

ALLOCATING RECREATIONAL-COMMERCIAL  
FISHERY HARVESTS: LITERATURE REVIEWS  
AND PRELIMINARY WORK TOWARD MODELING  
THE ISSUE

**EXECUTIVE SUMMARY**

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## FINAL REPORT

### I. SUMMARY

This report has reviewed models used in estimating recreational demand, and the literature dealing with demand estimates for fishery products. The reviews are conducted in the context of identifying issues important to the eventual development of a model to guide allocation decisions. The use of such a model would be that of consistently valuing changes in harvest allowed in either or both sectors. These valuations would allow managers to compare net economic effects of policies such as reducing harvests in either or both sectors, and shifting allowable harvests between the two sectors.

Several methodological and empirical issues have been identified as important to the development of an allocation model. On the recreational side, one of the most important of these is the effect of quality of the fishing experience, how fishermen perceive quality and its effects on their decisions (i.e., number of trips, etc.), and how we model and measure quality as an important variable in demand. The implied sensitivity of demand to, for example, an improvement in catch rate or average size of catch, is crucial to estimating changes in consumer and producer surplus in response to changes in the management of a recreational fishery that gave rise to these improvements.

An important finding arising from the critique of the recreational demand literature is that estimates of consumer surplus per unit of use of recreational resources are sensitive to model and estimation judgments by researchers. This result is likely to hold for empirical demand work in marketed commodities as well, but may be especially applicable to demand estimates for nonmarket goods and services. What this result suggests is that further investigation into the decision framework of recreational fishermen is warranted, and with refinements in modeling that decision process, will likely

reduce variation in estimates originating with researcher judgments. Modeling the effects of quality of fishing - and its perceived measure may differ between fisheries and/or groups of fishermen - is just one example of potentially important decision variables warranting further investigation.

Another issue that has received little attention concerns the relationship(s) between the change in one group's catch resulting from a policy-induced change in the other groups's catch. For example, curtailment of commercial harvest by one million pounds does not suggest a one million pound increase in recreational catch (or vice versa). The "receiving" group's improved harvest works through effects on stock (with contemporaneous and future effects likely to be felt). Modeling effects on recreational harvest of changing the stock incrementally requires additional research. Similarly, differential effects on stocks may result from "cropping" particular sizes of fish in the recreational sector. Targeting particular sizes in the recreational sector may also affect the size distribution of catch -- hence the "quality" of catch -- in the commercial sector, with potential revenue effects depending upon the distribution of prices by size classes.

In the commercial sector, demand estimates have resulted from models motivated by various questions (e.g., estimates of relative importance of demographic factors in seafood demand). Models applied to any one market level generally have not consistently incorporated product transformation and other input market price information from the other market levels. In addition, many demand estimates are dated, hence may not represent what many believe to be important shifts in consumer preferences in the 1980's.

Literature reviews and allocation issues addressed in this paper have approached the problem of valuation in the two sectors at the level of the key

input, fish. By doing so, we assure consistent treatment of surpluses in both sectors. In addition, most effective controls employed by managers today apply to harvests (e.g., through setting seasons to limit harvests, bag limits, and total harvest quotas). The report includes examination of conceptual issues for valuation at the vessel level (or primary harvesting). The quality issue discussed above is one such issue in the recreational sector. In the commercial sector, the report explores the importance of various assumptions about product transformation between marketing levels (e.g., retail versus exvessel) in deriving the demand function for fish at the vessel level. In addition, preliminary research is included in the paper which examines some of the issues in estimating a general equilibrium derived demand (at the vessel level). Under certain assumptions, it may be possible to estimate changes in consumer and producer surpluses originating in retail and wholesale markets with a vessel-level derived demand function. If such a function can be estimated (i.e., if required assumptions hold), then valuation of changes in economic welfare in the commercial sector from, for example, a change in allowable harvest, will be simplified.

Finally, the paper briefly reviews some enforcement cost issues that may be important to allocation models. If these costs differ between sectors, then allocations of allowable harvest may be affected (as may total harvest). However, this issue requires further research before much else can be concluded.

In summary, this project has reviewed the fishery economics literature relevant to valuing harvests in an allocation model. It also presents results of early exploration into many of the issues that will have to be addressed in developing a derived-demand based model for allocation of commercial and

recreational harvests. At this point, we are optimistic that such a model can, in fact, be developed as a guide to economists and managers; however, much remains to be modeled and refined before an allocation model can be applied.

