Basic Issues in Economic Comparisons of Commercial and Sport Fisheries: A Study of Allocation Alternatives for Alaska's Kenai River Sockeye Salmon Fisheries

by

Gunnar Knapp
Institute of Social and Economic Research
University of Alaska Anchorage
3211 Providence Drive
Anchorage, Alaska 99508
(907) 786-7710 (telephone)
(907) 786-7739 (fax)
afgpk@uaa.alaska.edu

Jeff Hartman
Economist
Alaska Department of Fish and Game
P.O. Box 25526
Juneau, Alaska 99802
(907) 465-6155
jeffh@fishgame.state.ak.us

Mike Mills
Assistant Director
Alaska Department of Fish and Game
333 Raspberry Road
Anchorage, Alaska 99518
(907) 267-2300 (telephone)
(907) 267-2422 (fax)
mikem@fishgame.state.ak.us

Prepared for presentation at a session on
"The Role of Economics in Fisheries Management"
at the 1998 Annual Meeting of the
American Fisheries Society
Hartford, Connecticut
August 24, 1998

Basic Issues in Economic Comparisons of Commercial and Sport Fisheries: A Study of Allocation Alternatives for Alaska's Kenai River Sockeye Salmon Fisheries

by

Gunnar Knapp, University of Alaska Anchorage
Jeff Hartman, Alaska Department of Fish and Game
Mike Mills, Alaska Department of Fish and Game

Abstract

Allocation between commercial and sport fisheries is becoming an increasingly difficult and divisive issue in fisheries management. As conflicts over allocation have increased, so has interest in the relative economic contributions of commercial and sport fisheries. This paper describes eight basic issues in economic comparisons of commercial and sport fisheries. These basic issues should be considered in evaluating or planning *any* economic comparison of commercial and sport fisheries--from a back-of-the-envelope comparison to a formal study. We illustrate these issues by describing how they arose in an economic comparison of commercial and sport fisheries for Alaska's Kenai River sockeye salmon.

The eight basic issues, and our conclusions, are as follows:

1. What economic measures are being compared?

The measures of economic effects--economic impacts or economic value--should be the same for both fisheries and should be relevant to the purpose of the comparison.

2. Is the economic comparison relevant to the policy choices at issue?

Economic comparisons of commercial and sport fisheries should be relevant to the policy choices under consideration.

3. Does the comparison measure total or marginal economic effects?

To be relevant, economic comparisons of commercial and sport fisheries should address marginal economic effects of the policy choices under consideration, rather than total or average economic effects of commercial and sport fisheries.

4. What is the geographic area for which economic effects are measured and compared?

The geographic area for which economic effects are measured and compared should be appropriate for the policy choices under consideration.

5. Does the economic comparison consider indirect economic effects of policy choices?

Economic comparisons of commercial and sport fisheries should consider indirect economic effects of policy choices if these indirect effects are relevant to the policy issues under consideration.

6. *What does the economic comparison assume about fishery management?*

Assumptions about fishery management should reflect how management might change in response to the policy choices under consideration

7. What does the economic comparison assume about factors beyond the control of managers which may affect economic value or economic impacts of fisheries ?

Assumptions about exogenous factors should be evaluated carefully: the recent past may not necessarily be a guide to the future.

8. *How reliable are the comparison's estimates of economic effects?*

The comparison should address the sensitivity of the results to key assumptions about fisheries management and other factors, as well as the range of uncertainty associated with estimates of economic effects.

Other general conclusions were that economic comparisons of commercial and sport fisheries can be complicated. Doing economic comparisons right can make them more expensive. Inherent uncertainty associated with management assumptions, exogenous factors or available data may lead to inconclusive results. Study results will not necessarily influence policy decisions. Thus, not all economic comparisons of commercial and sport fisheries are necessarily worth the cost.

Introduction

Allocation between commercial and sport fisheries is becoming an increasingly difficult and divisive issue in fisheries management.[1] As conflicts over allocation have increased, so has the interest in the relative economic contributions of commercial and sport fisheries. Both sport and commercial fishing groups are interested in demonstrating the economic importance of their respective fisheries. Fishery managers and the public--often caught in the middle of the debate, and often with limited expertise in economics--are interested in the potential economic implications of management decisions and the validity of sometimes extravagant claims made by competing groups. Economists find economic comparisons of commercial and sport fisheries both interesting and challenging, and are hard at work at refining techniques which may be applied--and glad to accept funding to continue their research.

How should we compare the relative economic contributions of commercial and sport fisheries? A variety of economic techniques have been developed which may be applied to such comparisons.[2] There are a number of theoretical and technical issues relating to these techniques which are the subject of considerable debate among economists.[3] To non-economists, these theoretical and technical issues can be confusing. Because of the complexity of the methodologies involved, non-economists may conclude that they have little to contribute to the design of economic comparisons of commercial and sport fisheries, and that they should leave all of the decisions about such studies to economists.

This is unfortunate. Our purpose in this paper is to argue that there are certain basic issues in economic comparisons or commercial and sport fisheries which should not simply be left to economists. These issues are not technical issues of economics. They relate to the broader issues

---

[1]Conflicts between commercial and sport fishermen (sometimes aligned with environmental organizations) are increasingly entering the political arena. In 1994, Florida voters approved an amendment to the state constitution to ban the use of gillnets in state waters. In 1995, Washington voters defeated a proposal which would have banned the use of commercial gear that did not meet strict by-catch standards. In 1996, Alaska sport fishing groups sought passage of an initiative which would have increased the share of salmon allocated to sport fishermen, but the initiative was removed from the ballot after a court ruling that the initiative was unconstitutional (National Fisherman, January 1995 and February 1996).

