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*Northeast Fishery Management
Task Force*

Economic and Biological Data Needs For Fisheries Management, with Particular Reference to the New England and Mid-Atlantic Areas

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16. ABSTRACT

The general categories of economic and biologic data needs required for fisheries management are identified. They are discussed in the following manner: (1) The objectives established for the major fisheries in the Northeast by the New England and Mid-Atlantic are identified: (2) Performance indicators that can be used as surrogates for measuring the attainment of the objectives are identified; (3) Based on the identified performance indicators, priorities were established for the general data categories required; (4) The general availability of the necessary data elements are discussed; and (5) A description of projects that should be undertaken for collecting data in the deficient areas are identified. (Sinha - OEIS)

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PREFACE

This document is the result of studies originating within the Northeast Fishery Management Task Force. The Task Force, organized in 1979 by the New England and Mid-Atlantic Fishery Management Councils and funded by the NMFS, seeks to promote discussion and dialogue on the major issues of fishery management and to explore the effects of various fishery management alternatives.

Composed of representatives from the fishing industry, Regional Fishery Management Councils, federal and state agencies, academic institutions, and general public, the Task Force will operate in three phases. The first phase will assemble background information for identifying and analyzing management options. The second phase will examine this background information to determine the data requirements, regulatory measures, administrative procedures, and enforcement methods associated with each management option. The third phase will critically review the various options for application to specific fisheries, particularly the Atlantic demersal finfish fishery.

This document is one of eight developed under Phase I operations, all of which are being issued in the *NOAA Technical Memorandum NMFS-F/NEC* series. This document and six others functionally serve as appendixes to the eighth and leading document for Phase I operations— "Overview Document of the Northeast Fishery Management Task Force, Phase I."

Jon A. Gibson, Coordinator
NOAA Technical Memorandum NMFS-F/NEC series

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I. INTRODUCTION

As part of the Northeast Fishery Management Task Force's overall effort to provide a forum for the discussion of issues and options under FCMA, this report attempts to identify the general categories of economic and biologic data needs required for fisheries management. The discussion in this paper is organized in the following manner:

1. The objectives established for the major fisheries in the Northeast by the New England and Mid-Atlantic are identified.

2. Performance indicators that can be used as surrogates for measuring the attainment of the objectives are identified.

3. Based on the identified performance indicators, priorities were established for the general data categories required. It should be stressed that an obvious critical step in the above process is not discussed in this paper. That critical step is a detailed discussion of the methodologies that would be used for conducting the analysis, for the methodologies thus identified would provide guidance for the data requirement. Since these methodologies are to be a topic of another paper, they are not discussed here. Rather, based on the authors' knowledge of the methodologies, the data needs and priorities were established in this document.

4. The general availability of the necessary data elements are discussed.

5. Finally, a description of projects that should be undertaken for collecting data in the deficient areas are identified.

It is important to point out that it is not the purpose of this paper to present a detailed evaluation of specific data elements currently being collected, or the programs under whose purview the collection is made, but rather a strategic planning paper outlining general areas of data needs and their current availability. The "specifics" on the above were well known to the authors and, when appropriate, are discussed. Obviously, the specifics on the current data base colored the general discussion presented here.

It is also necessary to point out that biological and economic data needs are not always independent. For example, a biologist who wishes to predict what next year's catch will probably be requires some information on the effect of price on catch. Likewise, an economist who wishes to predict next year's profits should under-

stand the effect of population size on producer's costs. There is a mutual use in many of the separate data elements that should be recognized. Thus, many of the data are inputs into more than one objective.

II-1 ECONOMIC DATA NEEDS AND AVAILABILITY

COMMERCIAL SECTOR

A. Required Data—New England

The Fishery Conservation and Management Act (FCMA) of 1976 gives the Secretary of Commerce the authority to manage fisheries out to 200 miles off the U.S. coastline. The Act established eight Regional Fishery Management Councils, two of which are in the Northeast Region—the New England Council located in Peabody, MA and the Mid-Atlantic Council headquartered in Dover, DE. The primary function of the Councils is to prepare fishery management plans (FMP's) for those marine fisheries the Councils deem important and which are covered by the Act—(an exception would be tunas.)

