Allocating Harvests Between Competing Users in Fishery Management Decisions: Appropriate Economic Measures for Valuation

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Introduction

Given the motivations for this paper, perhaps the subtitle should be, "Inappropriate Economic Measures for Valuation!" Most fishery economists probably have more experience with inappropriate measures than appropriate ones. All of this, of course, begs the question of how we gauge "appropriate." In general we would argue that where allocation is an issue, most economists would suggest that the end result of any allocation scheme satisfy marginality conditions. These conditions require that the net value of the last pound caught by competing user groups be equal (and equal to zero under open access; the marginal user cost under optimal management). These of course are standard conditions from economic models concerned with efficiency.

Much of the debate in the fishery economics literature has been over achieving efficiency goals (see, for example, the collection of papers in Anderson, 1977—with some exceptions, notably Bromley and Bishop and the collection of papers edited by Pearse, 1979). Excess effort, and the models designed to examine effects of limited entry, may be the single most important problem that fishery economists could have examined, and continue to examine (for a review of the development of economic models for management decisions, see Kellogg, 1985).

These models, as pointed out by Bromley and Bishop (1977), ignore distributional issues for the most part. In this paper, we will discuss some allocational problems faced by managers, and argue that these are, in fact, distributional issues and are likely to be more important (or at least as important) to managers as efficiency issues. We will first address economists' efforts to model fisheries and suggest some generalizations. Finally, we discuss some potentially practical alternatives for managers to consider in decisions and/or in the design of management systems—alternatives that we as fishery economists might address.

The motivations for this paper are several. One of the most important is observation of the difficulty encountered by managers in attempting to allocate allowable harvests between competing harvesting groups. Most of us are familiar with examples, and we have observed these problems in the Gulf and south Atlantic with recreational and commercial competition for red drum, mackerel, and snapper-grouper stocks. In the latter fishery, there are also conflicts among commerical groups.

Overshadowing our thinking about allocation problems are the following:

1) Economists have had an effect on fishery management, and may have even greater effects through more careful interpretation of models, their implications, and their applications to specific problems (i.e., empirical work). However, in the case of recreational-commercial competition for the same species, much theoretical work remains to be done as a foundation for empirical work and policy debates[1].

2) Distributional issues in fishery management decisions matter a great deal. While our experience under extended jurisdiction has a brief history, we do have longer experience and greater observation of management in state waters. There are some lessons from that experience which we will touch on below.

3) Many groups exert pressure on managers for larger shares of allowable catch. Some of the pressure-groups use estimates of value that are inappropriate to the decision at hand.

Why Fishery Managers Aren't Listening (Any More Than They Are) to Efficiency Arguments

Dynamic models usually start with an objective function of maximizing the present value of net benefits of harvest from a given stock, subject to net (of harvest) growth in stock, a harvesting capacity constraint, and an initial population size. This, of course, describes the Clark and Munro (1975) linear model. It generally is used to solve for the optimal path of effort. Colleagues at North Carolina State University have applied a modified

ABSTRACT—This paper discusses decision making by fishery managers and economists' efforts to model fisheries. Arguments and casual evidence are presented to suggest that distributional issues matter to managers. The paper concludes with a practical measure suggested as a means of achieving efficiency goals while simultaneously resolving conflicts between competing harvesting groups.

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[1]Development of such models has begun. See McConnell and Sutinen (1979), and Bishop and Samples (1980).

version of such a model to solve for the optimal season opening for the North Carolina bay scallop fishery—a single year-class fishery[2].

Such models and applications are, of course, concerned with efficiency. Our experience tells us that distribution matters, and perhaps we, as economists, ought to think about incorporating distributional issues into our models[3]. How do we accomplish this without violating rules of welfare economics? While we do not presume to have a definitive answer to this question, there are some avenues that are suggested from observing management at the state level which may be worth pursuing.

An economist's objective function in a model is generally oriented toward societal welfare, and its empirical counterpart is usually something like maximization of net economic returns. First order conditions thus generated are efficiency-grounded. We do not question the usefulness of such work (we have used such models ourselves). However, if we want to incorporate distribution issues and develop models that help explain observed behavior, existing models may be overly simplified.