[2]For introductions to theoretical and methodological issues in economic comparisons of commercial and sport fisheries, see Sutinen (1980), Bishop and Samples (1980), and Edwards (1990).

[3]Examples of these issues include the relative merits of travel cost and contingent valuation methods in estimating non-market values, and the proper application of each of these methods, and the application of input-output models for estimation of economic impacts of sport and commercial fisheries.

of the purposes of these comparisons and the questions which they are intended to answer. These issues are the legitimate concern of those who are paying for the studies or those who will need to make decisions based on the study results. Failure to think carefully about these issues in advance may lead to results which are not useful--or worse, misleading.

Consideration of these basic issues is particularly important given the highly politicized environment in which economic comparisons of commercial and sport fisheries are often conducted. There are plenty of advocates whose strategic interests exceed their interest in objective answers.[4] While those who hope to use study results to advance a position may welcome any study approach which will serve this end, those who stand to lose may seek out any weaknesses to deflect or derail the study conclusions. It is in the basic issues that these studies are most vulnerable to criticism.

In this paper, we describe eight basic issues in economic comparisons of commercial and sport fisheries. We illustrate these issues by describing how they arose and how they were addressed in an economic comparison of commercial and sport fisheries for Alaska's Kenai River sockeye salmon. In this paper, we refer to this study as the "Kenai River Study."[5]

Technical aspects of the study, including the model structures, data collection and estimation, have been described in the study report as well as in an article published in *Marine Resoure Economics*.[6] Our purpose in this paper is not to review the technical approaches of the study--which were complex and which are not easy even for economists to grasp. Instead our purpose is to illustrate basic issues which arise in this kind of comparison.

---

[4]Edwards (1990), in a review of theoretical and methodological issues in the application of economic analysis to commercial-sport allocation issues, argued that "many contemporary arguments which are advanced by user groups and related constituencies, while having a seemingly 'economics' ring to them, are usually incomplete, distorted, and even incorrect. For example, commercial fishermen sometimes characterize sport fishing as the adult equivalent of play--something devoid of economic value. . . As another example, game fish status is often advocated for a fishery resource . . . when revenues from anglers' expenditures on fishing supplies are greater than dockside revenue in the commercial fishery for the same species."

[5]The study, entitled Economic Effects of Management Changes for Kenai River Late-Run Sockeye (ISER, 1996) was completed in January 1996. Copies of the report are available from ISER/UAA, 3211 Providence Drive, Anchorage, Alaska 99508 (telephone: 907-786-7710; fax: 907-786-7739).

[6]Berman, Matthew; Sharman Haley and Hongjin Kim. 1997. "Estimating Net Benefits of Reallocation: Discrete Choice Models of Sport and Commercial Fishing." Marine Resource Economics, Volume 12, Number 4, pages 307-327.

We begin by briefly describing the Kenai River sockeye salmon fisheries, and the policy issues which led to the initiation of an economic comparison of the commercial and sport fisheries. We then review the basic issues which arose in the course of the study, and how they were addressed.

Kenai River Sockeye Salmon Fisheries

Of numerous allocation conflicts between commercial and sport fisheries in Alaska, one of the most intense has been over the allocation of Kenai River sockeye salmon. The Kenai River is the largest of several major salmon producing rivers flowing into Cook Inlet, a large bay of the Pacific Ocean located in southcentral Alaska. Millions of salmon return to Cook Inlet each year, including all five Pacific salmon species. Salmon have been fished commercially in Cook Inlet for more than 100 years. Most of the commercial harvest, including Kenai River sockeye salmon, occurs in Upper Cook Inlet.

The volume and value (as measured by total earnings of commercial fishermen) of Upper Cook Inlet commercial harvests varies widely from year to year, depending on run size and ex-vessel prices. Between 1980 and 1984, the Upper Cook Inlet commercial salmon harvest (all species) varied from less than 3 million to more than 15 million salmon, and the ex-vessel value ranged from less than $20 million to more than $100 million. In the 1990s, sockeye salmon have accounted for more than 90 percent of the value of the Upper Cook Inlet commercial harvest. The late run of Kenai River sockeye, which occurs in late June and July, accounts for the largest share of the sockeye harvest.

As with all Alaska salmon fisheries, entry to the Cook Inlet commercial salmon fisheries has been limited since the late 1970's. Salmon fishing in the Upper Cook Inlet area is currently limited to 745 setnet permits and 583 driftnet permits. Alaska residents own 86 percent of the setnet permits and 66 percent of the driftnet permits.

The Kenai River system is also Alaska's most popular salmon sport fishing area. The river has long been famous for its king salmon fishing, but the popularity of sockeye fishing has been growing. Between 1981 and 1994, estimated angler days fished on the Kenai River (for all species) increased from 179 thousand to 341 thousand. The Kenai River is within easy driving distance of Anchorage, where nearly half of all Alaskans live. Sport fishing by non-residents is also increasing. Sales of fishing licenses to non-residents almost tripled between 1983 and 1994. Non-residents accounted for about 56 percent of all households which fished the Kenai River in 1993.

Most of the sockeye salmon sport fishing on the Kenai River occurs during the last two weeks in July and the first week in August. In recent years, the sport harvest of Kenai River sockeye has varied from less than 40,00 sockeye to more than 330,000 sockeye--and from 11 to 26 percent of the in-river return.

