from fishing exceeds its monetary and time costs to them. As with commercial fishermen, sport anglers do not realize that in catching and harvesting fish, they are, jointly with other anglers, contributing to significant decreases in the total stock of fish in the fishery.

Common property resources existed and were successfully managed throughout history. In many places in Europe and elsewhere, over long periods of time, these resources were successfully "managed" by the people using them through various community sanctions against anyone violating the trust of the "commons." These systems of management were successful during periods of stability; during periods when technology was stable and when the demands for the goods and services provided by the commons were stable. They required the ability of the common users to impose sanctions on each other and to limit the use of the commons by those who were not one of the common "owners."

However, the conditions under which the requirements for successful management of the commons can be imposed are fragile. When technology changed or when new demands on the resources of the commons arose, the implicit sanctions tended to break down as well. When the common "owners" lose control of the commons, the resource(s) become what we call "open access" where everyone has rights to use of the resource without a means of imposing sanctions, except by government. In the case of redfish, a working situation broke down because of increased demand for redfish resulting in incentives to increase the commercial harvest of redfish which the then existing policy was unable to control.

The case of redfish is an example of what Harden (1968) calls the "Tragedy of the Commons." In trying to maximize profits, fishermen do not recognize how their individual actions in aggregate serve to deplete the fishery. To restore stability to an open access resource, one must restore a set of sanctions or incentives to convince users to reduce use to sustainable levels. An improved information base from travel cost or contingent valuation studies on how resources are valued would improve our ability to predict when an existing situation is likely to break down by being better able to predict changes in demand for the resource.

This "Tragedy of the Commons" is illustrated in Figure 1 from Tietenberg (1984 p. 196). For discussion purposes, it is assumed that fish price is constant so that any variation in revenues is due to changes in fishing harvest resulting from changes in fishing effort. For the fishery as a whole, each unit of increased effort results in declining marginal revenue in the lower portion of Figure 1 because of reduced harvest per unit of effort. However, each angler, commercial or recreational, has such a small impact on the harvest rate that each experiences the average revenue or harvest rate as its marginal revenue rate. When the average = marginal revenue for the individual angler is equal to marginal = average cost at a level of fishing effort which exceeds the maximum revenue point of the upper portion or the marginal revenue = 0 point b in the lower portion of Figure 1, then the fishery will be depleted. To prevent the "Tragedy of the Commons," management policy must reduce fishing effort below level b.

Management strategies such as fishing seasons, bag limits or quotas tell anglers, commercial or recreational, to stop fishing when, in their view, it is still profitable to do so, i.e., their "marginal" revenue from additional fishing effort at any level less than point c exceeds marginal cost. Anglers have incentives to "break" the law, and evidence suggests strongly that they do so. The record of success for these strategies is not good; some would argue that it is dismal! Therefore, there has been increasing call to try the tools of the economist which more directly impose total fishery stock effects on individual anglers, commercial or recreational.

Economists suggest several policy tools which can incorporate the aggregate effects of fish harvests on fish stocks into the incentive structure faced by commercial or recreational fishermen (Tietenberg, Howe 1979). Where feasible, the most effective policy would be to assign long-term property or harvest rights to individual commercial anglers over explicit areas of water. This type of policy would work where species are not highly mobile and where the citizenry, including sport anglers, accept limitations on access to the fishery waters. Such a policy would create "mini" fisheries where each angler faced the downward sloping marginal revenue curve in Figure 1. In most cases, however, such policies are not feasible for one or both reasons, at least in the USA.

Where property rights assignments are not feasible, economists recommend alternative incentive policies such as taxes or subsidies, input purchases, or several forms of quotas. Taxes may be levied on units of fish harvested or on inputs such as the size of the fishing vessel, the size and type of gear or the amount of labor. Or, subsidies may be paid to producers to idle resources, such as payments for so many days of use of a fishing vessel. In Figure 1, these taxes or subsidies have the effect of raising the marginal = average cost curve. This subsidy strategy has been used for many years in USA agriculture to purchase the annual services of land from landowners in order to reduce crop output. While economists argue that such a subsidy strategy is not efficient because it only affects one input, e.g., commercial anglers would use other resources (vessels not idled, labor, and harvest gear) more intensively, it is much more effective than seasons, bag limits or quotas.