In the New England area, the following FMP's are in the process of being prepared or are anticipated to be prepared in the near future:

• Herring

• Cod, Haddock and Yellowtail Flounder*

• Pollock*

• Ocean Perch*

• Silver Hake*

• Scallops

• Red Crab

*May be combined into an Atlantic Demersal Plan

Generally, the main objective stated in the plans developed under the auspices of the New England Council is to maximize the net economic and social benefits from the use of these resources. The criteria utilized in evaluating the various strategies for attaining this objective included:

• net income to the harvesting sector

• employment in the harvesting sector

• labor income in the harvesting sector

• net income in the processing sector

• employment in the processing sector

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- labor income in the processing sector
- regional income
- consumer benefits
- enforcement costs

All of these are evaluated in both an aggregate and disaggregate (distribution aspects) mode.

These are fundamental economic performance indicators and generally robust with respect to changes in objectives. That is, it would still be necessary for these data to be collected even if there were substantial variations in objectives. In essence then, there is an implicit recognition that by regulating the available flow of raw material (fish) to the industry, the Councils are operating in the mode of industrial management. Therefore, it is imperative that the Councils have a clear understanding of the current net financial position of various segments of the industry and that systems be established for monitoring the changes in the financial position of the industry in the future. Clearly, management strategy selection should be influenced by such knowledge.

Given this situation and a knowledge of various methodologies that will be necessary to evaluate all of the performance indicators, the staffs of the Region, the Center, the Council, and several academicians ranked the various data topics for the commercial sector for the major fisheries. This ranking appears in Table 1 for the New England area.

The ranking was done in such a fashion so as to preclude evaluation across data areas in an absolute sense. This can be illustrated in Table 1 which contains the data priorities for the New England area. The Table is structured with the principal data topic areas listed down the side and the fisheries across the top. Values of from 1 to 3 were assigned to each data area for each fishery reflecting data that is very important (1) to data that is not very important (3). Within data category 1, the data that is the most important were marked with an asterisk. However, in any given category, there is no attempt to establish priorities across data elements. In other words, for the Atlantic groundfish fisheries both cost/earnings data for the harvesting and processing sectors are ranked "1*". This is based on the Council's desire to determine net income impacts in both these sectors. However, the Council did not assign relative weights, at this time, to these two indicators, and thus no further ranking by the group was deemed appropriate.

Required Data — Mid-Atlantic

In the Mid-Atlantic area, the following FMP's are either being prepared or are expected to be prepared:*

- Atlantic Mackerel
- Tilefish
- Surf Clam and Ocean Quahog
- Squids
- Other Flounder
- Bluefish
- Dogfish
- American and Hickory Shads and River Herring
- Shark
- Butterfish
- Fluke
- Scup
- Sea Basses

*It is recognized that this listing may change in the future.

To date, the Surf Clam and Ocean Quahog Plan, the Atlantic Squid Plan, the Mackerel Plan, and the Butterfish Plan have been implemented.

In the Surf Clam and Ocean Quahog FMP, the evaluative criteria used are essentially the same as those used in the New England Plans. In the Regulatory Analyses (as distinct from the FMP's) for Squid, Mackerel, and Butterfish, the economic criteria listed previously were utilized.

Given the fact that many of the fisheries in the Mid-Atlantic are less developed than those in New England (except for Surf Clams) and some are "more recreational than commercially exploited", the priority listing of the various topic areas differed somewhat from the Mid-Atlantic area. These are listed in Table 2. Again, there was no attempt to rank the items across a particular category.

The next section contains summary statements regarding the general availability of the data topic areas required to conduct the appropriate analyses for the New England and Mid-Atlantic areas.