Management of Upper Cook Inlet commercial and sport fisheries is complicated by the fact that

salmon stocks from a number or rivers and streams mingle in the inlet; run sizes change dramatically and unpredictably from year to year; and runs are brief but intense, with millions of fish moving into the inlet within a period of weeks. Managers have to make decisions about commercial fishing openings and closures quickly based on limited .information about the potential for escapement to different river systems and for in-river sport and personal use fisheries.

The primary management goal is to make sure enough salmon spawn each season to produce healthy future runs. Commercial managers attempt to regulate the time and location of commercial openings to make sure enough salmon reach the Kenai river and other rivers to achieve both spawning goals as well as in-river sport harvest goals. Their decisions about when and where to schedule openings correspondingly affect the harvests and revenues of commercial fishermen--in particular set net fishermen who operate in fixed locations. The sport fishery is managed by bag and possession limits, gear and area restrictions, and time restrictions and closures. In recent years, the typical limits have been six sockeye harvested per day.

The Alaska Board of Fisheries sets a goal for the number of sockeye salmon entering the Kenai River to provide for both sport harvests as well spawning escapement. At the time of the study, the management goal set by the Alaska Board of Fisheries was 450,000 to 700,000 sockeye. In the remainder of this paper, we refer to this management goal as the "target range."[7]

The Kenai River Study

The Kenai River Study was undertaken as a result of three broad factors:

1. Increasing reference to changes in recreational and commercial fishing effort, earnings and expenditures associated with these fisheries in the press and in meetings of the Alaska Board of Fisheries;

2. Completion of other economic studies on Alaska recreational fisheries and commercial fisheries of the region, that raised the expectations for successful application of quantitative economic techniques; and

3. Continuing pressure from interest groups within the Board of Fisheries process to alter the management goals in the Kenai River salmon fisheries (particularly to bring about reallocation to recreational harvesters).

In 1994, in response to a long-standing debate between sport and commercial fishing groups, the

---

[7]The management target is actually defined in terms of the number of fish passing a sonar counter located 19 miles upstream from the river mouth. The fact that a substantial sport harvest as well as a personal use dipnet harvest takes place below the sonar counter complicated the analysis for the study.

Alaska Legislature appropriated $300,000 in funding for a study that would provide ". . . information and models that will enable comparisons of economic values of management alternatives for salmon in Cook Inlet . . . that are comparable for the commercial and sport salmon fisheries."

The legislation for the study placed the contracting responsibility for the analysis within the Alaska Department of Fish and Game. Yet the highly politically-charged allocation study ran contrary to the emphasis of the Alaska Department of Fish and Game's salmon management mission, which focuses on achieving a sustainable yield rather than allocation among competing uses, which is primarily the responsibility of the Board of Fisheries. As such, the highly political and divisive interests at stake placed ADF&G and its corresponding Divisions of commercial fisheries and sport fisheries in an unusually controversial position. To mitigate potential concerns for bias in the design of the study, a third party division within ADF&G (the Subsistence Division) was appointed to coordinate the contractor selection and contract design process, with socio-economic representation from the Division of Commercial Fisheries, Commercial Fisheries Entry Commission and Sport Fish Division. In effect a new institutional arrangement was specifically developed to house an unusually high profile project.

A formal Request for Proposal, that described the general scope of the project, was advertised to interested research organizations. Cumbersome agency procurement codes and the short time frame allowed for the project necessitated that the contract award process occur without revision to the RFP and survive legal challenges. Also, it was necessary to strike a balance between an RFP sufficiently detailed to elicit informed bids but sufficiently general to encourage contractors to demonstrate their relative skills in understanding the policy, and technical problems associated with the study.

Through no small degree of luck a contractor was selected without formal challenge to the selection process. The University of Alaska Institute of Social and Economic Research (ISER) was selected to undertake a study of how proposed management changes intended to reallocate Kenai River sockeye salmon from the commercial to the sport fishery would affect net economic value and economic impacts associated with both fisheries.

User group meetings were also initiated by ADF&G to describe the history of the study and the institutional structure for administering it, to solicit input on the scope of the policy questions to be addressed, and to discuss the type of economic tools that would be utilized and their potential limits.

During the study process, from the planning phase to the review of the draft report, an ADF&G study team, consisting of personnel from the commercial, sport and subsistence Divisions, met on numerous occasions with ISER research staff to discuss issues relating to the design and

implementation of the study.[8] Many of the basic issues described in this paper were identified, discussed and resolved in these meetings. ADF&G management biologists also provided information used to develop management assumptions for the study.

Data sources for the study included surveys of sport and commercial fishermen, fish ticket data on landings by commercial fishermen, and a wide variety of other public data and information collected from prior fisheries studies. Several telephone surveys of Alaska resident sport anglers were used to collect information on trips and expenditures of Alaska resident sport anglers, as well as responses to contingent valuation questions. Telephone surveys of Cook Inlet commercial limited entry permit holders and crew were used to collect data on fishing vessel operations and expenditures as well as information for contingent valuation and job ranking analysis. A short mail survey of non-resident anglers who had previously visited Alaska was used to collect information on Kenai River trips, expenditures and how these might have been affected by changes in Kenai River sport fishing opportunities.

The study was completed and presented to the Board of Fisheries in January of 1996, two years after it was funded by the Alaska Legislature. The key study results were summarized in a 12-page Executive Summary. The full report was several hundred pages long, with twelve chapters and twelve appendixes in two volumes. The cost of the study included not only the $300,000 appropriated by the legislature, but also the cost of the of the ADF&G study team and management biologists who contributed information to the study.