Consider for a moment the objective function of fishery management agencies. Is it to maximize the economic returns to resources engaged in harvesting? We would respond affirmatively, but that managers' objective functions include more arguments[4]. In working with management agencies, it is clear that managers are concerned with income distributional effects of fisheries regulations. One way this is frequently voiced is (in our words) to minimize the heat on the agency from irate fishermen. And irate fishermen are defined as losers, or those who perceive losses, from a particular policy[5].

[2]For a description of the model and results, see Kellogg, Easley, and Johnson (1985).
[3]For example, Crutchfield (1972) and Bishop, Bromley, and Langdon (1981) discuss incorporating more general objectives than simply maximum economic returns.
[4]We economists may have too long ignored the role of a management (and/or regulatory) agency.
[5]Note that there is no such thing as tenure for most directors of management agencies.

In addition to the problems we have in specifying models that might allow us to evalute tradeoffs between efficiency and distribution, we also have problems in estimating models. In most fisheries in the Gulf and south Atlantic region, there are no catch-effort data, and at best, imprecise estimates of stock. As Crutchfield (1972) has observed, we are likely to find "barn door" variances. Crutchfield (1977) also cautioned that we should try to formulate models that reduce, rather than increase, our demands for data. While such a goal may be inconsistent with adding distributional arguments to our models, let us pursue for a moment an example of Crutchfield's concern.

If we think for a moment about the Gulf mackerel fishery, we have a fishery considered to be in potential biological trouble. Both commercial and recreational fishermen harvest the resource (about 2/3 and 1/3 shares, respectively), and stocks apparently fluctuate significantly from year to year. Now, consider the problems that would be encountered with estimating a complete model of this fishery. Then, consider the problems of updating estimates of marginal values for fluctuating stocks, and the required timeliness of getting those estimates to the Gulf and South Atlantic Fishery Management Councils for appropriate decisions. Perhaps we ought to think of such estimates as yielding helpful information on desired direction of change of total catch, and, if we are lucky, for direction of change in catch for the two harvesting sectors. (Actually, all of this is further complicated by large catches by Mexican fishermen as well.)

Council's solution has been a bag limit on recreational fishermen, and a catch quota for commercial fishermen (once the commercial quota is reached, that fishery shuts down). This may well not be the best solution, but both harvesting groups seem willing to live with it. It may not be the worst possible solution either.

Given poorly specified models for allocation problems and the data problems we face, it should not surprise us that managers put less weight on efficiency objectives than economists do. (That is a polite way of saying that they may not be listening as much as we would like.) But before we throw our hands up in dismay, perhaps we should examine some reasons for this state of affairs.

Decision Making by Fishery Managers

In no way do we intend this discussion to be critical of fishery manager efforts. Management agencies are charged with overseeing fisheries in society's interest, but actions are definitely affected by constraints faced, especially political constraints[6]. Furthermore, the agency's objective functions themselves may be modified by fishermen who are the immediate group the agency is charged with serving.[7].

An example might help illustrate this point. For years the North Carolina bay scallop fishery has opened in early December, in spite of rapid growth of a scallop's meat through the winter months and price increases as the New England catch decreases. Why the early opening? A few very vocal fishermen have dominated public hearings—in favor of the early opening to earn "Christmas money." Several hypotheses have been offered to explain this method of financing Christman expenditures. The two most likely explanations are:

1) Lack of access to credit markets, and

2) Aversion by those vocal fishermen to being on the water in the usually worse weather of January and February.

If taken literally, the second argument is like the well accepted theory of compensating differentials in the determination of wages. Such differentials are legitimate arguments in social welfare. Note, however, that this argument also contains the issue of income distribution.

[6]An interesting variation of this argument is made by Baden and Stroup (1978) who contend that some government agencies have reduced environmental quality in pursuing the agency objective(s). Such results occur because the environment is a public good, and authority and responsibility for actions are separated.
[7]There are some interesting questions surrounding the accuracy with which managers translate the interests of fishermen into policy. Surely this translation is not without variance, and that variance may be large.

