REPORT OF THE NATIONAL WORKSHOP ON THE CONCEPT OF OPTIMUM YIELD IN FISHERIES MANAGEMENT

PART I

HOUSTON, TEXAS

June 6-10, 1977

Co-sponsored by

the

National Marine Fisheries Service,

National Oceanic and Atmospheric Administration,

and the

Regional Fishery Management Councils

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PREFACE

This is Part I of a report and summary of the National Workshop on the Concept of Optimum Yield in Fisheries Management, held in Houston, Texas, June 6-10, 1977, and co-sponsored by the National Marine Fisheries Service, the National Oceanic and Atmospheric Administration, and the Regional Fishery Management Councils. The workshop was divided into two sessions: a technical session on June 6 and 7, and a Council session on June 9 and 10. This report deals with the major points and issues which arose in the presentations and discussions in both of these workshop sessions.

Part I of this report is organized into several sections: A general introduction, the abstracts of the presentations made in the technical session, summaries of the panel discussions held by members of the Scientific and Statistical Committees of the Regional Councils, and a list of questions and issues involving the concept of optimum yield which were abstracted from the workshop discussions.

The introduction sets out the general philosophy of the workshop; that it was primarily intended to be a forum for discussion. Also listed in the introduction are the central topics around which discussions centered, and brief descriptions of the general points which were raised.

The abstracts of the presentations from the technical session give a synopsis of the formal and more detailed comments made by specialists in the fields of biology, economics, systems engineering, anthropology, sociology, and ecology concerning research methods and problems in the determination of optimal yields from U.S. fisheries. More complete versions of these presentations will be included in Part II of this report.

One of the most important segments of the workshop were the discussions by panels comprised of members from the Scientific and Statistical Committees of each Regional Council. There were two such panels. Panel 'A' was chaired by Dayton L. Alverson, and involved representatives from the Western Pacific, Pacific, New England, and South Atlantic Councils. Panel 'N' was chaired by Spencer Apollonio, and involved representatives from the Caribbean, North Pacific, Mid-Atlantic, and Gulf Councils. Each of the panel members' presentations and the ensuing questions and discussions brought specific regional problems and points of view into the discussions. These regional perspectives demonstrated the tremendous diversity and complexity which must be considered in developing an approach to the optimal use of fishery resources. The chairmen of these panels produced the summaries which appear in this report.

In the course of the discussions many questions involving central points and key issues were raised. Certain of these seemed to require immediate attention and to lend themselves to short-term resolution. Others, such as those problems which appeared to be related to deficiencies or situations embodied in the FCMA itself, will need careful thought and action which can only be implemented as the management plan process is developed over time. The breakdown of the points and issues within the sub-headings in this section reflects this distinction.

Part II of the report will contain complete records of the presentations made by the discussion leaders during the Council session, Donald McKernan's summary, an edited test of certain of the questions which arose in that session and their responses, and more complete texts of the presentations from the technical session. These items are the more time consuming tasks in summarizing the workshop and will appear later under separate cover. Parts I and II together will present a complete record of the entire workshop. Part I is being distributed now in the interests of communicating the basic points which were raised in the workshop to all those concerned with questions of optimum yield.

We would like to thank Kathy Hensley of the South Atlantic Council staff, Davis Hays of the Office of Scientific and Technical Services, NMFS, Don Wickham of the Office of Planning, Budget, and Evaluation, NMFS, Mary LoPresti of the Office of Fisheries Management, NMFS, and Stetson Tinkham of the Office of Executive and Administrative Support, NMFS, for their excellent efforts in the planning, recording, and summarizing of the workshop. C. P. Idyll of the Office of Marine Resources, NOAA, provided invaluable advice on the manuscript.

Finally, we would like to extend our gratitude to the Regional Council members, the members of their Scientific and Statistical Committee and staffs, representatives from State and Federal agencies and institutions, the fishing industry, and all of the other workshop participants for attending the workshop and contributing their ideas and expertise to the theoretical and practical development of the difficult and complex subject of optimum yield in fisheries management.

CONTENTS

Introduction

The Optimum Yield Workshop was intended to elicit regional points of view regarding the concept of "optimum yield" in fisheries management. It provided a forum for the expressions of common problems in the development of a workable meaning for optimum yield (OY), and was oriented toward providing guidance for the Councils in the future.

The workshop was not meant to be an exhaustive academic or practical treatment of the subject of optimum yield. It was an attempt to bring the technical expertise of the Councils, the States, and the universities to bear on the problem, and to develop common ground in support of the Council decision-making process. At the same time, progress was made in breaking down disciplinary barriers which are artificial impediments to the useful development of the new concepts of fishery management which are expressed in the Fishery Conservation and Management Act of 1976.

A central theme of the FCMA is the preparation of a fishery management plan for each fishery. Each of these plans must specify the optimum yield for the fishery with which it is concerned.

Optimum yield is defined in the FCMA as the yield which (a) will provide the greatest overall benefit to the Nation, with particular reference to food production and recreational opportunities; and (b) is prescribed on the basis of the maximum sustainable yield from such fishery, as modified by any relevant economic, social, or ecological factors.

Following this guidance, the definition of OY must consider the allocation of the benefits of fishery resources among all of the people affected by the fishery. These include commercial fishermen, recreational fishermen, foreign fishermen, processors, distributors, those associated with the support and service portions of the fishing industry, and consumers.

Each of these groups may have different, and often conflicting interests in the use of fishery resources. Achieving optimum yield will involve trade-offs in the complex interactions of these interests and interest groups. Almost any attempt to compile a list of possible objectives in fishery management (for example, see the attached list compiled by F. Christy) makes it clear that it will be impossible to maximize all objectives simultaneously. The trade-offs which must be made will result in a balance among the various objectives which must be taken into account in managing a fishery.

Since a Council's management decision as to what constitutes optimum yield will require trade-offs among several different groups, it will be necessary to develop techniques for assessing which groups stand to gain, which stand to lose, and the specific factors and their measures which are involved in achieving an optimum yield. Further, gains and losses will not only be measured in dollars and cents, but also in terms of sociological considerations, including employment and the preservation of options for the future in the distribution of the social benefits derived from the use of fishery resources.

The technical discussions at the workshop revealed that the results of biological and social research by themselves cannot lead to a determination of optimum yield. Instead, technical analyses will result in the formulation of alternatives which decision-makers (i.e., the Councils) can evaluate by the process specified by the FCMA. In other words, the determination of the optimum yield is really a Council decision-process based on the results of technical analyses.

The technical session of the workshop attempted to summarize and interpret research methods and current results in the biological and social sciences to present to the Councils as background for developing principles for determination of optimum yield. The second, or Council session of the workshop was devoted to discussion of the Council decision-making process. Although the Councils seek a definition of optimum yield, and common terms in which to state that definition, they do not expect a single definition to cover all cases under all circumstances. Rather, they are asking for a set of options which should be considered when attempting to establish OY.

The Workshop Discussions

The discussions focused on the factors which contribute to "who wins, who loses, and how much," and on how to provide advice to Councils on this complex question. Arguments among those who are involved in the various academic disciplines concerning how to determine an initial approach to establishing OY, however, were in most cases of minor interest to the Councils. The Councils sought a presentation of the options available so that they might select one or more of these options when considering a fishery or a group of fisheries in a management plan.

Both workshop sessions produced discussions of factors relevant to optimum yield, centering around the following topics: (1) biological yield concepts including maximum sustainable yield; (2) economic considerations; (3) domestic fishery capacity; (4) sociological considerations; (5) data needs and problems; (6) political considerations; (7) recreational fishing; (8) industry and consumer concerns (9) problems in fishery management plan development, (10) multidisciplinary approaches, and (11) approaches to synthesizing and evaluating complex systems of information, impacts, and alternatives.