The study was complicated and there were numerous assumptions, qualifications, and scenarios. The Executive Summary's most succinct statement of the study results was that increasing the Board of Fisheries target for the number of sockeye salmon entering the Kenai River would have the following effects:

> Estimated commercial losses appear somewhat larger than sport gains-a gain of $1.3 million for the sport side and a loss of $1.7 million for the commercial side. But given the range of uncertainty in our estimates, we can't definitely conclude that actual commercial losses would be larger than sport gains.
>
> The Alaska economy would probably lose slightly more jobs than would be created. A rough estimate is that increased spending for sport fishing would create about 46 jobs, but lost commercial harvests would cost the economy 64 jobs. But given the uncertainty about the future level of visitor spending, the actual number of jobs created on the sport side could range from 13 to 70.

Thus the study did not provide conclusive support to either side in the political debate between

---

[8]One of the authors of this paper, Gunnar Knapp, was a member of the ISER research group which prepared the report. The two other authors, Jeff Hartman and Mike Mills, were members of the ADF&G study team.

sport and commercial user groups.

After the study was completed, the Board of Fisheries increased the target range for late run Kenai sockeye by 100,000, from between 450,000 and 700,000 to between 550,000 and 850,000. The primary reason cited for this decision was to allocate more fish to the sport fishery. It is difficult to tell what effect the report may have had on the Board's decision. The Board listened to the presentation of the study results, and asked questions, but the study results did not feature prominently in the Board's decision-making deliberations on the allocation issue.

Basic Issues in Economic Comparisons of Commercial and Sport Fisheries

We may now turn to a review of basic issues in economic comparisons of commercial and sport fisheries. We argue that these issues are relevant for any economic comparison of commercial and sport fisheries, ranging from back-of-the-envelope comparisons to a formal study such as the Kenai River study. These issues should be considered in evaluating any economic comparison of commercial and sport fisheries. They should also be considered carefully in planning studies intended particularly for the purpose of economic comparison of commercial and sport fisheries, such as the Kenai River study. These issues go the heart of what can and cannot be learned from such comparisons: they should be considered by anyone interested in such comparisons, and not left to economists alone.

1. What economic measures are being compared?

Some economic studies of commercial or sport fisheries measure economic impacts, some measure economic value, and some measure both. For any economic comparison of commercial and sport fisheries, it is important that the same measures are being used and that they are relevant to the purpose of the comparison.[9]

The difference between the concepts of economic impacts and economic value is poorly understood by non-economists, and the two concepts are often confused. As described in the Kenai River Study Executive Summary, "Net economic value is a measure of benefits minus costs: we add up all the benefits of a change, and then subtract the costs. . . Economic impacts are changes in payroll, jobs, or sales. Impacts are aggregate rather than net measures of change."

There is a big difference between these two measures. In some cases, higher economic impacts may be associated with lower economic value, or vice versa. For example, if anglers have to spend a large amount of money to fish a stream, this increases the economic impact of the fishery, by increasing the incomes of gas station owners, fishing guides, tackle shop owners, and so forth. However, these costs to the angler reduce the economic value of the sport fishery.

---

[9]Different economists use different terms for the concept of "economic value"as used in this paper and in the Kenai River study. These terms include "value," "net value," "net economic value," "economic benefits," "net economic benefits," and "net benefits."

There are also big differences in methods and data requirements for measuring economic value and economic impacts. Measurement of economic impacts requires data on expenditures by sport and commercial fishermen, as well as data on expenditure flows between different sectors of the economy. Measurement of economic value for sport fisheries usually requires surveys of anglers to ask questions about what anglers would be "willing to pay" for sport fishing (contingent valuation approaches) or to collect data about anglers' sport fishing decisions under different circumstances (travel cost approaches).

Conceptually at least, the comparison of economic impacts between commercial and sport fisheries is straightforward. In contrast, the comparison of economic values between commercial and sport fisheries is much more difficult, because economic values of commercial fisheries are primarily "market values" which can be measured based on market prices and costs, while economic values of sport fisheries are primarily "non-market values" which can not be directly observed.

Which measure should be used? The answer depends entirely upon the purpose of the study. What, in fact, do those who are funding the study or who hope to use the results wish to know? Economists, who are typically concerned with economic efficiency in the allocation of resources, will often argue that economic comparisons of commercial and sport fisheries should focus on economic value or net economic benefits of fisheries. However, policy makers and the general public may be far more interested in economic impacts, in particular jobs and income.

The Kenai River study examined both economic value and economic impacts of commercial and sport fisheries. This got around the problem of which measure to use--but increased the scale and cost of the study.

To avoid confusion, in the remainder of this paper we use the term "economic effects" whenever we are referring generally to both "economic impacts" and "economic value."

2. Is the economic comparison relevant to the policy choices at issue?

This is the most fundamental of our basic issues. Economic comparisons of commercial and sport fisheries are useful in making policy choices only if they are relevant to those policy choices.

The importance of making an economic comparison relevant to the policy choice at issue was dramatically illustrated by the Kenai River Study. The policy issue was whether or not to increase the management target for the number of fish entering the river. To implement this policy would require reducing the commercial harvest of Kenai River sockeye. However, the increase in the sport harvest would not be equal to the reduction in the commercial harvest, because not all of the "extra" fish entering the river would be caught by sport fishermen. Management biologists estimated that sport fishermen would catch only about one-fifth of the fish given up by

commercial fishermen, while about four-fifths would escape to spawn.[10]

Prior to the study, sport fishing advocates had argued that the marginal economic benefits per fish harvested were much higher for the sport fishery than for the commercial fishery. The study results implied that this was indeed the case. However, since increasing the sport harvest by one fish required reducing the commercial harvests by about five fish, the study found that the proposed management change would not necessarily increase overall economic value.