## II. INTRODUCTION

The accompanying paper represents one of the first attempts to provide a methodical review of the current status and applicability of fishery economics research relative to a number of issues important to recreational-commercial allocation issues. Management and industry are concerned about overexploitation in many of our fisheries, and user conflicts may exacerbate efforts by managers to either moderate declines in stocks, or to rebuild stocks toward more optimal levels.

User conflicts arise from the multiple uses of open access, renewable resources. In marine fisheries recreational and commercial fishermen compete in their access and harvesting of stocks that are fixed in each period. Because one group's harvesting generally reduces the stock available for the other (hence increases the required effort by the other to realize a given catch), there is an externality arising from open access. We generally model this externality as a dynamic effect (i.e., this year's harvests affect next year's stock and effort requirements). However, we also observe contemporaneous influences arising from the effects of crowding within or between groups.

In fisheries with binding stock constraints, or in those with declining stocks, comparisons of value of harvests to competing groups is essential to more efficient use of our fishery resources. To economists, the principles of comparing values to each group is clear: We need only consider the allocation

problem as one involving the maximization of an inter-temporal function of the sum of the economic surpluses realized from uses of each fishery. Moreover, by undertaking this evaluation at the level of the demand for the key "input" to both activities -- the fish -- we assure consistent treatment of all gains (or losses) associated with corresponding transformation of the outputs at each stage of the process. This latter point seems especially relevant to the derived demand for fish arising from commercial activities.

The purposes of the accompanying paper are to review the relevant fishery economics literature, and to consider the research issues that arise when we attempt to implement this seemingly straightforward approach to the allocation problem. As the reader will see, there are several methodological and empirical issues to be resolved. The methodological issues arise largely from the fact that there are no markets for what we might term "in situ" fish. Consequently, we must recover recreationists' demand for and valuation of fish from their demands for recreational fishing. Since the attributes of "fish" -- the likelihood of catching at least one, the expected number caught, the size and quality of the catch, etc. -- in recreational fishing are best treated as quality dimensions of the activity, deriving estimates for the consumer surplus generated by alternative allocation rules requires estimating recreationists' values for these quality changes from their demands for fishing. Bockstael and McConnell (1987 -- see paper for reference) have recently demonstrated that there are important theoretical and practical limits to our ability to estimate these values. On the commercial side, we will argue that it may be possible to use an analogous relationship based on the insights available from retail-to-farm marketing margins to develop these estimates. Of course, these will require detailed knowledge of the production relationships involving fish.

Two early models relating to allocation issues maximize the stream of net benefits to both commercial and recreational sectors, subject to biological constraints.

The emphasis of both models appears to be that of exploring optimality conditions of stock and either effort or harvests in a model with both recreational and commercial fishermen, and both address conceptual allocation issues. However, neither paper carefully explores practical issues in developing these models for use in an allocation dispute. In addition, there are problems in defining optimal effort as in the McConnell and Sutinen (1979 - see paper for reference) model: managers do not have control over effort in the sense that access is seldom limited. Thus defining marginality conditions for achieving optimal stock in terms of effort in each sector suggest difficulties in achieving desired management goals. These include definition and measurement of what constitutes effort, and problems with implementing effective controls.

By concentrating the conceptual issues around the key input fish, not only do we attempt to ensure consistent treatment of gains and losses as noted above, but we also emphasize conceptual issues at the level of fishery management where controls are most likely to be deployed and/or effective -- that of quantities of fish harvested.

### III. PURPOSE

#### A. Problem Description

The basic problem addressed in this project is the lack of an economic model to guide commercial-recreational harvesting allocation decisions -- decisions which are currently being made by managers.

Components of this basic problem include uncertainty about: a) applicability of recreational demand models and estimates for marginal benefit estimation, b) the role of fishing quality (e.g., catch rates) in recreational demand models, c) applicability of food-fish demand estimate to marginal (fish consumer) benefit estimation in the commercial sector, d) uncertainty about which market level to use in estimating consumer (and producer) benefits/costs of changing harvests, e) uncertainty in incorporating effects of substitute species in models of both sectors, and, f) potential data and estimation problems to estimating benefit functions.