1. Biological Yields. While the computation of MSY is a prescribed requirement of the Act for determining OY, there are difficulties in its use as a universal concept of biological yield. For example, MSY is defined in terms of an unrealistic single-species equilibrium condition. The theory of MSY does not consider user groups, explicit changes in recruitments, or mortality and growth rates. Furthermore, in practice, MSY is difficult to estimate because of a series of problems, including correlations among year classes and between catch per unit effort and effort, and the difficulty of estimating fishing mortality. Nevertheless, since the Act requires that MSY be used as a benchmark, it will be necessary to develop MSY models which resolve both the conceptual and the estimation problems. More emphasis should be placed on ecosystem models which will permit evaluation of biomass/trophic level balances of important ecological groups. These models will provide a quantitative basis for estimating standing stocks, and an insight into an ecosystem's internal consumption as compared to losses due to fishing.

2. Economic Considerations. Among the economic considerations which need to be taken into account in achieving optimality are (1) maximizing the values of goods and services produced, and (2) distributional considerations, which are important because they are concerned with the impacts on those who sustain the economic gains and losses resulting from management decisions

(fishermen, processors, consumers, and so on). For some fisheries, losses in catch will be compensated by an increase in price; this is an important consideration in the Councils' analyses. The FCMA is not clear on either the definition of economic efficiency or the way in which economic efficiency is to be incorporated as a goal of management. It is important to match the short-run economic considerations against the long-run, because each may necessitate a different management strategy. Since many fishermen may not derive their total employment from fishing, the implications of alternative or multiple employment must also be explored.

3. Capacity. Domestic capacity is a critical component in considering the level of domestic catch. It is a difficult concept to measure in most fisheries. In the commercial fisheries, the volume of hold-space employed over the year is greater than the catch. Furthermore, the "capacity" of the recreational fisheries is difficult to determine. In either kind of fishery, capacity can be estimated roughly on the basis of past catches. For the more sophisticated economic requirements of the optimal size and activity of the economic unit involved in a fishery, this figure must be related to some profit-maximizing condition subject to various constraints. If the economic unit is operating at a greater than the optimal economic level, it may be wasting its capital. If it is operating at a less than optimal level, it may be wasting

the resource. Some of the papers presented at the technical session discussed methodologies for computing capacity using various indices of capacity and employing the theory of linear programing.

4. Sociological Considerations. Fisheries management has traditionally concentrated on biological factors, and in more recent years, economic factors. While social factors have always been integral to management concerns, only recently have attempts been made to put these factors into an analytical framework. The appropriate modifications to MSY to make an estimate of OY will have to reflect the importance of(1) demographic characteristics of fishery participants, such as numbers of people, their ages, education and training levels, their location, and the existence of ethnic or other cultural groupings;(2) the goals, preferences, and values of the people involved in fishery activity; and 3) the user interest groups which are based on common demography or involvement in a fishing community or fishery related activity.

5. Data. Good information is the basis for good decisions, and the FCMA requires that decisions be made on the basis of the best scientific information available. There are many areas in which data are deficient (e.g., biology, interspecies, interactions, economics, costs of fishing, sociology, profiles of the recreational fishing community). Suggestions were made that the minimum sets of data we will require be defined, and that the necessary degree of accuracy in these data be specified.

It was stressed that while increased emphasis is required to collect more data, it is urgent that attention be paid to gathering the right data in the right quantities, and to avoiding the collection of data which will be of little value. In addition to the wise choices required regarding the kind and amount of data we collect, we need also to commit an appropriate amount of resources to the analysis of data so that the collection process can be effective. It was also pointed out that government agencies and other organizations such as the River Basin Commissions, Office of Coastal Zone Management, the Labor Department, or the Census Bureau may be able to provide the Councils with information useful in their optimality decisions.

6. Political Considerations. The development of a better decision process is an appropriate subject for technical analysis, and this kind of analysis will involve an understanding of political factors. The legitimacy of an optimum yield determination can be enhanced, for example, by developing methods for ensuring maximum public participation. Mechansims should be explored for achieving increased and more cost-effective public participation, and for sharpening our understanding of the political processes necessary for effective fisheries management.

7. <u>Recreational Fishing.</u> The recreational fisherman is one of the winners or losers in optimum yield determinations. The recreational segment is the sleeping giant in our understanding of fishery management in the United States, and we must know a great deal more about this segment before we have a complete understanding of the total fishery management process. The principal problem associated with recreational fisheries is the evaluation of an activity which uses a resource, but which has objectives other than the direct consumption of that resource. Much work is needed on the theory and analysis of recreational fishing: the measurement of demand, the perceptions of the quality of the recreational experience, and many other aspects. Also, another of the many data and statistical requirements is a measure of the socio-economic characteristics of the recreational fisherman.

8. <u>Industry and Consumer Concerns.</u> The problems and concerns of the fishing industry and the needs of the consumer are integral parts of any optimum yield determination. Industry representatives at the workshop stressed that a primary industry need was for stability in economic and other aspects of fishery systems. They urged closer communication between the Councils and industry in order to maintain an adequate knowledge of industry plans for development or expansion and other factors which may affect Council recommendations concerning harvest levels, capacity, and matters of allocation.

Caution was advised in considering management alternatives which may have drastic effects on either industry or the consumer, or in moving too rapidly with management options before a reasonable prediction of their full ramifications can be made. The need to broaden our concept of a fishery to include infrastructural elements such as businesses which rely on the tourist trade, chandleries which supply commercial fishing concerns, and other important parts of both the commercial and the recreational fishery industries was stressed. It was pointed out that the "consumers" of U.S. fishery products are world-wide, and that many Council decisions regarding the needs of the U.S. consumer would have to take into account foreign demand and market systems. For example, a lowering of the price of fishery products in the U.S. may create increased exports of U.S. fishery products to more lucrative markets abroad.

9. <u>General Problems Concerning Optimum Yield and Fishery Management Plans.</u> Several problem areas were discussed with respect to the FMP documents themselves. A primary concern was the time factor in determinations of optimality. Changes which occur during what may often be a lengthy plan review and implementation process may render a particular optimal mix of management

options obsolete. It was the consensus that the Councils, with the help of adequate information-gathering and modelling techniques, will have to develop ways to deal with these time lags. The power of labor or industry organizations can change the situations in particular fisheries very rapidly, and the Councils must develop communications with these organizations to create an atmosphere of cooperation. The strong traditional practices and attitudes of fishermen and those associated with fishing communities, the historical difficulties in promoting innovation, and the fact that fishermen make many of their decisions on the basis of factors other than economic maximization make the Councils' task even more complex.

Several individuals pointed out that legal issues and processes will play a major part in developing, and especially in implementing optimum yield decisions. The legal issues revolving around the use of limited entry as an allocation scheme, for example, may have important effects on the use of certain management options. In addition, the Councils must carefully document the reasons their decisions concerning optimum yield deviate from MSY in order to clarify and defend their decisions for the Courts and others. Any optimum yield decisions must be both attainable and enforceable, and both of these ends are closely related to the credibility of the Councils with their constituencies.

10. Multidisciplinary Approaches. In the technical session the fishery management problems were approached variously from the viewpoints of the biologist, the economist, the sociologist, the anthropologist, and the systems modelling expert. This disciplinary compartmentalization becomes artificial in view of the requirements of fishery management as a discipline in itself. The necessity for researchers from different disciplines to work together within this synthesized disciplinary perspective was emphasized.

11. Advice to the Councils. The need to develop efficient and effective ways to transmit advice to the Councils is critical. They need to know how their decisions affect various groups, and the complexity of the fishery management process may make a simplistic approach misleading. Methods need to be developed for displaying and analyzing all of the relevant components in a systemic way. One technique for putting components such as this into a package is to develop a "model." The discussion revealed the need to bring those who generate models concerning optimum yield closer to the needs and problems of the decision-makers, and at the same time to make the decision-makers more aware of the utility and limitations of decision-oriented models of fishery systems.