If in fact these fishermen have a distaste for fishing during colder months, then by shifting the season forward, they may be assured of a larger share of the catch. In any event, these hypotheses may be put to the test when the North Carolina Marine Fisheries Commission goes to public hearings in the fall with a recommendation of delaying the season opening until January[8].

What this example suggests is, in effect, that managers act as if their objective function included something like: Minimization of changes in the income distribution of harvesters (or groups of harvesters). Another even clearer example of this is in the Pamlico Sound (North Carolina) shrimp fishery. Small boats trawl the shallow bays and estuaries; large boats trawl the main body of the sound. Small-boat fishermen want the shrimp season opened earlier while more shrimp—though smaller in average size and price—are abundant in the bays. Large-boat ("hog boats" to the small boat fishermen) pressure managers to open the season later when the shrimp have grown and are migrating across the Sound toward the ocean. The season usually opens while there are still shrimp in bays. These are smaller shrimp, but the purpose is to make available part of the stock to small boats. Public hearings on when to open the season are animated events, but this is clearly a distribution issue between two groups of commercial fishermen. Shrimp and bay scallops are single year-class fisheries, and biologists believe next year's stocks are unrelated to this year's harvests. Hence, population constraints are less binding and this may mean that distributional issues assume added weight.

Similar distributional issues could be cited (see, for example, cases reviewed by Bromley and Bishop, 1977), as well as issues involving gear conflict. But our point is that some argument appears to exist in the decision function of management agencies that incorporates distributional effects. There may be better specifications, but for lack of a better definition, we refer to it as minimization of political disfavor[9]. That there are trade-offs between efficiency and political objectives of management surprises no one. But what is surprising is that we have not attempted to explicitly incorporate political objectives and constraints into our models.

In a sense, a start in this direction has been made by McConnell and Sutinen (1979) in a model that jointly maximizes consumer and producer surplus with both commercial and recreational harvesting. From this model, they find that allocation of harvests depends critically upon the own-price elasticity of effort in each of the fisheries (where price is the derived demand price for each type of effort). The optimal mix of catch would favor the harvesters with the relatively smaller own-price elasticity (less elastic). They argue (p. 134) that this result ". . . suggests that prescribed allocations between commercial and recreational fishers based on historical catch shares can result in allocations significantly different from the efficient allocation."

Bishop and Samples (1980) also model a fishery with recreational and commercial conflicts, and include harvesting capacity constraints for both harvesting sectors. In their linear model, movement along the optimal time path requires either recreational or commercial fishing to go to zero if net benefits of the last pound caught is not equal in the two harvesting sectors. This conclusion may be modified by capacity constraints, i.e., if insufficient capacity exists in the favored sector to harvest the optimal quantity, then the other sector becomes the "residual claimant." They also raise an important question about the effect of stock on net benefits per pound caught in the two sectors. They speculate that at some levels of stock, net recreational benefits per pound exceed net commercial benefits per pound, and for other stock levels, the reverse could hold. In their nonlinear model, harvestable surplus is divided between sectors such that marginal net benefits are equal. They also note (p. 228) that ". . . once demands for recreationally and commercially caught fish become downward sloping in g and h [harvesting rates], respectively, the two groups will share in the steady-state harvest unless $\hat{R}$ and $\hat{C}$ [Total net benefits in the two sectors, respectively] are such that a corner solution occurs."

We would like to summarize their important conclusions (p. 231-2):

1) Models (linear and nonlinear) show multiple use of fishery resources may be optimal.

2) The relative economic merits of sport and commercial fishing must always be compared at optimal population levels [otherwise we may get greatly biased estimates of relative net benefits].

3) Entry of recreational fishermen into a previously commercially exploited fishery (under the nonlinear model) increases the size of the steady-state biomass. Similarly, "if commercial fishermen begin exploiting a population which serves as prey for a recreational species, optimal management would require a reduction in the population of the predator species."

We think these papers are important contributions to the recreational-commercial allocation debate. However, we add one last anecdote: Regarding the last conclusion, the North Carolina Marine Fisheries Commission recently retricted the commercial menhaden fishery to fishing some distance off shore. Menhaden is a prey species for many recreationally and commercially harvested species; however, recreational fishermen were advocating the restriction, and greatly outnumbered commercial menhaden fishermen.