#### B. Project Objectives

The general objectives of the project were to review the fishery economics literature on recreational and commercial demand, and to begin developing a conceptual approach to modeling the recreational-commercial allocation decision. Specific project objectives were:

- 1) To survey the recreational fishing demand literature, and the demand for commercially harvested species,
- 2) To evaluate alternative recreational fishing demand models, and
- 3) To begin developing a conceptual framework for modeling allocation decisions by managers

These objectives were accomplished. Detailed results of the work are contained in the attached paper.

#### IV. APPROACH

This study, from the outset, was conceived as one with the overriding purposes of reviewing the fishery economics literature relevant to the

allocation issue, and to lay the groundwork for eventual development of an allocation model to guide fishery management decisions. As such, most of the work done consisted of conceptualizing important economic issues in modeling allocation, and review/critique of many studies (both conceptual and empirical).

A. Description of Work Done and Findings

1. Recreational Demand Review -- A thorough review of the recreational fishing demand literature is provided. This review includes a critique of models generally employed in estimating recreational demand, empirical results of estimations, results of a test for sensitivity of estimated consumer surplus to the particular specification of the model employed in a large sample of studies in the literature, and a critique of the recreational demand literature (i.e., models and results) relative to the allocation issue. See Sec. II of accompanying paper for complete details.
2. Commercial Demand Review -- The empirical literature on demand for fishery products is reviewed and summarized. Critique of these estimates for allocation decision is provided. In addition, a critique is provided of the importance to allocation decisions of modeling various market levels and price transmission between those levels (e.g., retail vs. vessel). See Sec. III of accompanying paper for specific details.
3. Conceptual Issues in Measuring Consumer and Producer Surplus Changes from Fisheries Policy -- A conceptual approach to measuring producer and consumer surplus is developed and

discussed, using the commercial sector as an example. Use of equilibrium derived demand is contrasted with more traditional derived demand (the latter holding adjustments in other markets constant) in the context of fishery markets. Data requirements for estimation are also examined. See Sec. IV of accompanying paper for specific details.

4. Enforcement Costs -- A review is provided of the very brief literature on economic models of enforcement costs. An approach to examining the conceptual importance of enforcement costs to an allocational model is provided. See Sec. V of accompanying paper for specific details.

#### B. Project Management

Project management is under the supervision of J. E. Easley, Jr. Project tasks were distributed to research team based upon natural divisions in work to be done, and specific expertise of team members. Firms were not involved with this work. The research team, and each member's work area(s) are:

J. E. Easley, Jr.	Commercial fishery demand review; general allocation issues and model; enforcement costs; project reporting, etc.
V. Kerry Smith	Recreational demand review; general allocation issues and model.
Michael K. Wohlgenant	Modeling market levels; price transmission between levels; derived demand models.



- b. Critique of these estimates for allocation models
  - c. Conceptual review of importance of market levels in deriving demand for fish at vessel level, and
  - d. Illustration of importance of: i) substitute inputs (including other species) to derived demand model, and ii) potential use of price transmission data in estimating derived demand
3. Measuring Consumer/Producer Surplus
- a. Procedures for measuring producer and consumer surplus are illustrated for i) partial equilibrium derived demand, and ii) general equilibrium derived demand
  - b. Implications of general equilibrium demand for single-market estimation illustrated
  - c. Data requirements for these estimation procedures are discussed
4. Enforcement Costs
- a. Literature reviewed; importance of modeling enforcement costs to size of optimal stock illustrated.
  - b. Potential effects on optimal stock of different enforcement costs in the recreational and commercial sectors are illustrated.

A general accomplishment is that economists' and fishery managers' understanding of many of the economic issues in modeling allocation are expected to be more sharply focused.

## B. Problems Encountered

No significant problem was encountered. However, due to the many conceptual issues involved in modeling allocation, some internal shifting (within budget) of funds was necessary to carefully explore more of these issues. Involvement by Wohlgenant and Thurman, with expertise in derived demand, price transmission, and econometrics allowed expanded investigation of many of these issues. As required by the contract, the Gulf and South Atlantic Fisheries Development Foundation was notified of, and approved, these internal budget shifts.

## VI. EVALUATION

### A. Goals/Objectives/Benefits

1. The original project goals are reviewed in Sec. III above. To summarize those, this project was designed to review relevant fisheries economics studies of recreational and commercial demand, and to critique their importance to modeling allocation issues. It should be noted that evaluating these results is more difficult than evaluating, for example, improvements in gear.