ABSTRACTS OF THE PRESENTATIONS

Lee G. Anderson, Associate Professor of Economics and Marine Studies,
University of Delaware

Optimum Yield: The Law, Economic Theory, and Practical Application

Optimum yield as described by the law is not a clearly definable term in the sense that maximum sustainable yield, maximum economic yield, or open-access equilibrium yield are. The latter can be defined, in the abstract, as the tangencies or intersections of various curves, but not so for optimum yield. It can only be described as a specific point in time for each fishery on a case by case basis. The only reasonable goal for this workshop is to specify a process for determining an optimum yield. Or to be more specific, to describe the types of information and means of displaying it so that the Councils can choose what they think to be an optimum yield knowing full well as many of the ramifications of that decision as are deemed relevant and can be meaningfully measured.

I contend that a useful way to do this is to design models of the various fisheries that can demonstrate at what point the open-access fishery will achieve maximum economic yield. I chose to use MEY as the zero point because the economically efficient use of fish stocks and harvesting inputs is important for society. It may not be all important, but it certainly is a good place to start. The model should be devised in such a way, however, that measurements concerning other important variables are obtained simultaneously. Therefore, the description of MEY should include the amount and kind of effort that should be used, the amount of the economic rent, and other parameters for such things are income distribution among fishermem, the general profit level in the harvesting and processing sections, the number of possible recreational days fished and accompanying environmental impacts. Then, by studying how this vector of parameters varies as regulations other than those that will achieve MEY are used, decision makers will be able to study the trade offs involved. This should help them in defining what they believe the optimum yield to be.

As an example, consider a two dimensional case where the vector of parameters includes the amount of rent earned and the number of otherwise structurally unemployed individuals that are working in the fishery. If the vector at MEY is ($100, 18 people) but by using a specific entry program designed to help the structurally unemployed it changes to ($50, 38 people) then the price in terms of lost efficiency of putting the extra 20 people to work is $50.

Several interrelated points are in order here. Although I admit that the number of structurally unemployed people used in a fishery may be an important consideration, regulation schemes which only consider them are very likely to be socially sub-optimal even in this 2 D case. That is, unless there is some absolute necessity for reducing the number of structurally unemployed people to zero, when faced with a range of regulation options and using only the number of these types of people employed as a judgement criteria can the decision maker be sure that the one he chooses will be the best policy. The answer is no because he does not know what he is giving up. Obtaining redistribution goals may not be worthwhile if the loss of valuable output is too high.

One might accept the above point about trade offs without accepting MEY as a bench-mark. Why not just test all possible policies and then compare the vector of parameters for each and select the one that appears the best. It is possible of course to make statements about the relative desirability of different policies, but the lack of an absolute standard leaves something to be desired. In addition, it is a backward way of going about fisheries management. It would be almost impossible to list and test all of the possible ways of managing a certain fishery. And even if it were possible, it would be very difficult for the decision makers to compare each with every other. By starting at the economically efficient point, the decision makers can request information on which policies will change a variable with which they are particularly concerned and then see if the change they want is worth the price that must be paid.

L. J. Blédsoe, Research Assistant Professor and Program Director,
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K. Mesmer and P. Katz

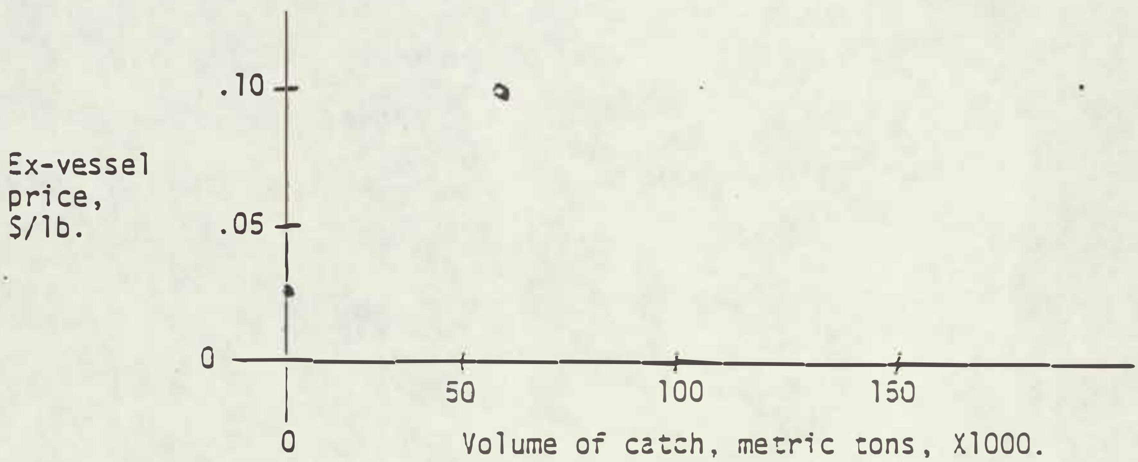
Calculation of Supply Curve for Domestic Groundfish From the North Pacific

Two approaches to determination of relation between price paid to the fisherman and volume of catch produced for a hypothetical domestic Alaska pollock fishery in the E. Bering Sea are presented. One approach is based on a large scale simulation of the existing shellfisheries which would, supposedly, share vessels and gear with the pollock fishery; the second approach involves a data analysis of costs of trawling, value of harvest, per cent of utilization of existing capacity and protected catch rates for pollock. The model based approach is incomplete but has proceeded to a stage of verification of the method by hindcasting the 1974 shellfish catch in western Alaskan waters. The data analysis approach reveals that, based on variable costs of fishing alone, and assuming an ex-vessel price of .10/lb., 55,900 mt of pollock could have been harvested in 1974 at a net value to the fishermen of $10.1 million dollars. This estimate is based on the critical assumption that 60 days of non-fishing time (maintenance, vacation, preparation etc.) is a reasonable figure for the average requirement of all combination vessels which fished western Alaskan waters in 1974.

The model based approach operated by consideration of catch rates for a variety of stocks (Kodiak, Bering Sea and Dutch Harbor blue and red King Crab, Kodiak tanner crab, Kodiak and Penninsula shrimp, Bering Sea pollock) which were or might have been harvested in 1974 at prices extant that year. Detailed population dynamics submodels for these stocks assuming 10-14 hours per day trawling. The class eight combination vessels (NORFISH Tech. Rep. 63) capable of otter trawling have hold capacities for pollock of 50 - 80 mt indicating that 1.4 to 7.3 days of trawling will be required for a full load. Assuming that one half day average travel time from a Dutch Harbor port to the Bering Sea fishing grounds is adequate and considering that pollock quality deteriorates substantially after three days on ice, fishing trips of four days for a 50 mt load and a one week trip unit including port time, seems a reasonable overall average. This ignores a number of technological possibilities including both pair-trawling and extensive installation of freezing facilities. A comparison of these conclusions, costs of vessel operation, relative catch abilities and hold capacities for pollock and king crab will reveal that a price per pound of about $.30 for pollock would be required to induce fishermen to switch from Bering Sea king crab at $.24/lb. (ignoring gear costs). Since realistic pollock prices are closer to $.10/lb. (Jan 1977, Seattle, $.30/lb) a pollock fishery can only develop when no opportunity to fish for more highly valued species exists, ie. when some harvesting capacity excess to the present fishery exists.