A related point to be drawn is that economic studies of particular commercial and sport fisheries are not necessarily relevant to other fisheries or issues. Within and beyond Alaska, the Kenai River study was reported in the press as having found little economic support for reallocation between the commercial and sport fisheries. The reasons for this result were not obvious without learning more about the specific questions addressed by the study--but it would clearly have been wrong to generalize from this result to other policy issues. Had the allocation issue involved a one-to-one tradeoff between commercial and sport harvests, the economic implications of a reallocation might have been dramatically different.

Another related point is that in designing economic studies of commercial and sport fisheries, there is a tradeoff between how specifically to focus on particular policy issues as opposed to developing more general economic information about the fisheries. The more specifically a study focuses on a particular policy issue, the more relevant it is to that issue, but the less useful the results of the study may be for addressing other issues. The Kenai River study represents an extreme example of focus on a particular policy issue. Much of the $300,000 spent on the study went to prepare analysis relevant only to the issue of reallocation of one run of Kenai River sockeye salmon. It would have been possible to use the same funding to gather information of a more general nature, such as how spending by sport and commercial fishermen affects the Alaska economy, or how different management choices (daily bag limits, catch and release, etc.) affect the non-market benefits derived by sport fishermen. This kind of analysis would have been less directly relevant to the specific policy issues involved in changing the management target for the Kenai River, but more useful in addressing the many other policy issues related to allocation between the commercial and sport fisheries in Alaska.[11]

---

[10]The actual tradeoff between commercial and sport harvests depended on both the size of the run and how the policy change was implemented in the management of the commercial, sport and personal use fisheries. For different scenarios examined in the study, the increase in sport and dip net harvests as a percentage of the reduction in commercial harvests varied from as low as 10% to as high as 36%.

[11]An interesting contrast to the Kenai River study was a study prepared during the same time period by ARA Consulting Group Inc. (The Economic Value of Salmon: Chinook and Coho Fisheries in British Columbia, 1996). This study provided a much more general analysis of economic value and economic impacts in the comercial and sport fisheries of Bristish Columbia, not tied to specific policy issues. In part because these comparisons were on a per-fish basis, they

3. Does the comparison measure total or marginal economic effects?

This issue directly affects the relevance of an economic comparison for a given policy choice.

Total economic effects are the total economic value or economic impacts associated with a commercial or sport fishery. Average economic effects are total economic effects divided by the number of fish harvested. Marginal economic effects are the economic changes resulting from a change in harvests, which may also be measured in terms of marginal economic effects per fish harvested.[12]

There is an important difference between average economic effects and marginal economic effects. To the non-economist it may appear that--and user groups may argue that--a commercially caught fish will have a certain economic value or economic impact per fish and sport caught fish have a different (higher or lower) value per fish. It may seem logical to argue, for example, that if sport fishermen catching 1000 fish derive a total economic value of $20,000--or $20 per fish--that allocating these sport fishermen another 1000 fish would result in a further increase in economic value of $20,000.

However, this is not necessarily the case at all. In both commercial and sport fisheries, both total economic value and total economic impacts are clearly not necessarily proportional to total catch. Both economic value per fish and economic impact per fish depends on how many fish are being caught. Put differently, average economic value or impact per fish may be very different from marginal economic value or impact per fish.

For a sport fisherman, economic value is a non-market value derived in part from the sport fishing experience which is not necessarily directly proportional to the number of fish caught. Most anglers probably derive more enjoyment from catching their first fish of the day than from catching their sixth fish. Put differently, the difference between catching six fish and five fish is not the same as the difference between catching one fish and zero fish.

The economic impacts associated with sport fisheries--income and jobs--result from expenditures by anglers such as for travel, tackle, boats or guiding services. These expenditures may be relatively fixed, regardless of the number of fish caught. If the number of fish allocated to sport anglers doubles but the number of anglers stays the same, this may result in much better fishing but no increase in total expenditures by anglers--in effect cutting in half the "economic impact per

---

appeared relatively more favorable to the recreational fishery than did the results of the Kenai River study.

[12]Average and marginal economic effects need not necessarily be measured per fish harvested. In some cases, it may be more appropriate to measure these effects per fish allocated, in particular when not all of the fish allocated to a fishery are necessarily harvested-as is the case with the Kenai River sports fishery.

fish." Even if the number of anglers increases in response to better fishing, there is no reason to assume that the increase in expenditures would be directly proportional to the number of fish.

Similarly, many of the costs faced by commercial fishermen are fixed costs of boats and gear, or semi-fixed costs such as fuel expenditures per trip. If the total commercial harvest increases, profit per fish (a rough measure of economic value per fish) may go up, and the size and distribution of economic impacts per fish may change.

For all of these reasons, calculating total or average economic effects of commercial or sport fisheries and applying these average effects to specific *marginal* policy choices such as changing allocations between fisheries is of questionable validity. Estimates of marginal economic effects of policy decisions are of far greater relevance to policy decisions about marginal changes in fisheries than are estimates of total or average economic effects.

In fact, knowing the total economic effects of any sport or commercial fishery is of questionable relevance to any policy decision unless the decision involves whether to eliminate the entire fishery. In the hypothetical example above, knowing that a sport fishery which harvests 1000 fish has a total value of $20,000 says nothing about the value that would be generated by increasing the allocation to the fishery (except that it would probably be less than $20 per fish).