Another economic based management strategy which has potential in fisheries management is to purchase inputs from producers. In USA agriculture policy, there are provisions for long term idling of sensitive lands through longer term agreements, usually of about 10 years. In Ohio, the Division of Wildlife was legislatively forced in 1982 to purchase gill nets from commercial anglers to reduce yellow perch harvest and the incidental catch of walleye. The gill net is by far the most effective and efficient harvest gear for yellow perch. While even economists would have argued that this strategy was not efficient nor needed at the time it was implemented, it was effective in reducing yellow perch harvest and eliminating incidental harvest of walleye. The purchase of certain types of harvest gear, thereby eliminating it from use in a fishery, can be an effective and reasonably efficient strategy where destruction of a fish stock is occurring, or where bycatch is a serious issue.

Quotas of various types have been used by fisheries managers, but are effective and efficient management tools only under certain conditions. The first condition is that harvest can be monitored under the quota because a quota does not have a direct effect on the marginal cost of harvesting fish. If this is true then Tietenberg (p. 204) lists three conditions for efficient quotas.

1. The quotas entitle the holder to catch a specified weight of fish.

2. The total amount of fish authorized by the quotas held by all fishermen should be equal to the efficient catch for the fishery.

3. The quotas should be freely transferable among fishermen.

It is important that the quota be on quantity of fish harvested. Quotas on days of fishing, which do not consider variations in fishing effort per fishing day, provide incentives for increased vessel size or increased gear and/or labor per vessel because anglers still have the incentive to engage in more effort than the optimal level. The second condition is necessary for optimal harvest, and also makes obvious the need for effective monitoring. Finally, efficient quotas must be transferable among anglers because of differing costs per unit of fishing effort across commercial fishing firms. Higher cost firms must be able to sell their quota to more efficient or lower cost firms in order to minimize the cost of harvest for any given fishery.

While we are still far from effective and/or efficient management of fisheries, the individual transferable quota or ITQ is being accepted as a management tool by fisheries managers and by commercial anglers. Anderson (1989) and other papers in Neher et al. (1989) discuss ITQs and ITQ policies in the various fisheries in which they are being used. The International Joint Commission (IJC) and U.S. Environmental Protection Agency (USEPA) have begun to examine how to use economic tools to reduce toxic emissions into the Great Lakes and other bodies of water. While these are encouraging signs, there is little evidence of the acceptability of other strategies in fisheries management unless forced on them from outside, as in the case of Ohio's purchase of gill net fishing rights.

Inadequate Data Bases

Federal statistical budgets in the USA declined in real terms during most of the 1980s, and have only begun to recover (OMB 1992 and earlier issues). My perception of USA fisheries agencies (Fish and Wildlife Service, National Marine Fisheries Service) is that they are not very concerned about data, economic or biological.

Recreational valuation studies have been completed at widely differing dates, using data which is inadequate in one or more ways, and using biased statistical estimation methods. We are only at the beginning stages of assessing the use of various economic management tools in the "real" management of fisheries. It is from this sketchy and inadequate base of research studies that we develop and justify management plans for fisheries.

The social scientist needs the support and assistance of fisheries agencies in gathering the necessary data and in obtaining the needed financial support to carry out the research necessary to develop the data base. At present, USA funding agencies are biased strongly toward development of new theories and away from base data collection and application of frontier theory in the estimation and evaluation of economic policies. Further, the social scientist must become an integral part of fisheries policy making if effective use is to be made of economic policy tools.

Implications for Improved Policy

Economists and other social scientists need access at the policy making level to effectively bring economic and social science policy tools to fisheries management. One cannot expect biologists to incorporate sophisticated policy tools into management strategies any more than the social scientist could be expected to incorporate biological information and policy tools into a management strategy. The development stage of economic and other social policy tools amplifies the need for economists and other social scientists at the policy making level.

Resource management agencies in the USA have not made rapid progress to incorporating economists and other social scientists at the policy making level for two reasons. First, resource management agency heads have not made the transition from the "management of fish" to the "management of people." Until they recognize that incorporating human behavioral responses into the policy process are critical to policy success, continued progress will be slow. Second, they are not aware of the contributions that economists and other social scientists make to the policy frameworks of other areas such as agriculture. Such awareness on their part would increase confidence that the social sciences have much to contribute.