To provide some information as to whether such excess capacity exists, an analysis of the times of fish landing of each vessel capable of hauling and otter trawl and which also participated in W. Alaskan shellfisheries in 1974 was undertaken. This analysis revealed that 95% of the fishing trips undertaken were two weeks or less in duration. Using this statistic and the critical assumption that 60 days of non-fishing time is sufficient on the average, 1118 one week unit trips could be made by the 146 class eight vessels alone. Class eight (modern steel combination boats) vessels alone were analyzed because these vessels are known to be of sufficient horsepower and size to harvest pollock via otter trawl. This effort would harvest 55,900 mt of pollock with a gross ex-vessel value of $12.3 million, net value (approx. $2000. per trip direct costs) $10.1 million. These estimates ignore fixed gear costs and do not allow for gear loss. If the non-fishing time requirement is 120 days average (rather than 60), only 2150 mt could have been harvested. The break-even price for Pollock harvest under the above assumptions is $.02/lb., again considering variable costs alone.

Based on the above assumptions and considering the known limitations of the procedures described, we can tentatively project two points on a short term supply curve for a domestic pollock fishery. These data points also assume that $10.1 million net value is sufficient incentive to attract all of the 146 combination boat skippers to spend their excess time fishing for pollock and to layout the fixed expenditures required.



J. W. Devanney, III, Associate Professor of Marine Systems,
Massachusetts Institute of Technology

Fishermen and Fish Consumer's Income Under the 200-mile Fishing Limit

This paper describes a series of single species models of the principal Georges Bank groundfish stocks. Empirical evidence suggests that, at least at lower levels of landings, demand for these fish can be quite inelastic. Further, at least for yellowtail flounder, the possibility of a double-humped fisherman revenue curve obtains. The paper emphasizes the importance of bringing fish consumer income into the analysis in such situations. The models are dynamic, and results are presented which indicate that these fisheries can be very lightly damped with natural periods of 5-15 years. Hence the applicability of steady state models to the generation of actual management schemes for these fisheries may be very limited. The stock recruitment relationship and our uncertainty as to the form of this relationship is addressed by Bayesian regression, and this approach is outlined in the paper. Finally, results are presented which indicate that for the stocks studied, not only is there no current surplus left by the departure of the foreigners, but also that present levels of domestic effort should be cut back sharply.

Low Lee Loh, Fishery Research Biologist, Northwest and Alaska Fisheries Center, NMFS

Ecosystem Dynamic Considerations in Optimum Yield Determination

The derivation of Optimum Yield obvicusly must start at the resource level itself. At present, the study of most fishery resources in the North Pacific has been approached on a single species basis and brings into consideration multiple species interactions only at an empirical level. As one gains more knowledge of the ecosystem, studies must progress from empirical and traditional population dynamics analyses to include models on species interactions and ecosystem dynamics. A major thrust of such modelling projects at the Northwest and Alaska Fisheries Center (NWAFC) has been on the eastern Bering Sea (EBS) ecosystem which supports extremely valuable resources such as marine mammals, crabs, fish and petroleum.

Dealing with the biological system itself, the NWAFC has initially developed a static-trophic Bulk Biomass Model in order to evaluate biomass balances of important ecological groups in the EBS. This model provides quantitative insight of plausible standing stocks of the ecological groups and insight into ecosystem internal comsumption as compared to losses due to fisheries. Computations show that the greatest part of most of the ecological groups are consumed as food by other ecological groups. The results underline the fact that enhanced evaluation and management of marine resources in the EBS requires consideration of the dynamics of the marine ecosystem as a whole.

In order to consider dynamics of the EBS ecosystem, a Dynamic Numerical Marine Ecosystem (DYNUMES) Model was also formulated. The model, at present, permits evaluation of the interactions of 8 representative biological components--fur seal, bearded seal, herring, pollock (3 size groups), shearwaters and murres. Results of the model indicate several phenomena within the ecosystem that have received little attention in the past research, but which seem to be among major determinants of the balance within the system. One of the general conclusions from the use of the model is that availability of food is a limiting factor for most ecological levels and groups. Furthermore, the model indicates that some transient stocks, such as pollock, have long-term periodicities of abundance, caused by interactions of several factors determining their abundance. The use of the submodel also demonstrates that the dynamics of marine ecosystem and man's effect on it can only be ascertained in detail with a rather sophisticated, reasonably complete model.

Michael K. Orbach, Social Anthropologist, Fishery Management Operations Division, NMFS

Social Science and Fishery Systems

One of the main thrusts of the concept of optimum yield in fisheries management is a shift in concentration from fish and other natural resource populations to the broader perspective of fishery systems as patterns of human interaction. This paper follows this thrust by maintaining that, subject to the conservation of natural resources, people and their behaviors and interactions are the primary components of a fishery system rather than the natural resources themselves.

Following this approach, the paper suggests that there are three categories of social scientific analysis which will enable us to better understand and deal with out fishery systems. These are (1). Demography, (2) Community Organization, and (3) Individual Goals, Values, Constraints, and Preferences. Examples are given of factors in each category and the roles these factors play in fishery activity.

Demography encompasses the sociological variables which are quantifiable in a direct sense, and which produce a basic picture of the people involved in a fishery. Factors such as number of participants, their residence or work location, their ages, their familial organization, their education and their ethnicity or other cultural grouping all go together into a picture of the demographic characteristics of a fishery community.

An analysis of the community organization of the participants in a fishery provides a dynamic aspect to the basic description afforded by the demographic information. Community organization involves the analysis of the interest groups in a fishery and the social and political organizations which represent those interests. An analysis of the community organization of a fishery provides a set of linkages among the individuals and groups described in the demographic data.

The most difficult aspect of the human component of fishery systems to research and describe are the individual goals, values, constraints and preferences of the individual members of the system. The paper argues, however, that an adequate understanding of these kinds of factors is integral to our understanding of fishery systems.

Finally, the paper comments on the possible applications to which the results of social science research may be applied in assessing impacts, determining optimum configurations of natural resource use, and in developing a better general understanding of fishery systems in the United States.

Susan Peterson, Research Associate, Marine Policy Program, Woods Hole Oceanographic Institution

Social Science Research in the New England Fishing Industry

Social data which might be useful in determining optimum yield is not uniformly available throughout the New England and Mid-Atlantic region. Because the existing data was collected by social scientists and NMFS personnel using different research designs and methods, and because the data was stored, analysed, and used for different purposes, assessing the value of the information is the first step in determining OY. Some specific examples are given from the New England fisheries which not only illustrate the problems in evaluating data, but also suggest ways to improve the collection and analysis of social data.

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Joseph J. Mueller
Brian J. Rothschild

Procedures for the Estimation of Harvesting Capacity and its Allocation in a Multiple Species Fishery

The FCMA requires that under the National Fishery Management Program, any fishery managemnet plan prepared by any Regional Council or the Secretary of Commerce shall:

> "assess and specify...the capacity and the extent to which fishery vessels of the United States, on an annual basis, will harvest the optimum yield..."

This provision of the FCMA requires that fishery management plan assess and specify (1) capacity (potential production capacity), and (2) measure the "extent" of the catch or how much fish the fleet is expected to catch under certain assumptions regarding biological factors and market conditions during a given period of time.

This paper addressed three issues regarding capacity:

(1) definitions and measures of capacity
(2) methods for estimating capacity
(3) estimate capacity and extent to which vessels will harvest certain species.

The method used to estimate capacity and "extent" are summarized as follows:

A. ESTIMATE OF CAPACITY

Economic capacity was defined as: the level of output the fleet would prefer to produce as determined by market conditons, input prices, given technology, and the existing scale of plant.

Capacity was estimated by dividing physical output by an estimate of capacity utilization. For example, if a firm can produce 100 units operating at 80% capacity utilization, the capacity is 100/80 or 120 units. The fishery fleet studied was the otter trawl fleet in Maine, Massachusetts, and Rhode Island. Estimates of capacity utilization were not available for this fleet. A proxy measure was developed using an index of catch per gross registered ton using 1957 as a base year.