However, there are problems associated with measuring marginal economic effects rather than total economic effects. First, it is usually more difficult to measure marginal economic impacts than it is to measure total economic impacts. It is much easier to learn how much anglers spend in total on fishing gear and fishing trips than it is to learn how their expenditures would change in response to a specific policy change.

Second, many members of the public and policy makers are confused by the difference between marginal and average impacts. They want to know the answer to an apparently simple question--"what is the value per fish?"--and may not want to hear that the answer depends upon whether we are talking about the first fish harvested, the last fish harvested, or the "average" fish harvested.

In the Kenai River study, an effort was made throughout to measure marginal economic effects of the proposed policy change--as is reflected in the study title (*Economic Effects of Management Changes for Kenai River Late-Run Sockeye*). The early decision to define the study question in this way helped to keep the study theoretically consistent and correct. For example, in the analysis of economic impacts of commercial fisheries, changes in the allocation to the commercial fishery were assumed to affect only variable costs, and not fixed costs--since the size of the fleet is fixed by the number of limited entry permits.

4. What is the geographic area for which economic effects are measured and compared?

Economic effects of both commercial and sport fisheries depend critically on how the geographical area is defined for which economic effects are measured. There may be significant

differences between commercial and sport fisheries in the geographic distribution of economic impacts as well as the geographic distribution of costs and benefits.

In considering economic effects of the Kenai River commercial and sport fisheries, there are at least four possible ways of defining the geographic area of interest: the local area (the Kenai Peninsula), the State (Alaska), the country (the United States), and the world. For the Kenai River study, the area of interest was defined as the State of Alaska. However, sport fishermen come from all over the world to fish the Kenai River. The economic benefits estimated for the sport fishery would have been significantly higher had the non-market value derived by Texans or Germans been included in the estimates.[13] Similarly, the economic benefits estimated for the commercial fishery would have been higher had the profits earned by non-resident limited entry permit holders been included in the estimates.

Many of the economic impacts of both the sport and commercial fisheries occur outside the State of Alaska, such as expenditures of non-resident sport fishermen for travel or expenditures of commercial fishermen for gear. Had these economic impacts been included, both the absolute and relative magnitudes of these impacts would have been different.

5. Does the economic comparison consider indirect economic effects of policy choices?

In the Kenai River study, the most important indirect economic effect on other fisheries occurred as a result of the reallocation of sport fishing effort from other sport fisheries to the Kenai River sockeye salmon fishery. Better fishing on the Kenai River was projected to cause resident Alaskans to take 4,045 more trips to the Kenai River, but 3,399 fewer trips to other fishing sites--for a net increase of only 646 trips statewide. As a result, the net increase in economic value or economic impacts of all Alaska sport fisheries was considerably less than the increase in economic value or economic impacts of the Kenai River sport fishery by itself.

Ironically, some kinds of sport fishing expenditures were projected to decrease as a result of increased allocations to the Kenai River sport fishery. For example, because it is less expensive for Anchorage anglers to drive to the Kenai River than to drive to most substitute sites, projected expenditures for fuel were projected to decline rather than increase.

Another potential indirect effect of a change in the management target for the Kenai River would be changes in commercial and sport fishing for other Cook Inlet river systems. Because sockeye salmon in the Central District of Upper Cook Inlet returning to the Kenai River are mixed with sockeye salmon returning to other river systems, any management actions intended to reduce commercial harvests of Kenai River sockeye salmon would also reduce commercial harvests by the Upper Cook Inlet drift net fleet of sockeye returning to other river systems. This would in turn improve fishing opportunities both for commercial set net fishermen in the Northern District

---

[13]In practice, estimating the non-market value enjoyed by non-residents would have been technically difficult, and would have significantly added to the cost of the study.

of Upper Cook Inlet, as well as for sport fishermen in the Susitna River drainage. Because consideration of the economic effects on these fisheries would have greatly increased the scope and complexity of the study, these effects were not studied.

Another potential indirect effect considered by the Kenai River study was the effect of reduced Upper Cook Inlet commercial sockeye harvests on market prices. Even if a reduction in Upper Cook Inlet commercial sockeye harvests had only a small effect on prices, the net statewide effects on commercial fishing profits might be important if prices also increased for other Alaska sockeye salmon fisheries as well. In effect, from a statewide perspective, lost revenues from reduced harvests in Upper Cook Inlet might be offset in part or in full by increased revenues from higher prices for sockeye harvests not only in Cook Inlet or the rest of Alaska. (This serves as another example of the importance of the geographic area of perspective for economic comparisons of commercial and sport fisheries.) The study considered the potential effects of a change in commercial harvests on ex-vessel prices, but concluded that these effects would likely be small.

6. What does the economic comparison assume about fishery management?

The relative economic effects of commercial and sport fisheries depend on how the fisheries are managed. Similarly, the economic effects of policy changes depend on how the policy changes are implemented by fishery managers.

In the Kenai River study , for example, the estimated increase in the net economic value of the sport fishery was higher if managers increased the sport fishing daily bag limit than if they left the bag limit unchanged: sport fishermen benefit more from better fishing if they are allowed to keep more fish.

For the commercial fishery, the projected changes in net economic value depended on how managers went about reducing the commercial harvest, in particular whether the driftnet or the setnet commercial harvest was reduced. Because the setnet fishery has lower variable costs, a greater share of any reduction in the value of the commercial fishery would be a reduction in profits--while for the drift net fishery more of the loss in value would be offset by a reduction in costs.

