

Priority Research in Fisheries Management

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PRIORITY RESEARCH IN FISHERIES MANAGEMENT¹

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Abstract: Research can contribute to solving some of the complex decision-making problems in natural resource management. In fisheries management, priority research areas are identified as (1) formalization of management objectives or objective functions, (2) clarification of the decision-making process, (3) development of methodology to evaluate decisions to determine how well decisions have worked, and (4) development of sound models that can be effectively used in evaluating decision alternatives. These four research areas are amenable to university research environments, and significant research along any of these lines would enhance decision-making.

It is only too apparent that we are confronted with some exceedingly complex decision-making problems in all areas of renewable natural resource management. Recreational fisheries management is certainly no exception. Anyone familiar with fisheries problems would agree that difficult decision-making situations face us; for example, how can finite research budgets be allocated to improve fisheries management decisions? Equally important when possible, how can research be directed so as to be useful in decision-making? Specifically, what is the university's role in such research?

In suggesting priorities for research opportunities of special use in decision-making for recreational fisheries management, I do not propose to preclude any research activity as to its potential impact on fisheries management, but rather to attempt to identify research opportunities that will probably have the highest payoff. These priorities were formulated by a review of major fisheries journals over the last 25 years, and by discussion with state, federal, and university fisheries scientists. From these sources, I see the major immediate *research-*

able problems in decision-making to be lack of (1) formal management objectives to achieve broadly stated goals; (2) a sound understanding of the decision-making process; (3) methodologies to evaluate management decisions; and (4) adequate models of fisheries (defined in the broad sense of the aquatic ecosystem, anglers, and physical components such as access facilities). Assuredly there are other substantial problems in decision-making, but many of these fall into political and social arenas where they are less easily identified and studied.

MANAGEMENT OBJECTIVES

The first suggested research priority—*formalization of objectives*—is paramount. Formalizing objectives may seem simple at first, but is actually exceedingly complex. Toward what end are we managing? How do we decide when we have met an objective? Business management is aimed at profit within social and legal constraints, superficially, at least, a fairly straightforward approach. Fisheries, on the other hand, are normally managed on *soft objectives* (often defined as goals), something like *wise* or *best* use. This jargon is quite acceptable for public consumption; in fact, it may be better than some approaches covered here, but management effectiveness cannot be evaluated with soft objectives or

¹Based on comments presented as part of a panel, "Opportunities for Investigations to Enhance Decision-Making," at the Coordination Meeting, Cooperative Fishery and Wildlife Units, Salt Lake City, Utah, July 14, 1973.

goals. Equally important, optimization procedures are useless in decision-making without rigorous objectives.

Most managers recognize the inherent difficulties with using soft objectives; many have tried to substitute more functional objectives. The most common approach has been to maximize pounds or numbers of fish, the historic approach in both recreational and commercial fisheries management. Maximizing catch or yield is also used in most fisheries models. A common variant to maximizing catch is to maximize catch of certain species (as largemouth bass rather than bluegill) or catch of a certain size (as in a trophy fishery). Such objectives have some desirable properties: they are quantifiable from creel or catch data, they are conceptually simple, and they constitute an objective-oriented approach to fisheries management. The foremost disadvantage is that most anglers regard catch as only one of several measures of output from a fishery; such other aspects as outdoor experience, environmental aesthetics, sporting challenge, and personal rejuvenation are also important to the angler.

Among more recent efforts to replace soft objectives have been attempts to measure such quantities as angler use, assuming that maximizing the number of anglers or the number of angler-days in a particular fishery is a valid measure of system output. Some fisheries scientists may further assume that maximizing angler-days or number of anglers is a way to maximize recreational benefit, an approach that may result in an "amusement park" situation. Variants of this objective include placing arbitrary upper limits on system output to prevent damage to both habitat and the biological resource.

Maximizing aesthetics is another potential management objective. This is an al-

truistic approach, but how does the manager quantify it? The heterogeneous angling public is not easily conducive to the market survey used in consumer product development.

Consider commercial fisheries, systems in which participants are interested in monetary output. Should managers be maximizing product output or profit? Should the management objective be measured by dollar output to the average fisherman, all fishermen, or net output to society? How do economic and biological optima differ? These are only a few of the problems that must be faced with this objective.