Potential output was calculated by dividing physical output (landings) by the index of catch per gross registered ton. However, this estimate does not reflect changes in stock abundance or technological conditions. Estimates of potential capacity were deflated by an index of stock abundance for ICNAF designated subarea 5 and statitstical area 6 for finfishes and squids. In 1976, the deflated estimate of capacity for the otter trawl fleet was around 300 million pounds on an annual basis. This was adjusted upward by 25 million pounds to reflect technological change.

A linear programming model was then employed to allocate (the estimate of) capacity among various species. The model covered 11species, 1 vessel category (otter trawls), 1 time period (1 year), and 1 area. The LP model was used to answer the "extent" part of the capacity problem.

The LP model provided estimates of U. S. catches and also surplusses. For the most part, the surpluses were higher than those in the PMP's. However, this model did not include all gear classes nor the mid-Atlantic area. If this was done, the surplusses would probably be lower than the estimate from the base LP model.

The model can be extended to include:

(1) different vessel classes

(2) different gear classes

(3) different fishing areas

(4) more than 1 time period

(5) allowing price to vary as a function of quantity landed.

An example of how to calculate (potential) capacity.

Assume we have an output (landings) series X1, and a catch/gross registered ton series X2 for a particular gear class, e.g., otter trawls.

Period	X1 (landings) (pounds)	X2 (Catch/GRT)	X3 (Index of Utilization)	X4 (potential capacity-pounds)
1	500	40	.53	940
2	800	45	.60	1333
3	1500	75	1.00	1500
4	1200	60	.80	1500
5	900	50	.67	1350

In column 4 (X3) we construct an index of catch/GRT using 75 -- the maximum value -- as a base or reference point.

$$\frac{40}{75} = .53; \quad \frac{45}{75} = .60$$

Potential capacity is computed by dividing X1 by X3. Estimates of potential capacity are shown in X4.

This estimate of potential capacity is based on abundance conditions in the base period (#3). To adjust the capacity estimates for changes in stock abundance, we can deflate the estimates by an index of stock abundance.

Assume abundance index is given by X5.

Period	X5 (Abundance index)	X4 (Potential capacity)	X6 (adjusted estimate)
1	.7	940	658.0
2	.8	1333	1066.4
3	1.0	1500	1500.0
4	.6	1500	900
5	.5	1350	675.0

Potential capacity, adjusted for stock abundance, is calculated by multiplying X5 by X4 to give X6.

Michael P. Sissenwine, National Marine Fisheries Service, Northwest Fisheries Center, Woods Hole Laboratory, Woods Hole, MA

Is MSY an Adequate Foundation for Optimum Yield?

MSY is the maximum yield that can be harvested from a fishery resource on a sustained basis. Traditionally, MSY has been estimated from Stock Production models. A second approach has been to relate MSY to the product of average or medium recruitment and maximum yield per recruit. These approaches to MSY are an inadequate foundation for Optimum Yield. A common method of fitting stock-production models to data may falsely indicate that the model satisfactorily describes a fishery because of the manner in which fishing effort is estimated. Due to random fluctuations in productivity of fisheries, the fishing mortality rate corresponding to MSY (according to stock-production models) may not be sustainable. Maximum yield per recruit may lead to a severe depletion of spawning stock size and recruitments failure. For multispecies fisheries, independent management of several species aimed at achieving MSY may be self-defeating. The concept of MSY implies constancy in yield. A constant yield can be achieved by setting annual catch at a level low enough to assure conservation of the fishery resource even during a series of years of low productivity, but during years of higher productivity yield may be lower than is necessary to achieve conservation objectives. Greater utilization of a fishery resource may be affected by adjusting yield in response to fluctuations in productivity and the current status of the resource.

Courtland L. Smith, Associate Professor, Department of Anthropology,
Oregon State University

Optimum Yield, Models, and Politics

Any attempt to define and model Optimum Yield faces a number of political constraints. "Optimum" can only be defined in terms of a particular set of values. Any model of Optimum Yield is always open to the criticism of being logically inconsistent or incomplete, and opponents of the model will attack these inadequacies. Models, for simplicity, lump people into categories with certain values and objectives. Often these social categories do not relate well to natural social settings, and to the real world goals and constraints of fishery participants. These problems can best be solved by integrating modeling with a program of public participation, in the development of a concept of optimality in fisheries management.

SUMMARY OF DISCUSSION

PANEL A, D. L. Alverson, Chairman
Technical Session, Optimum Yield Workshop, June 1977

The participants in Panel A included Dayton L. Alverson (Chairman), Don Bevan, Peter Eldridge, Richard Shomura and Leah Smith who represented the Scientific and Statistical Committees of the Pacific, Atlantic, Western Pacific, and New England Councils. The panel was asked to address the questions and or topics concerned with:

1.e Viewpoints on the concept of optimum yielde

2.e Calculation and application of fishery capacity and associatede problems

3.e Adequacy and relevancy of the required provisions of the FCMAe as related to management plan development

4.e Data and statistical needs and problemse

5.e General problems in the development and implementation ofe fishery management plans

6.e Priorities for action in the use of the optimum yield concepte and fishery management plans in general.

As might be expected, the responses to these questions varied among panel members depending on: local "council" experience related to the state and character of fishery development; scientific resources available; and emerging perspectives of the concept of optimum yield. In this respect there is no simple viewpoint that can be used to reflect the panel's response to the questions addressed.

Viewpoints on Optimum Yield

It was apparent both from the responses of the panel and the questions and views stated from the "floor" that a perspective of Optimum Yield was not easy to grasp. Although all panel members had a firm understanding of the functional characterization of Optimum Yield as expressed in the FMCA (that is, a basis to depart from an identified biological surplus as needed to achieve desired ecological, sociological and economic objectives) it was more difficult to identify the criteria which would guide the Council in its departures from an identified biological yield.

Similarly, it was difficult for some panel members to identify the nature of the data and mechanisms or analytic procedures which could be used to quantify the numerical departure from the MSY.

Although the panel acknowleged that a great deal of thought has recently been directed toward developing models which could assist councils in examining various alternatives, many panel members and participants reflected the view that most of these efforts needed to be modified or recast in terms of more practical and realistic understanding of the data availability, its reliability, the institutional aspects of Council operation political forces influencing decision making and the time frame governing implementation of management plans.

The panel noted that O.Y. as expressed in the FCMA culminates in a number and that this number as it represents a departure from MSY assumes t dimension in terms of stated socio-economic goals or objectives relating to ecosystem management. Hence with any management plan O. Y. establishes thet total allowable catch level for recreational and commercial fishing including domestic and foreign harvesters.

Irving A. Spaulding, Professor, Department of Resource Economics and Sociology, University of Rhode Island

"Marine Recreational Fisheries and Optimum Yield"

This statement addresses the question of defining and justifying a portion of fishery Optimum Yield for allocation to marine recreational fishing. It provides a way of looking systematically and comprehensively at the importance of marine recreational fishing as a contributor to "the greatest overall benefit to the Nation."

In this perspective, a systematic distinction is made between the recreational fisherman and the commercial fisherman. The commercial fisherman is viewed as completely dependent upon his fishing activity for livelihood and social status; for him fishing is an occupation. The recreational fisherman is viewed as having a basis for livelihood and social status other than fishing; for him fishing is not an occupation.

The significance of marine recreational fishing, then, for "the greatest overall benefit to the Nation" lies in that activity's contribution to recreational experience and to each of several functions which are necessary if a society is to remain a viable and sustained entity. Recreational experience can be an aspect of the behavior by which these functions are achieved.

Eight such functions are considered; the first four are viewed as germane to defining and justifying an allocation of fishery Optimum Yield on the basis of the benefical contribution of marine recreational fishing to the nation. The next four are viewed as germane to maintenance of marine recreational fishing, and to the implementation of the provisions of the Fishery Conservation and Management Act of 1976. The functions which recreational fishing performs for members of our society and are relevant to defining and justifying an allocation are:

1) Securing new members and terminating memberships.