Many conceptual issues are discussed pertaining to modeling allocation. Thus these results lay much of the groundwork for the development of an allocation model that can potentially be applied to many fisheries exploited by both commercial and recreational fishermen. Such a model can act as a guide to economists and managers in estimating and predicting the economic effects of alternative allocations. Ultimate benefits

to the fishing industry will arise primarily from improved estimates of economic effects on producers and consumers of alternative allocation policies. Managers currently have little guidance in estimating/predicting these effects. Improved conservation of fishery resources may also result in the future from both improved allocations, and improved models of effects of alternative harvests in both the recreational and commercial sectors.

2. The original project goals are not amenable to quantification.
3. No modifications were made to goals.
4. Goals and objectives were attained. In addition, we believe more progress was made toward eventual model development than were anticipated at the outset of the project. We also have significantly improved our understanding of the economic issues surrounding allocation, and believe that readers (of the accompanying paper) will also gain improved understanding.

B. Specific Accomplishment/Products

1. Products

a. Papers and Presentations

- "Allocating Harvests between Commercial and Recreational Fishermen: Issues for Economic Modeling" (Easley and Smith), presented at Southern Natural Resources Economics Committee Workshop, Marine Fishery Allocations and Economic Analysis, Tampa, May 1988.
- "Toward a Model for Allocation of Fishery Harvests" (Easley), presented at Assoc. of Env. and Resource

Economists Workshop, Sport Fisheries: Economic Valuation and Management, Seattle, June 1988.

-- "Allocating Recreational-Commercial Fishery Harvests: Literature Reviews and Preliminary Work toward Modeling the Issue" (Easley, Smith, Wohlgenant and Thurman) Final report prepared for GASAFDF Contract No. 37-09-28750/6000 (NMFS Award No. NA88-WC-H-06070).

b. Other

This project, and 1988 papers on allocation played at least a small role in the selection of Fishery Management Conflicts: Recreation versus Commercial as a sub-topic of the Fourth Annual AERE Workshop. We believe the output is playing a role in encouraging debate and further research by economists in refining models to guide allocation decisions.

2. The papers listed above contain: a) the literature reviews, b) the evaluation of recreational demand models, and c) the foundations for development of a conceptual model. These are the objectives for the current project.
3. Allocation of harvests between competing recreational and commercial fishermen represents one of the toughest issues faced by management in those fisheries in which biological stock constraints are binding. This describes many -- if not most -- of our Gulf and south Atlantic fisheries. Yet managers do not have good models to guide these allocation decisions. Not all techniques in use are defensible from an economic efficiency

perspective, and even where economic efficiency is ignored, we do not have good estimates of what the costs are of deviating from efficient harvesting rates.

Thus this work is the first step toward development of such a model. Once developed, an allocation model may be used to either improve harvesting efficiency (by improving allocation), or to estimate economic costs of deviating from the economically efficient solution (in harvests and/or stocks).

4. Because this project reviews and evaluates research, outlines the elements of a conceptual framework and takes first steps toward evaluating the issues involved in developing this framework, its value will ultimately take the form of enhanced information. That is, with this improved information we would expect to see better decisions and improvements in resource allocations. Once the model is developed and is applied, the resulting allocations can be compared with historical allocations, or those under consideration, to estimate economic costs of deviating from a more efficient solution. In effect, the model's output (in the form of solutions) can be contrasted with recent or observed practices to value the project's contribution to the fishing industry.

#### C. Project Benefits

1. As the information generated is public information, and has been (and will continue to be) made available to managers and professional economists, the industry should have full access to

the information. A "layman's guide" is to be prepared later this year under a continuing project.

2. Representatives of management, NMFS, and university economists (through papers and professional meetings) have had extended these results through the project. While early, we expect these results to assist other researchers in more clearly focusing on particular allocation issues, and to perhaps stimulate interest in improved models and estimates of valuation of harvests in the two sectors.
3. Current output is likely to be used by industry to improve members' understanding of the economic issues in allocation. One might suspect these results to be used by industry to pursue improved management.
4. To the extent this project contributes to a focusing of attention on important economic issues in allocation decisions, we believe it will speed development of improved models and valuation of fishery harvests.

D. Specific Economic Benefits

1. Clear economic benefits

a,b Clear economic benefits as with new gear development, for example, are not directly evident as this project is a first phase of a longer term project. However, indirect benefits include compilation/critique of recreational demand estimation procedures, compilation of commercial (fishery product) demand estimates, and discussion/demonstration of important economic issues to

consider in modeling the allocation issue. Indirect benefits relate to improved industry (and management) understanding of the economic issues, and model components. This work will reduce start-up time for other researchers as well, and may in fact stimulate interest in allocation as both a research and public policy question.