This apparent paradox suggests again that we look at political tradeoffs to efficiency objectives. Such models would allow more complete comparisons of management as sometimes observed, and management for efficiency goals. One wonders, for example, how the steady-state stock generated from a more politically-oriented model would compare with that generated from efficiency-based models. In addition to the implica-

[8]The Commission did delay opening the season in 1986 based on the work reported in Kellogg et al. (1985). Let us hope we were correct.

[9]A student of the economics of government agencies might argue that economists should perhaps specify the objective function with some other politically-oriented argument, and include in the model a distributional constraint. In any event, interesting hypotheses may emerge from a marriage of public choice and fishery models.

tions quoted above, there is some casual evidence to suggest the steady-state stock resulting from such a generalized model would be smaller.

Some Practical Measures for Promoting Efficiency and Resolving Conflicts

We make no pretense about having problems with this topic: We have no magic wand. However, allocation decisions are being made, and many of us are uncomfortable with attempting to offer advice. And like many economists, we have done our share of lamenting the lack of data with which we are confronted. Allocation decisions will be made. The question is, can economists assist? We think yes. We propose the following ways:

1) First, with more complete development of theoretical models to assist in the debate over allocation issues and to help guide public policy. And more general models may be necessary.

2) Application of models to specific problems to quantify costs and benefits of proposed actions.

3) Do a better job of conveying to managers and the fishing public the implications of our analyses.

The demand for theoretical work is obvious and overdue, especially in the increasingly important competition between recreational and commercial fishermen. The only thing we would add is that, following the discussion in the previous section, it may be productive to include managers' objectives (reflecting competing fishermen) into our models' objective functions and/or constraints.

Regarding application of models to specific allocational issues, several questions arise. We quote from the conclusions of Bishop and Samples (1980:232):

> . . . recreationally caught fish have usually been valued at either their recreational benefits per pound or expenditures per pound. On the commercial side, the value of the catch has usually been set at the dockside price. A number of problems with this approach are immediately apparent. First, costs are not adequately taken into account. Commercial fishing costs are ignored entirely. While recreation benefits measured, say, by the travel cost method are net of costs borne by the recreationists directly, other costs such as those for stocking and management may go unrecognized under this approach. Second, even where the recreational benefits are adequately measured—and obviously angler expenditures are inappropriate—benefits per pound constitute a measure of average rather than marginal benefits. It is marginal benefits that are important for allocation decisions and, except for the special case portrayed in the linear model, average benefits will exaggerate the contributions of recreational fishing at the margin. Third, such comparisons may fail to capture the true economic relationships between sport and commercial fishing by considering relative values only at the current level of the fish population. We have shown here that the relative economic contributions of sport and commercial fishing should be considered across a broad range of biomass levels. Finally, when more than one species of fish is involved, as in our predator-prey model, the interaction effects between the two species become an additional consideration that must be weighed in defining efficiency conditions.
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> Clearly economists have much more work to do before they can adequately assist public decision-makers confronting conflicts between sport and commercial fishermen. A top priority has to be adequate assessment of the derived demand for recreationally caught fish. While we have blithely talked of the demand for recreationally caught fish . . ., the fact is that present demand work focuses almost entirely on the demand for entire recreational products measured in days of recreation. Fish are only one input into recreational fishing. To attribute the entire benefits of fishing to the fishery resource is like attributing the entire benefits of farming to a single input such as fertilizer . . . .

There is obviously much work to be done. Marginal valuation has to be an improvement over some techniques now used in arguments, such as: Total recreational expenditures last year were estimated at $X, which greatly exceeds the value of commercial landings in the same year of $Y; therefore, we (recreational) fishermen deserve exclusive harvesting rights. One occasionally hears similar arguments from the commercial side, sometimes couched in terms of employment.

Much preferred to such casual valuation techniques would be estimation of a model such as Bishop and Samples (1980). Yet they acknowledge problems in generalizing from such estimates based on participation in fisheries with biomass well away from the optimal size. This may describe many of our fisheries which are exploited by both recreational and commercial fishermen. And while on the one hand we believe such work to be helpful, we are also concerned about the data requirements and timeliness of such work.