If economics and other social sciences are to take their proper role in fisheries management, there are two major requirements. First, increased support for the data base and the social science research base is required. Second, economists and other social scientists must become integral parts of the fisheries management policy process.

Table 1. Definitions of Terms, Concepts, and Methods

Definitions of Concepts

Gross Willingness-To-Pay: The total amount one is willing to pay for a resource or amenity rather than go without it. It is approximated by the area under the demand or average revenue curve up to the level of consumption in Figure 1.

(Net) Willingness-To-Pay: Gross willingness-to-pay minus the costs of purchasing the output. In Figure 1, it is approximated the area under the demand or average revenue curve and above the price or average cost line.

Consumer Surplus: An approximation of willingness-to-pay as defined as the area under the demand or average revenue curve and above the price or average cost line.

Use Value: The value placed on a resource or amenity by an individual for its use in recreational activities such as the value of a particular fishery or the value of a population of fish within the fishery.

Existence Value: The value placed on a resource or amenity by an individual because of its existence irrespective of use, such as placing a positive value on a population of fish even if one never fishes.

Option Value: The value placed on a resource or amenity by an individual to maintain the possibility of using the resource or amenity at some future time, such as placing a positive value on a population of fish because one might want to fish for them at a future time.

Definitions of Methods

Travel Cost (Recreation) Demand (TC): An approximate demand for recreation activities using proxy variables such as number of trips for quantity demanded and the cost of travel and other recreation expenses for price. The estimated TC demand function allows estimation of consumer surplus.

Contingent Valuation (CV): The direct questioning of individuals about the valuation placed on recreational or other resources or amenities. The CV method can be used for direct estimation of willingness-to-pay, existence value, or option value.

Hedonic Function: The relationship between the price or value of a recreational or other resource or amenity and the characteristics of that amenity. The hedonic price is the contribution of a particular characteristic, such as fishing quality, to the total price of a resource or amenity.

Table 2 (continued)

State	Valuation Method	Species	Economic Value ($/day)
Washington	TCM	coldwater	$53.52 (1)
	TCM	salmon river	$26.35 (1)
	TCM	steelhead river	$35.93 (1)
	CVM	trout	$16.07 (1)
	CVM	salmon	$118.62 (1)
West Virginia	CVM	trout	$16.07 (1)
Wisconsin	TCM	coldwater	$4.28 (1) per trip
	TCM	trout/salmon	$16.76 (1)
	CVM	trout	$28.55 (1)
Wyoming	CVM	trout	$13.15 (1)
	CVM	coldwater	$22.18 (1)
Regions:			
Rocky Mountains	CVM	coldwater	$14.08 (1)
Lake Mead	TCM	largemouth bass	$91.21 (1)
U.S.	CVM	bass	$43.17 (1)
	CVM/TCM	trout	$46.83 (5)
	CVM/TCM	anadromous	$129.51 (2)
	CVM	panfish	$43.17 (1)
	CVM	catfish	$34.17 (2)
	CVM	pike/walleye	$70.43 (1)
	CVM	general	$40.90 (1)
	TCM	bass, etc.	$88.61 (1)
	TCM	other	$86.34 (1)
	TCM	coldwater	$39.62 (1)
	TCM	warmwater	$35.18 (1)
	TCM	rough fishing	$26.31 (1)

Table notes:
Valuation Methods: CVM - Contingent Valuation Method
TCM - Travel Cost Method
Hedonic - Hedonic Method
Standardized Value: Average of studies using the same valuation technique for the same state and species. These numbers are adjusted for methodoligal differences and updated to 1989 values using the CPI
( ) Indicates number of studies in sample

For explanation of valuation methods and standardization process please see Recommended Procedures for Accounting for Economic Damages Due to Fish-Kills

Table 2 (continued)