2. a-e As noted above, benefits of this first year's output are indirect, though not insignificant. Once a model is developed, results of that model compared to historical (or planned) allocations can be used as a direct measure of benefits (also see VI, B-3, B-4 above). Those benefits will be continuing as such a model will represent an improved management tool.

E. Need for Federal Assistance

As an improved management tool for our common property fishery resources, developing a model for evaluating allocation decisions is a legitimate role for Federal research assistance. The benefits of such a model, including improved fishery utilization and conservation, may be considered public benefits as well as industry benefits. Due to the competing nature of the demands for fishery resources, it is unlikely that one group will fund such comprehensive research. Thus, continued Federal assistance is important to objective research aimed at helping solve a politically sensitive (by competing users) problem.

## VII. CONCLUSIONS

- A. In addition to the major goals of reviewing the recreational and commercial demand literature, specific conclusions reached that are important to the allocation issue are as follows:
1. The results of this project provides much improved understanding of the range of values of recreational fishing days in the literature. Though the quality of the fishing experience matters, and modeling/measurement issues are not yet resolved, fishing values differ between fisheries (therefore recreational values in one fishery may not always transfer to another fishery).
  2. Estimated consumer surplus per unit of use is sensitive to model formulation/empirical specification judgments by researchers.
  3. Though sensitive to researcher judgments as noted in 2, models give different results for recreational values in part because of different assumptions about the way recreationists make decisions (e.g., frequency of use, site selection, species substitutions). Many of these issues arise from data limitations. Nonetheless, we are not yet at the stage of determining which of the modeling assumptions describing the behavior of the recreationists is best.
  4. Quality of the fishing experience appears to be important, at least for some decisions by recreational fishermen. How changes in commercial catch get translated (via stock effects) into changes in quality of recreational fishing is insufficiently understood. Likewise,

5. Changes in recreational catch may also effect current and future commercial catch (through stock effects). "Quality" of the commercial catch may also be important as, for example, measured by the size distribution of catch vis-a-vis the distribution of prices by size classes. These "stock effects" are insufficiently understood.
6. There is significant variance in price elasticity estimates in the commercial demand literature, and
7. Models at the vessel level have not consistently treated other market levels in deriving demand at the vessel level.
8. Demand characteristics may have changed considerably since the late 1960's/early 1970's when many of the earlier works were undertaken, thus these estimates may be less than ideal for use in current valuation/allocation problems.
9. Production practices and other input supply elasticities (including other species) affect price elasticity at the vessel level, i.e., the vessel level derived demand for fish. Model assumptions about input substitutions will affect derived demand elasticity, and should perhaps be tested.
10. Price transmission information between market levels may also be used to estimate derived demand own-price elasticity. The elasticity of price transmission may also be used to net out changes in quasi-rents to producers from a general equilibrium estimate of total welfare change induced by changes in exvessel prices (i.e., to decompose total welfare effects into changes in consumer and producer surpluses).

11. Single market (e.g., vessel level) demand estimation procedures may, under certain assumptions, be used to estimate all producer and consumer surplus changes induced by a change in quantity harvested at the vessel level. This model should be tested against more traditional derived demand models.
  12. Enforcement costs, if different between recreational and commercial sectors such that total enforcement costs are higher (than exists with a single, homogeneous group of fishermen), may imply larger equilibrium harvests and smaller stocks. Different enforcement costs between the sectors may suggest differences in allocations based upon social costs rather than private costs; however, this case has not been modeled and we do not know enough yet to predict outcomes.
- B. We believe the project has provided the information desired, and that output exceeds reasonable expectations.
- C. Further work to be done is to complete the development of a basic allocation model. Work beyond that will involve testing alternative formulations and/or assumptions. Particular emphasis should be given to modeling and estimating: 1) effects of quality on recreational demand; 2) links between foregone harvest in one sector and harvest (current and future) in the other; 3) modeling/estimating derived demand in the commercial sector, and testing sensitivity of estimates to model assumptions; 4) modeling/estimating general equilibrium derived demand, and testing the sensitivity of estimates to model assumptions; and 5) modeling potential effects of enforcement costs.