There is yet another possible approach to the allocation problem (whether between groups of recreational fishermen, recreational-commercial, or between commercial fishermen). Economists have long discussed alternatives for limiting entry, including various property rights schemes such as restricted licensing and allocated quota. We are not familiar with applications of these schemes to recreational-commercial conflicts. Rights to access or to a given quantity of fish may be more acceptable to fishermen as a means of allocating the resource between competing users than as a means for achieving efficiency goals. Marketable fishing rights may automatically solve the distributional problem. One would expect the offer price by, say, a commercial fisherman for X pounds per year (or access to a fishery) to roughly reflect his discounted net earnings. He presumably sells at a price with which he is satisfied.

Several objectives could be raised to such a use of property rights. One is that the common property problem prevails, and it would be in no single recreational fisherman's interest to purchase rights (especially if there is a lumpiness problem). To that we respond that we would not be surprised to see fishing clubs, tournament sponsors, etc., purchase fishing rights or quota (as clubs have leased stream bottom for fresh-water trout fishing). Note that this example implicitly assumes growth in recreational demand relative to commercial demand for harvests.

Institutional arrangements that would allow such a market to function do not now exist. However, we note that these arrangements have been developed for property rights to access or harvest of other resources.

Another objection frequently raised with proposed allocated quota schemes is enforceability. We usually assume away enforcement costs, or assume that they are the same for alternative actions (which makes them irrelevant). Do enforcement costs vary by policy? We suspect so, but have no real evidence. In our region of the country, given extremely low probabilities of detection, and relatively low fines if caught and convicted of a violation, then the expected value of the cost of a violation is quite low (approaching zero?). Certainly one alternative would be to increase the size of the fine if probability of detection of violation remains low.

There would, of course, be many practical problems to solve before implementing such schemes. Does the management agency simply issue access rights, first-come first-served? Or does it auction them? Does it assign access rights or quota to everyone currently in the fishery, then cancel those rights as participants leave the fishery in order to achieve efficiency objectives? Does it allow markets for those rights to function, solving the allocation problem? What is the optimal tax on transfers? And how do we minimize rent-seeking activity if a fund is created?

These are illustrative of the types of questions raised regarding various property rights schemes for limiting entry, and apply as well to use of such rights for allocation purposes. However, they may offer a viable alternative for solving allocational problems, particularly between recreational and commercial conflicts—conflicts where in many cases timely empirical results are not likely to be available.

Summary and Implications for Research

We have discussed two ideas that may merit some attention by economists. The first is developing models that explicitly include management agency objectives against which efficiency goals are traded off. We have argued that there is much casual evidence that income distribution matters in management decisions. Some of this evidence and observation suggests that some measure of distributional effects of a policy may enter managers' objective functions directly. Yet it may make more sense to specify a politically-oriented argument for the objective function, with changes in the distribution of income acting as a constraint. Results such as optimal harvest and biomass from such a model compared with results from models concerned only with efficiency would provide some information on tradeoffs between those goals. Such models and research may also suggest hypotheses about why we may come closer to achieving efficiency goals in some fisheries than in others.

The second idea discussed is the potential use of some property rights scheme to allocate harvest between competing fishermen. Such a scheme may have merit in a fishery exploited by both commercial and recreational fishermen. Note that transferable fishing rights could be used to solve the allocation problem, and could initiate movement toward efficiency goals. Little information about the relative value of competing uses would be required by managers since a market for rights solves the efficiency problem. A market also has the inherent flexibility to adjust to changing circumstances. We conclude that a property rights scheme to promote markets in fishing rights (or stocks) seems ideal.

We believe both of these ideas deserve further study. We also endorse Bishop and Samples' (1980) suggestions that greater thought be given to modeling the derived demand for fish as an input into recreational fishing. Recreational-commercial conflicts are likely to intensify, at least in the Gulf and south Atlantic. Development and application of such models could be extremely useful to managers in the years ahead.

Acknowledgments

I acknowledge helpful comments on an earlier draft by Thomas Johnson, Charles Knoeber, Kerry Smith, and Walter Thurman; however, I am responsible for any shortcomings of the paper.

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