More generally, the net economic value of the Upper Cook Inlet commercial fishery is lower than it could be if the fishery were managed more efficiently. For example, if there were fewer limited entry permits the fixed costs of boats and gear would be smaller for the same total catch, resulting in higher profits and greater net economic value. Because the fishery is not managed as efficiently as it could be, the reduction in net benefits resulting from a reduction in the commercial harvest is less than it otherwise would be.

How a commercial or sport fishery is managed affects the economic value and economic impacts that it creates. This leaves the choice of whether economic comparisons of commercial and sport

fisheries should compare the economic effects that they *do* have under current management, or the economic effects that they *could* have under different management. The answer depends, of course, upon the purpose of the comparison.

The Kenai River study assumed that actual management policies for both fisheries would continue unchanged. Similarly, the study asked fishery managers to describe how they would implement the proposed change in the management target, rather than attempting to estimate an "optimal" method for achieving this target.

7. What does the economic comparison assume about factors beyond the control of managers which may affect economic value or economic impacts of fisheries ?

There are many factors beyond the control of managers which may significantly affect the economic value or economic impacts of sport and commercial fisheries, which may change significantly in the short or long run, and which are difficult or impossible to predict for the future. What is assumed about these "exogenous" factors may greatly affect estimates of the economic effects of both commercial and sport fisheries.

The most obviously important exogenous factor for the Kenai River study was the ex-vessel price received by Upper Cook Inlet commercial fishermen for sockeye salmon. What is assumed about the ex-vessel price directly affects the estimated economic value and economic impacts of the commercial fishery. Between 1991 and 1995 prices ranged from as low as $1.00/lb to as high as $1.60/lb. Significant changes in price from year to year are common. Nor are average prices necessarily likely to be stable over the longer term. As world markets adjust to the rapid growth in the supply of farmed salmon, prices for wild sockeye salmon may--but will not necessarily--decline significantly.

Another exogenous factor was the size of the Kenai River sockeye salmon run. The total run size can vary dramatically from year to year, and is impossible to predict accurately in the short run or the long run. Between 1980 and 1994, the Upper Cook Inlet commercial sockeye salmon harvest varied from as low as 1.4 million fish to as high as 9.5 million fish. In developing study assumptions for how an increase in the Kenai River target range would be implemented, commercial fisheries managers pointed out that in year with "high" runs (more than 5 million sockeye), increasing the target range would not result in *any* change in management or in the commercial harvest, because enough fish would enter the Kenai River to achieve the higher target range. However, in years with "low" runs (less than 2 million sockeye), commercial sockeye harvests might be very greatly reduced because the restrictions imposed on commercial fishing for Kenai River sockeye salmon would also result in significant reductions in harvests of sockeye returning to other Upper Cook Inlet river systems. Thus assumptions about the size of the run--which is impossible to predict accurately--are very important for assessing the economic effects of the proposed management change.

Yet another example of an uncertain but important exogenous factor is the number of

non-resident sport fishermen visiting Alaska. The number of non-resident fishermen has grown rapidly in recent years, and many of these visitors fish the Kenai River. If better fishing on the Kenai River causes these visitors to spend more time in Alaska this can significantly increase their expenditures and thus the economic impacts of their visits. However, it is difficult to predict the future rate of growth of non-resident sport fishing in Alaska, which makes it difficult to predict the potential future economic impacts of increasing the number of fish available for Kenai River sport fishermen.

8. How reliable are the comparison's estimates of economic effects?

How useful economic comparisons of commercial and sport fisheries are for making policy depends on how reliable they are. How reliable they need to be depends both on the policy choice as well as the relative magnitudes of the estimated effects. If the estimated marginal value of a fish to the commercial fishery is $10 and the estimated marginal value of a fish to the sport fishery is $100, then for most policy decisions it doesn't matter if the confidence interval for both estimates is fairly wide. But if the estimated marginal value per fish for the sport fishery is only $12, it does matter if the confidence interval for both estimates is fairly wide.

The reliability of estimates of the economic effects of commercial and sport fisheries depends in part on the management and exogenous assumptions used in making the estimates, as discussed above. Rather than attempting to choose a single "best" set of assumptions about fishery management and exogenous factors, the Kenai River study estimated economic effects for ten different "scenarios" representing different combinations of assumptions. For example, most scenarios assumed a "medium" ex-vessel price of $1.43/lb, but the "high price" scenario assumed an ex-vessel price of $1.75/lb and the "low price" scenario assumed an ex-vessel price of $1.00/lb. Estimated economic effects varied significantly between scenarios.

Estimating economic effects for different scenarios was an effective way of illustrating the importance of key management and exogenous assumptions, and making the point that the estimates for any particular scenario were only as "reliable" as the assumptions on which the scenario was based. However, presenting the results of many different scenarios was cumbersome, and made it more difficult for readers to understand the study results.

Even if there were no uncertainty associated with assumptions about management or exogenous factors, estimates of economic effects of commercial and sport fisheries would still be subject to statistical uncertainty because the models used for such estimates do not fit the data perfectly--nor are the data perfect. Unfortunately, due to the complexity of the techniques used for modeling economic impacts and economic value, it is difficult to calculate classical confidence intervals for these estimates. The Kenai River study report included statements such as "given the range of uncertainty in our estimates, we can't definitely conclude that actual commercial losses would be larger than sport gains." Although these kinds of statements served to caution the reader that the results were subject to significant uncertainty, the study did not--and could not--provide any formal indication of the range of uncertainty associated with the estimates.