State	Valuation Method	Species	Economic Value ($/day)
Mississippi	No Studies		
Missouri	TCM/CVM	trout	$22.38 (2)
Montana	TCM	coldwater lake	$37.47 (1)
	TCM	coldwater str.	$55.22 (1)
	CVM	trout	$17.53 (1)
Nebraska	CVM	trout	$19.00 (1)
Nevada	CVM	trout	$16.07 (1)
	CVM	coldwater	$22.18 (1)
New Hampshire	CVM	trout	$10.23 (1)
New Jersey	CVM	trout	$14.61 (1)
New Mexico	TCM	warmwater	$28.08 (1)
	CVM	trout	$20.46 (1)
New York	TCM	coldwater	$39.86 (3)
	TCM	muskellunge riv	$99.16 (1)
	TCM	muskellunge lk.	$26.21 (1)
	TCM	all	$58.13 (2)
	TCM	lake	$30.07 (1)
	TCM	stream	$40.17 (1)
North Carolina	CVM	trout	$14.61 (1)
North Dakota	CVM	trout	$17.53 (1)
Ohio	TCM	walleye	$4.96 (1)
	TCM	yellow perch	$4.08 (1)
	TCM	walleye/perch	$15.32 (1)
	CVM	trout	$10.23 (1)
Oklahoma	CVM	trout	$29.22 (1)
Oregon	TCM	coldwater	$95.77 (1)
	TCM	steelhead	$71.88 (2)
	TCM	salmon/ steelhead	$49.61 (1)
	TCM	salmon river	$26.35 (1)
	TCM	steelhead river	$35.93 (1)
	TCM	coho	$37.36 (1) per trip
	TCM	steelhead	$55.72 (1) per trip
	CVM	trout	$17.53 (1)
Pennsylvania	CVM	trout	$11.69 (1)
Rhode Island	CVM	trout	$13.15 (1)
South Carolina	CVM	trout	$11.69 (1)
South Dakota	CVM	trout	$17.53 (1)
Tennessee	TCM	coldwater	$43.84 (1)
Texas	CVM	trout	$35.07 (1)
Utah	CVM	trout	$16.07 (1)
	CVM	coldwater	$22.18 (1)
Vermont	CVM	trout	$10.23 (1)
Virginia	CVM	trout	$16.07 (1)

Table 2. Average Valuation of Freshwater Recreational Fishing

State	Valuation Method	Species	Economic Value ($/day)
Alabama	CVM	trout	$29.22 (1)
Alaska	CVM	trout	$40.91 (1)
Arizona	TCM/CVM	trout	$17.12 (3)
	TCM/CVM	coldwater	$74.65 (3)
	TCM	warmwater	$145.49 (1) per trip
	TCM	coldwater	$158.83 (1) per trip
Arkansas	CVM	trout	$21.92 (1)
California	TCM	coldwater	$21.04 (1)
	CVM	trout	$23.38 (1)
Colorado	CVM	trout	$16.80 (2)
	CVM	coldwater	$16.46 (4)
Connecticut	CVM	trout	$11.69 (1)
	CVM	all	$10.81 (3)
Delaware	CVM	trout	$16.07 (1)
Florida	TCM	warmwater	$37.85 (1)
	CVM	all	$17.43 (1)
	CVM	trout	$13.15 (1)
Georgia	TCM	warmwater	$34.50 (1)
	CVM	trout	$14.61 (1)
Hawaii	No Studies		
Idaho	TCM/CVM	coldwater	$23.95 (6)
	TCM/CVM	warmwater	$24.73 (6)
	TCM/CVM	steelhead	$22.34 (6)
	CVM	mixed	$14.87 (1)
	TCM	cold/mixed	$32.25 (1)
	TCM	warm/mixed	$35.14 (1)
	CVM	trout	$18.89 (1)
Illinois	CVM	trout	$24.84 (1)
Indiana	CVM	trout	$13.15 (1)
Iowa	CVM	trout	$29.22 (1)
Kansas	CVM	trout	$24.84 (1)
Kentucky	TCM	coldwater	$11.74 (1)
	CVM	trout	$19.00 (1)
Louisiana	Hedonic	warmwater	$36.31 (1)
Maine	TCM	coldwater	$33.61 (1)
	CVM	trout	$13.15 (1)
Maryland	CVM	trout	$19.00 (1)
Massachusetts	CVM	trout	$13.15 (1)
Michigan	TCM/CVM	trout	$17.86 (2)
Minnesota	TCM	coldwater	$42.37 (1)
	CVM	trout	$20.46 (1)

Source: AFS, forthcoming, 1992a.