Key points in this review of the status of management objectives are that decision-making problems will keep recurring with soft objectives, and a solution to the lack of formal objectives is a precursor to resolution of other problems in decision-making. How can we get away from soft objectives and move toward something that will allow us to use some contemporary analytical techniques? First, we need a precise definition of management objectives. We need philosophical research to answer the questions: what are we trying to do? How can the management objective or objective function be defined? We need to move these kinds of questions and answers to fisheries literature and further orient our profession toward thinking in terms of objectives. Benefits from success in this area would be that (1) a problem clearly defined is often nearly solved, (2) increased emphasis on objective-oriented management approaches would improve efficiency, and (3) defining a management objective is the first step in the decision-making process and will form the foundation for later activities.

After we have defined an objective, we must consider its quantification: a very

difficult avenue from a research standpoint, but one that is exceedingly important. For example, in business management we might say: how will this particular decision help us make money? In fisheries management, we are more likely to say: how will this particular decision improve the quality of the fishery? How do we quantify improvement? We need a measure of output from a fishery that accurately reflects our management objective. As a possible solution, we might consider the *management benefit unit*, a measure of output from a fishery expressed in a common denominator, much like the dollar is the common denominator in commerce.

Once an objective is quantified, a level of the objective to be achieved must be set. Setting such a value is more of a policy decision than a research problem. Once the objective is defined and quantified, setting a level to be attained seemingly would present a somewhat simpler problem.

DECISION-MAKING

The next suggested priority for research to enhance decision-making is to study decision-making as a process. As one example, research is needed here to study decision-making from the personnel aspect. For instance, most professionals in fisheries have *not* been formally trained in decision-making. How do they differ from other decision-makers? Is fisheries science the best educational background to solve current and anticipated management problems? Perhaps agencies should recruit management personnel from management science or operations research departments. How do decision-makers in fisheries management perceive resource problems and solutions? What type of people are attracted to fisheries? What is their orientation? The thrust of this priority is that we have to in-

corporate personnel aspects in our research to enhance decision-making.

DECISION EVALUATION

Another priority area in research efforts to enhance decision-making is methodology to evaluate management decisions. Specifically, how well does a particular decision or management strategy meet an objective? Given a *good* objective, we must then have ways to predict the effect of a particular decision.

The creel census—commonly used by most fisheries agencies to collect large volumes of data to evaluate particular management decisions—is an example of potential research. Questions we must answer include: how much data are needed? What are the important statistics? What degree of accuracy and precision is required? We need to develop methodology to make us accountable for the results of our past decisions. Decision evaluation is, in general, difficult and very painful to the manager, but is exceedingly important.

FISHERIES MODELS

The final suggested research priority area, developing better fisheries models, is also essential to improved decision-making. We need a sound conceptual base to develop efficient and realistic management plans. Despite masses of data that have been generated, most fisheries are poorly understood. For example, most existing fisheries models are for single species and do not include predator-prey or community interactions, much less environmental or angler interactions.

It is difficult to select specific critical research avenues to improve fisheries models, so one general example will be presented for illustration. A key problem we face in decision-making is to predict output from a fishery. Output is defined in

the same units of measurement as the management objective. In general, methodology to predict output is not available. There have been many specific studies, but few general models have been developed. The key problem appears to be integrating population dynamics models, environmental factors, and anglers. Models of this type would be of tremendous decision-making interest, because if we could predict output from a fishery, we could test independent variables and optimize. We could do more drawingboard research to evaluate what would happen *if* we made a particular decision. This may ultimately lead to total decision-making models integrating social, economic, and biological factors.

CONCLUSIONS

Key research priorities to enhance decision-making in fisheries management are (1) formalization of objectives; (2) a better understanding of decision-making as a process, including workable models of decision-making and management personnel; (3) methodology to evaluate decisions to see how well decisions have worked; and (4) sound fisheries models that can be used effectively for evaluating decision alternatives. Significant research along these lines is possible in the university environment and would move us well down the road to appreciably enhancing decision-making in fisheries management.