2) Training members to conform and handling deviants;

3) Handling illness and physical limitations of members;

4) Securing usable goods and services and dealing with the by-products of recreational activity such as the disposal of wastes.

The functions relevant to maintaining marine recreational fishing and implementing provisions of the Act are:

5) Stabilizing and alternating members' position within the society;

6) Affirming the identity of members and of the society;

7) Managing the society;

8) Accommodating to social pressure and uncontrolled or uncertain events.

In most of these areas, we lack as much systematic evidence as we would like to have with respect to marine recreational fishing. Evidence which, once it was collected, would then have to be analyzed to give an adequate rationale for defining and justifying an appropriate allocation of fishery Optimum Yield to the recreational fisherman.

However, marine recreational fishing and commercial fishing are similar with respect to an aspect of the fourth function mentioned above--that of providing usable goods and services. Most of the catch of each is ultimately used by consumers, and both contribute to the economic system in their primary activity and through their supporting industries. It is in this area that the evidence we have seems most readily available; it is from evidence that justification for allocations may first have to be sought. Social scientists seem to have no more than rudimentary evidence about marine recreational fishermem and their relationship to the other functions.

Hence, the current situation stands as an opportunity and a challenge to natural and social scientists, to marine recreational fishermen, and to personnel of involved government agencies. This opportunity and challenge if threefold: first, to make the best possible use of the evidence at hand in working toward equity in allocation of Optimum Yield; second, to expand and improve the scope of relevant data, thus developing a more adequate basis for defining and justifying that equity; third, to improve the coordinated organization of marine recreational fishermen so they can be more effective in achieving their goals in accord with the Fishery Conservation and Management Act of 1976.

Edison Tse, Assistant Professor, Deparatent of Engineering-Economic Systems, Stanford University

A Model of a Fisheries Management System

1. OPTIMUM YIELD

The concept of optimum yield as defined by the FCMA is fuzzy, broad, general, and moreover, it is different things to different people. What is optimum to one group of end users is not necessarily optimum to another group of end users. Thus the concept of "optimum" here is, in some sense, best trade off between different groups. However, the Act stipulates components which are relevant to the determination of optimum yield. They are

(1) Food Productione

(2) Recreational opportunitiese

(3) MSY

(4) Economic Factore

(5) Social Factor, ande

(6) Ecological Factor.e

While the task of the fishery management decision maker is to select a decision option which compromises the trade off among these factors, the basic questions which are confronted to an analyst -are

(1) How can one assess the value of each of these components under difference policy alternatives?

(2)eWhat kinds of data are required in order to allow one toe make the assessment?

(3) How does one suggest policy alternatives that a decision maker ought to consider?

In this paper, a mathematical modelling approach is described which will provide systematic methods for evaluating impact of policy alternatives on the several factors which are relevant to the determination of optimum yièld.

2. USE OF MATHEMATICAL MODEL AND DESIGN CHARACTERISTICS

A mathematical model is a simple and abstract idealization of the real situation. As such, a mathematical model cannot be used to give us forecast result as many of the details are left out. For a model to be useful, it must capture some of the important characteristics of the phenomena under study such that it can

(1) help to provide further understanding of the complex system,

(2) help to provide insight to the question of data requirement and its utility in policy assessment, and

(3) help to provide insight to the choice of policy alternatives.

To concentrate our modelling effort, we first determine the modelling objectives. First of all, since we are dealing with fisheries, the model must be able to account for those factors which characterize the nature of the fishery system. Second, since we are concerned with the implementation of FCMA, the model must be able to account for those factors which characterize the nature of the management task and decision process called for by the Act.

The nature of fisheries system are characterized by the following factors:

(1) The system is subject to dynamic change, e.g. level of fish stock, continuing technology improvement, etc.

(2) Fish is a common property.

(3) There is interaction between species at the biological level (e.g. predator - prey) as well as the market level (e.g. by catch, consumer substitution).

(4) The structure of fish markets (e.g. processing and distribution systems) is adjusting to dynamic changes.

The nature of management task called for by the Act is unprecedented in the American fishing industry. Therefore, we would expect a substantial amount of experimentation, future adjustment in response to new circumstances and new understanding of the fishery system as it is affected by the implementation of the Act. The nature of decision process in these unprecedented circumstances is such that choices of alternative courses of action must be able to accommodate to substantial improvements in the understanding of the fishery system and effectiveness of different techniques in managing it. These considerations lead us to the design of a model having the following characteristics:

(1) Dynamic - so that it can account for the dynamic change of the fish population and fishery industry.

(2) Integration - so that it can take into full account the interaction between the biological system and the human behavioral system.

(3) Universality - so that it can be applied to different fisheries.

(4) Modularity - so that the model can grow as our knowledge is improved.

(5) Decision Orientation - the model is useful mainly in policy assessment.

3. MODEL DESCRIPTION

In order to evaluate the full impact of a policy, we must be able to determine its short term as well as long term consequences. Guided by this need, the model developed consists of two components.

(1) Tactical Submodel which integrates several structural submodels which account for market equilibrium in different sectors (commercial and recreational fishing).

(2) Strategic Submodel which integrates several structural submodels which account for the fish population dynamic and the structural change in the fishery industry as a result of fishery management decisions.

The "short" term market equilibrium solutions are obtained by the intersection of supply and demand functions. In the commercial fishing, the supply side is determined by the aggregate effect of independent actions by all fishermen, and the demand side is determined by the consumer preference and processor's decision behavior. In the recreational fishing, the fishing opportunity determines the supply picture whereas the desire and willingness to pay for recreational fishing determine the demand function. In the following we shall discuss the commercial fishing sector in greater detail. The recreational fishing sector is more ambiguious but a similar concept and approach can be applied. The latter sector is now under development and results will be reported in a later data.

In anticipation of the class of policy (e.g. quota,fishing season, gear restrictions, etc.,) that can be exercised to influence, to a great extent, the supply picture of the commercial fishing, a supply submodel which takes into account explicitly the independent decision behavior of the fishermen is developed which displays the changes in the fish supply level as some of the decision variables are changed. The demand model is a simple one which accounts for material lost,price mark up by the processors and the retail demand of the consumers. A mathematical algorithm is developed which gives the market equilibrium solution.

The dynamic linkage between periods is obtained by integrating the following components.

(1) Species interaction which influence the population fluctuations of different species.

(2) The potential investors perceive what are their future opportunit is fishery before they made any investment decision in fishery. Such perception is formed based on presently available information.

(3) The decision of the investors will induce dynamic changes in the future market structure. These changes can also result from technological improvements and fishery management decisions.

SUMMARIES OF THE SCIENTIFIC
AND STATISTICAL COMMITTEE
PANEL DISCUSSIONS

The manifestation of various goals and objectives which underlie the OY concept, do not however, bear so much on the OY value but the manner in which regulations are impossed. Examples noted that achieveing economic objectives associated with net economic yields in most instances would require structuring the fishery in terms of numbers of vessels, types, size of fish, seasons, fishing stocks etc. Objectives associated with recreational interest would be in sharp contrast with those of commercial interest and hence the regulatory regime concerned with an OY concept for this user group would be of a different character. The main point stressed by the panel being that although application of OY in plans as a number will allow certain OY goals to be achieved, the broader concept of OY can only be manifested as a product of the number in combination with regulations designed to control the fishery pattern of various user groups.

Most of the panel members pointed out that there was a strong need for Councils to establish goals and objectives for management plans that were associated with OY and that guidance was essential for the scientist in order to collect the appropriate data and to develop analytical processes which would aid Council members in evaluating alternative stratagies and hence in making enlightened decisions.