Conclusions

In this paper we have suggested eight basic issues which should be considered in any any economic comparison of commercial and sport fisheries, ranging from a back-of-the-envelope comparison to a formal study. Corresponding to these eight basic issues we offer eight general suggestions about the proper design of economic comparisons of commercial and sport fisheries intended to provide insight into policy choices:

1. The measures of economic effects--economic impacts or economic value--should be the same for both fisheries and should be relevant to the purpose of the comparison.

2. Economic comparisons of commercial and sport fisheries should be relevant to the policy choices under consideration.

3. To be relevant, economic comparisons of commercial and sport fishery should address marginal economic effects of the policy choices under consideration, rather than total or average economic effects of commercial and sport fisheries.

4. The geographic area for which economic effects are measured and compared should be appropriate for the policy choices under consideration.

5. Economic comparisons of commercial and sport fisheries should consider indirect economic effects of policy choices if these indirect effects are relevant to the policy issues under consideration.

6. Assumptions about fishery management should reflect how management might change in response to the policy choices under consideration.

7. Assumptions about exogenous factors should be evaluated carefully: the recent past may not necessarily be a guide to the future.

8. The comparison should address the sensitivity of the results to key assumptions about fisheries management and other factors, as well as the range of uncertainty associated with estimates of economic effects.

We may also offer some more general conclusions about economic comparisons of commercial and sport fisheries. As illustrated by the Kenai River study, economic comparisons of commercial and sport fisheries can be complicated. This is partly because the economic techniques used for these studies are complicated. But it is also difficult to think clearly about the basic issues involved in framing the analysis so that it is actually relevant to the policy issues under consideration.

Doing economic comparisons right can make them more expensive. In some cases, the inherent

uncertainty associated with management assumptions, exogenous factors or available data may lead to inconclusive results. Nor will the results, even if they are conclusive, necessarily influence policy decisions. Put simply, not all economic comparisons of commercial and sport fisheries are necessarily worth the cost.

Because of the mixed stocked nature of the Cook Inlet commercial fisheries, those who lobbied for the Kenai River study as well as the Alaska legislature hoped that it would provide a way to make economic comparisons of commercial and sport fisheries for all of the important fisheries in Cook Inlet and its watershed. They hoped that the $300,000 cost of the study would be sufficient to achieve that goal. Instead, they received only an analysis of policy options for the late run of sockeye salmon to the Kenai River--which is just one of several Kenai River sockeye runs and one of dozens of salmon runs in Cook Inlet. This is not to fault those who administered or carried out the study: it reflects the complexity of both the fisheries and the analytical task.

Finally, experience with the Kenai River study also suggests some lessons for resource agencies planning to contract for economic comparisons of commercial and sport fisheries. To carry out a comprehensive economic analysis of a specific allocation tradeoff, such at the Kenai River study, resource agencies should:

- Be prepared to provide an institutional structure that will be considered sufficiently impartial to administer contracts and reviews.

- Have sufficiently skilled staff to design the contract and objectively select among competing bidders.

- Encourage public support for and cooperation with the study by working with user groups to seek input into study design and participation in data collection efforts such as surveys.

- Have sufficient staff to evaluate use response to the range of major management actions under consideration.

- Have a good understanding of and realistic expectations about what can and cannot be learned from such studies.

References

ARA Consulting Group Inc.. 1996. *The Economic Value of Salmon: Chinook and Coho Fisheries in British Columbia.* February, 1996. Prepared for Canada Department of Fisheries & Oceans; BC Ministry of Agriculture, Fisheries & Food; BC Ministry of Environment, Lands & Parks; and BC Ministry of Small Business, Tourism & Culture, February 1996.

Berman, Matthew, Sharman Haley and Hongjin Kim. 1997. "Estimating Net Benefits of Reallocation: Discrete Choice Models of Sport and Commercial Fishing." *Marine Resource Economics*, Volume 12, Number 4, pages 307-327.

Bishop, R.C. and K.C. Samples. 1980. Sport and commercial fishing conflicts: a theoretical analysis. *Journal of Environmental Economics and Management* 7:220-233.

Carter, Christopher N. and Hans D. Radtke. 1986. "Coastal Community Impacts of the Recreational/Commercial Allocation of Salmon in the Ocean Fisheries." Oregon Department of Fish and Wildlife Staff Report.

Carter, Christopher N. and Hans D. Radtke. 1986. "Selected Economic Aspects of the Commercial/Recreational Allocation of Willamette River Spring Chinook." Oregon Department of Fish and Wildlife Staff Report.

Edwards, S.F. "An Economics Guide to Allocation of Fish Stocks Between Commercial and Recreational Fisheries," NOAA Technical Report NMFS 94, U.S. Department of Commerce, 1990.

Institute of Social and Economic Research (ISER), University of Alaska Anchorage. *Economic Effects of Management Changes for Kenai River Late-Run Sockeye.* Prepared for Alaska Department of Fish and Game, January 1996.

Jones & Stokes Associates, Inc. 1991. *Southeast Alaska Sport Fishing Economic Study.* Final Research Report. December 1991. (JSA 88-028.) Sacramento, CA. Prepared for Alaska Department of Fish and Game, Sport Fish Division, Research and Technical Services Section.

Jones and Stokes Associates, Inc. 1987. *Southcentral Alaska Sport Fishing Economic Study.* Prepared for Alaska Department of Fish and Game, Sport Fish Division, Research and Technical Services Section.

Sutinen, J. G. 1980. *Economic principles of allocation in recreational and commercial fisheries. In Allocation of Fishery Resources* (J.H. Grove, ed.), p. 432-436. FAO, New York.