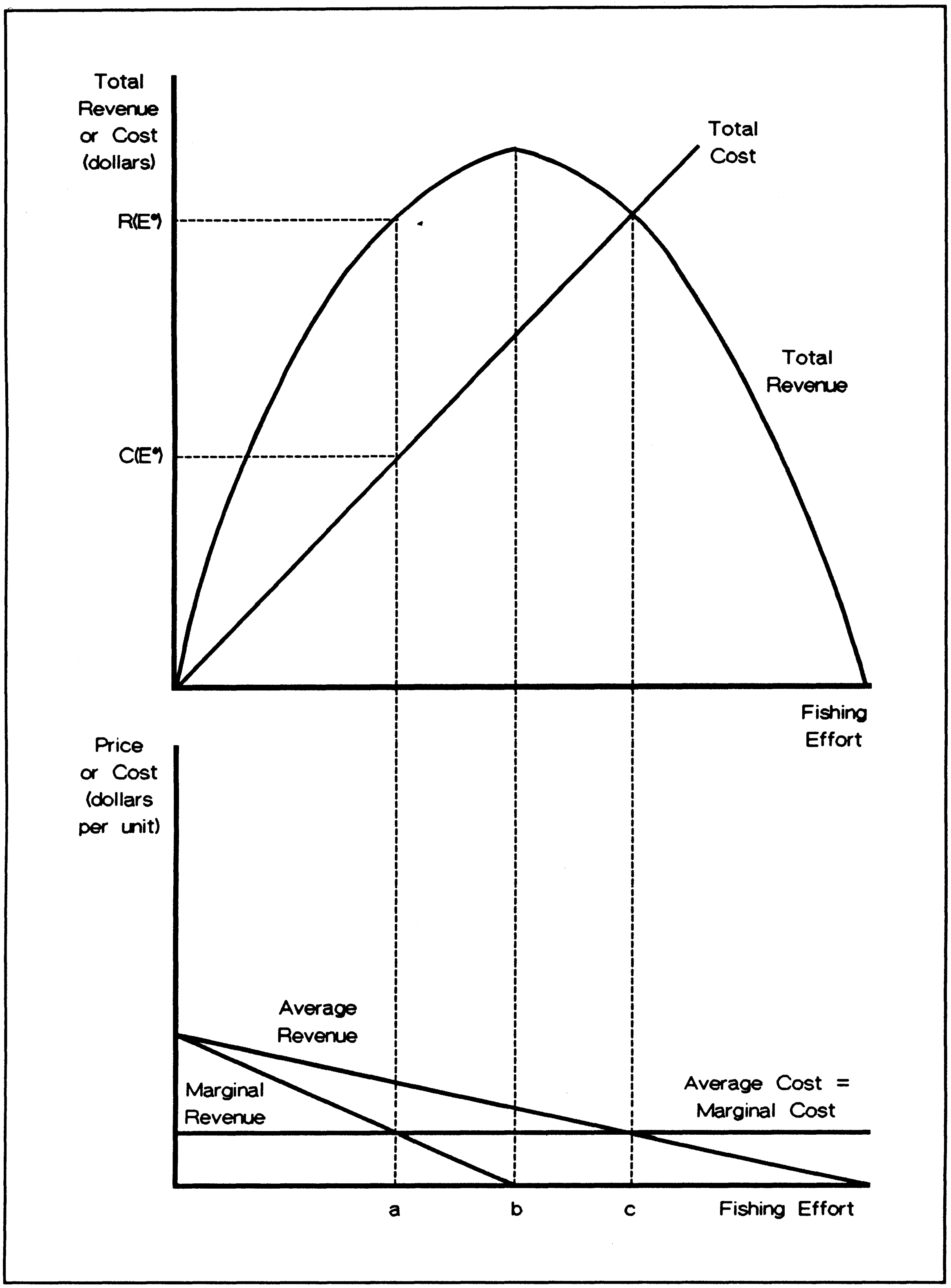

Figure 1. Market Allocation in a Common-Property Fishery.

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