There was a concensus view that the OY concept allowed for flexible regional interpretation of the importance of various socio-economic and ecological factors influencing management. In fact there seems to be little likelihood that the various parameters evaluated in determining OY can be given equal weight between Councils or even between fisheries within Councils. The nature of these different perspectives however become important and may lead to conflict, when stocks are shared and managed between Councils.

Although the panel's view did not do a great deal to crystalize a common perspective of OY, there was a general theme or attitude regarding it - OY is an evolving concept that relates to a strategy designed to insure that holistic approach is taken in development of plans to manage living marine resources and the people who use or enjoy them. The concept demands an interpretation of a variety of factors (e.g., sociological, economics, ecological, data quality, etc.) other than the status of an existing target species or species in establishing catch quotas and other regulations. At present the mechanism and nature of quantifying certain parameters associated with OY are nebulous and leave the budding OY embryo without shape or dimension. In the end policies at a Council level are quite likely to play a major role influencing the objectives and goals which will ultimately lead to a metamorphous of the embyo. OY into a more recognizable creature. Paraphrasing Peter Larkin, we may have given birth to Heaven or Hell but which one still remains to be seen.

Fishing Capacity:

Most panel members did not see a great deal of difficulty in establishing some reasonable estimates of fishing capacity for commercial fishing activities and for obtaining some reasonable estimatese of growth potential. The problem for recreational fisheries seemse more difficult as the data base is not nearly as well established. Hencee a real need for recreational fishery statistics was noted. The panel e noted that capacity must be recognized as a highly variable or transiente feature of a fishery fleet particularly when identified with a singlee fishery. It was noted that many of the boats/vessels are multipurposee in character and fish for a variety of species depending on markete demand, resource availability, regulations etc. In this sense it seemed more logical to explore the overall physical capacity of a fleet or fleets and subsequently determine the probable allocation of the fleet or total capacity to certain fisheries. The allocation would be determined by processing capacity and markets, etc.

It was noted that physical capacity was really a small factor (in most fisheries) in determining likely U.S. production which was the real number level of foreign fishing. Markets and processing capacity were more likely to be critical factors influencing the TALFF. Although it was possible to develop models to handle and evaluate these factors - it seemed to some panel members that determining likely production was really not that difficult. If stated capacity figures in management plans were in reasonable accord with historical catch trends and demonstrated investment patterns they were not likely to be highly controversial.

It was noted that capacity as used in the FCMA was more concerned with foreign fishing activity than it was with the concept of OY. Nevertheless capacity was noted to have a close tie with potential fishing effort and its identification in some form could be important in designing schemes for effort control.

Adequacy and relevancy of the required provisions of the FCMA

Some concern was expressed related to the intention of the Act as regards to inclusion of certain information into management plans and as to what was expected in terms of documentation. All panel members agreed that although there was a need to follow a general format in plan development that there would be a need for flexibility to meet localized problems. The panel pointed out that perhaps the major short coming of the "Act" was a failure to percieve and provide guidance in terms of plans for managing resources which were trans-council or national in character or which were both state and Council responsibilities. In such instances a high degree of co-operation must prevail between management entities and mechanism must be developed to insure proper management of stocks of international concern.

Data and Statistical Needs/Problems

The panel pointed out that at present certain sociological and economic data needed for OY determinations and or development of EIS was not generally available to management teams. In some instance the data had not been collected and in others it was not easily assesed by the government. It was noted that it was important to initiate the collection of these data as well as additional biological information on the status of exploited and latent resources. Strong emphasis was placed on data needed to improve government decision. It was also cautionedthat excessive demands for data would generate major cost as well as add to a burgeoning bureaucracy. The scientist were asked to insure their demands for data were relevant and that we not generate a "paper mill" that would stagnate rather than facilitate the management process. The cost of data to the fisherman and the government, must be taken into account in the total beneficial cost analysis of any management scheme.

General Problems in the Development of Management Plans.

Several key problems were identified in the development of management plans. Some of these were related to expected problems relating to adequacy of data, availability of personnel, clarity of guidelines, etc. More urgent concerns of panel members were associated with:

1. Mechanisms for within year changes in regulations

2. Preparations of environmental impact statements

3. The time frame for plan development and impelmentation

4. Treating incidental or by-catch issues

5. Treatment and tactics concerned with managing fisheries having larger year to year variations in recruitment and

6. How to monitor progress in attaining plan objectives.

Priorties for Ootimum Yield

The panel established the following priorities associated with optimum yield.

1. Development of more definitive goals associated with short and long term goals for regional and national fisheries management.

2. Standardization of terminology between Councils.

3. Begin developing, specific ecological, sociological and economic goals for fisheries and collecting relevant data for analysis.

4. Encourage development of models in analytical tools for examing alternative consequences of decisions.

As regards to item 4 the Panel A participants noted the need to (1) make the decision maker more aware of the potential utility of models to accomplish analytical tasks for communications and on the other hand to (2) develop models that more closely reflect the "real world" particularily in terms of biological structure upon which the models rest and the socio-economics and potential climate in which fisheries and Councils function.

Summary of Discussion, Panel "N" - Spencer Apollonio, Chairman, Technical Session, Optimum Yield Workshop, June 7, 1977

Panel "N" Discussion participants were:

Dr. Eugene Cronin, Member of Mid-Atlantic Council and Chairman of the S&S Committee; University of Maryland;
Dr. James C. Cato, Member of the S&S Committee of the Gulf of Mexico Council; University of Florida;
Dr. Arthur E. Dammann, Chairman of the S&S Committee, Caribbean Council; Director, Bureau of Fish and Wildlife, Virgin Islands
Mr. Don W. Collinsworth, Member, S&S Committee, North Pacific Council; Department of Fish and Game, Alaska.

The Panel members, each in turn, commented on the six discussion questions with particular reference to the regional problems, perspectives, and organizational patterns of their particular Council. It was clear from this discussion that there is a wide diversity of problems and probable response by the various Councils.

The panelists addressed the six questions only indirectly and by implication. The concepts of optimum yield and capacity, it seemed clear, will have to be defined regionally taking into account the peculiar problems of each region, no two of which appear to be comparable.

Dr. Cronin summarized the characteristics of the Mid-Atlantic region:
- high population density;
- highly developed and intensive commercial fisheries;
- highly developed and complex recreational fishery;
- substantial foreign fishing;
- extensive waste disposal and pollution problems.

With such a complexity of immediate and intense problems, the Mid-Atlantic Council has not yet evolved a governing concept of optimum yield. Instead it has adopted a pragmatic approach of developing plans for surf clams, mackerel, and squid, for which extensive data already exist, in order to implement immediate management controls on heavily fished resources. The Council has recognized the need to include the effect of plans upon consumers in its determination of optimum yield and it is exploring the desireability and consequences of abandoning the single-species approach to definition of optimum yield and plan preparation.

The Council believes that it should be closely linked to its S&S Committee, a member of the Council is chairman of the committee -- to insure rapid and effective communication and coordination between the two bodies. The Council strives to identify its management objectives very early in the planning process, and it is the role of the S&S Committee to review and advise upon possible management objectives.

A disadvantage of such a close link between the Council and Committee is that it makes difficult the clear separation of the two roles of policy advise and policy decision.

Dr. Cato noted the characteristics of the Gulf Council's fisheries:

- a large and increasing recreational fishery;
- species of equal interest to recreational and commercial fishermen
- lack of clear distinction between recreational and commercial fishermen;
- a multi-species fishery harvested by single gear units;
- fisheries highly dependent upon estuarine conditions;
- short-lived (approximately 1 year) species;
- probable divergence of State and Council management objectives for species migrating across the limits of the territorial seas;
- intense competition among domestic fishermen in the offshore waters of the Gulf.

Dr. Cato noted that the short life of many of the species, and the seasonally changing fishery patterns, complicate the problems of compiling reliable data and adequately defining units of catch or effort, or fishery capacity.

Mr. Collinsworth stated that the North Pacific Council has jurisdiction over the conservation zone off the coast of the State of Alaska. (A single State Council).

- there are essentially no recreational fisheries or interest in most of Alaska's commercially important species for which the Council must prepare management plans;
- relatively few transboundary and transnational stocks;
- few multiple species problems;
- while the above listed conditions make the development of management plans somewhat easier relative to other Councils who have to deal with these problems, the North Pacific Council must develop plans for which there are major foreign fisheries.

It is clear from the presentation of these regional concerns that there are strong regional differences in priorities and objectives for management plans, in data needs and means of collecting or interpreting relevant data, in interpretations of the national standards within the FCMA, and in the definitions of certain key terms of the Act.

The differences may be sufficiently great as to preclude a national consenses on the definition and interpretation of the key elements that go toward determining optimum yield. Optimum yield may have to be determined largely with the restraints of regional perspectives.

DISCUSSION POINTS

During the workshop sessions, questions and concerns arose which were not answered directly nor resolved. These major questions and concerns are listed on the following pages, divided into three categories:

1. Questions related to the present FCMA management structure
2. Concerns
3. Questions which involve possible amendments to the Act (FCMA) regarding optimum yield.

Questions Related to the Present FCMA Management Structure

1. In what form should information be presented to the Councils in order to make it most useable in determining optimum yield and domestic allocation?
2. Do we have sufficient time, manpower, and data to justify the use of models in the first-round preparation of fishery management plans?
3. Will Council use of models justify the cost, in consideration of the fact that many of the models under development require large volumes of data to become operational in a predictive mode?
4. Should standard techniques and policy be established for the collection and use of biological, economic, and sociological data in the optimum yield determination process, and is there a critical need for comparable data from all regions of the country?
5. In cases where there is no real scientific basis for estimating maximum sustainable yield, should some value be established to meet the requirements of the Act, and if so, should a standard convention be established for this value?
6. Should a standardized convention be established to permit comparative weighing of the costs and benefits to commercial and recreational interests at various optimum yield levels until such time as quantitative methods of weighing are devised?
7. The lack of clear distinction between commercial and recreational fishermen in some fisheries presents major problems in determining optimum yield. Can some standard convention be developed to facilitate dealing with this situation?

8. In dealing with the social, or human aspects of optimum yield, what questions should the Councils ask, and how can the Councils use quantifiable and non-quantifiable sociological data in the optimum yield determination process?

9. Perceived costs and benefits are often at variance with measured costs and benefits when determining optimum yield. How should the Councils deal with this problem?

10. Should the Councils set optimum yield values at levels which maximize domestic catch-per-unit-effort, or which develop opportunities at the expense of reduced total allowable levels for foreign fishing?

11. Should the Councils consider the assignment of property rights to the resource to permit the realization of optimum yield through the private sector thereby avoiding many of the difficulties of open access and common property rights?

12. In the process of determining optimum yield, should the Councils initially set management objectives and then proceed with modeling and collection of supporting data or should management objectives be derived after analysis has been made of data relevant to the fishery system?

13. To what extent should the Councils delay preparing plans in order to encourage more extensive public participation in developing management objectives and determining optimum yield?

14. How should the Councils approach the problem of in-season adjustments to management plans (e.g., changes in OY or capacity)?

15. How should the Councils deal with fisheries in which there are frequent short term changes in capacity? How should the plans account for long term capacity changes?

16. What improvements can be made in the communication between the Secretary of Commerce (including NMFS and the Councils regarding management plan review and modifications?

17. How and to what extent should the Councils consider stock enhancement in their determination of optimum yield?

18. What is the best way for the Councils to communicate with marine recreational fishery interests concerning the responsibilities of recreational fishermen for resource conservation and for bearing a portion of the costs of management?

CONCERNS

1. Data collection activities should be designed to account for the constraints of the specific objectives and needs of management plans, in order to reduce costs and improve the relevance and utility of data.

2. Present data collecting and analysis systems are not adequate to provide necessary monitoring/feedback for optimum yield/allocation evaluations and improvement.

3. The Councils do need a more thorough foundation of capacity and additional analysis of capacity in recreational and commercial fisheries.

4. Management concepts and data on the marine recreational fisheries require considerable development in order to fully evaluate the contribution of recreational fishing to the measurement of optimum yield. The development of data acquisition systems is only part of the problem since major conceptual difficulties are involved in evaluating the components of recreational fishing.

QUESTIONS WHICH MAY INVOLVE AMENDMENTS TO THE ACT REGARDING OPTIMUM YIELD

1) How can a shorter preparation and review process be attained for the fishery management plans?

2) With regard to (1) for example, should relief be sought from Environmental Impact Statement requirements to expedite initial adoption and implementation of management plans and their subsequent revision, on the basis that the purpose of the management plans is resource conservation.

3) Should the Councils approach Congress for relief from some of the Federal Advisory Committee Act requirements in order to expedite Council and Scientific and Statistical Committee business in the process of plan development?

4) Should the Councils seek changes in the Act to allow for a stronger role in controlling activities which affect habitats critical to fisheries (e.g., waste disposal and land development in estuarine and coastal areas)?

5) What is the most useful starting point for assessing optimum yield since the two existing major alternative starting points, maximum sustainable yield and maximum economic efficiency, have both conceptual and measurement difficulties.

6) Should optimum yield always be expressed as a single value?

Attachment

Managment Objectives – Francis Christy, Member, Scientific and Statistical Committee Mid-Atlantic Council

The following list is an initial and tentative attempt to identify bona fide objectives for the management of fisheries. The statements need to be refined and elaborated. They are designed to provide specific objectives that may serve as useful guides for the making of decisions on fishery management plans. And, because many of them are in conflict with others, they are designed to elicit a sense of priorities so that trade-offs can be made more explicity.

1. Minimize cost to consumers of a stable supply of high quality fishery products.
2. Maximize diversity of consumer products at low prices.
3. Minimize the net costs to the taxpayer of: development, research, management and enforcement for (1) commercial or (2) commercial and recreational fishing (or)
   3.a Maximize benefit/cost ratios (or cost effectiveness) for public investments in development, research, management and enforcement for (1) commercial, or (2) commercial and recreational fishing

4. Maximize income to the public treasury from the use of fishery resources (stream of revenues discounted to present value).

5. Maximize employment opportunities

   a (1) for present commercial fishermen or

     (2) for present and future commercial fishermen

   b (1) for full-time fishermen or

     (2) for full-time and casual fishermen

   c (1) at present levels of earnings or

     (2) at improved levels of earnings

   d (1) under present conditions of freedom, risk, independence and other non-economic attributes or

     (2) under different conditions constraining some of the non-economic attributes.

6. Maintain employment opportunities for subsistence fishermen.

7. Maximize net economic revenues from fish-catching industry (or)

   7.a Achieve most efficient allocation of capital and labor in fish-catching industry (or)

   7.b Achieve most efficient allocation of capital and labor in fish-catching industry (or)

   7.c Maximize discounted stream of economic revenues, consumer surpluses, net of costs of fishing, development, research, regulation and enforcement (or)

7.d Maximinze contributions to the national economy of:

1. fish-catching (or)
2. fish-catching and processing (or)
3. fish-catching, processing, and distribution (or)
4. fish-catching, processing, distribution, and vessel and equipment supplies.

8. Maximize opportunities for recreational fishermen for:

a (1) trophy-sized fish (or)

(2) quantity of fish (or)

b widest diversity of species

c highest quality (most enjoyable) experiences

d (1) present recreational fishermen (or)

(2) present and future recreational fishermen

e the least cost.

9. Maximize contributions of recreational fishing to the national economy.

10. Minimize balance of payments deficits in trade of fishery products.