B. Available Data—New England

Generally, the socioeconomic data that are either available or unavailable in New England are consistent across fisheries. That is, the data gathering/storage systems that are in place in New England collect similar data for all of the fisheries. Thus, the discussion below on the availability of data in the various data topic areas will not be fishery specific.

1.0 Commercial Harvesting Sector

1.1 Number of Vessels & Gear

1.2 Detailed Vessel Inventory Data have been available under the NMFS Weight-Out trip ticket reporting system and from the NMFS annual vessel survey, except that data have not been available for boats under five net tons. Also, the Northeast Regional Information System (NERIS), a permit system recently developed for vessels harvesting groundfish, herring, and tuna, contains information describing vessel characteristics. Vessel characteristics data are available on a continuing basis. The NMFS Weight-Out system enables a

determination to be made of the number of vessels and gear involved in the fisheries.

1.3 **Cost and Earnings** Periodic cost and earnings studies have been conducted of various fleet sectors in the New England area in the past (see Noetzel and Norton, 1965; Dunham and Mueller, 1975; Holmsen, 1977). However, they were not systematic across fleet sectors. These should be continued on a periodic basis.

A cost model should be developed where changes in prices, and input costs can be used to provide updated cost and earnings figures continuously. The future periodic cost and earnings studies can then be used to calibrate the model. The specifics of an ongoing study are detailed in Section D.

1.4 **Employment on Vessels** Employment data for individual vessels is available through the NMFS's annual survey and NERIS file. The total employment in any particular fishery in any month can be ascertained by linking the NMFS annual vessel survey file and the NMFS weight-out file. In essence, a system has been developed to link the files together under various pre-specifications desired. This system is currently available to the Council staff and to NMFS staff.

1.5 **Income Level and Distribution** Through the NMFS weight-out file, a determination can be made, on either a monthly or annual basis of the gross incomes of the various fleet sectors. However, because of the current absence of current cost data on the vessels as was stated above, no determination can currently be made of the net income distribution (except for scallop dredge vessels for which a cost model was recently developed by NMFS/NEFC).

1.6 **Age, Education, and Experience**

1.7 **Cultural Characteristics** Limited data are available on both these topic areas. At the present time they are felt to be sufficient.

1.8 **Capacity Consideration** The general approach that has been taken in the New England Region is that capacity is defined in an economic sense. That is, it is a determination of expected output to be produced during a particular period of time, given expected commodity prices, factor costs, and factor productivity. In fact, "capacity considerations" are not a data topic area, but rather an empirical determination. The data required to make such a determination for a particular fishery include the cost/earnings data above. Various studies have been completed the last few years that are useful from a methodological sense (Siegel, Mueller, Rothschild, 1979; Smith and Peterson, 1979). However, the cost data alluded to previously are necessary to use the Siegel, Mueller, Rothschild model.

1.9 **Landings and Effort** Landings data are collected continuously via the NMFS port pool system from the principal ports in New England and through the NERIS logbook system (for surf clams and tuna only). The landings at the principal ports are estimated to account for about 85% of the total New England landings. Effort data, in terms of days at sea and days fishing, are collected through the same systems. It should be stressed that these are landings data, not catch data. The two differ by the amount of discards. Ex-vessel price data are derived from the landings data, since both total catch and total revenues are reported.

There has been concern expressed the last two years over the integrity of the data collected through the port pool system, due to misreporting associated with the quotas. At this time, there has not been a systematic evaluation of the magnitude of this problem. As of October 1, 1979, the logbook system was extended to cover the groundfish vessels. In essence, there will be parallel systems in existence. It is believed that the NMFS will eventually phase out the port pool system once the validity of the new system has been established. No information is currently available as to the specific methods and procedures that will be used to evaluate the new system or a precise timetable as to when the phaseout will begin.

2.0 **Processed Production**

2.1 **Production and Prices**

2.2 **Number of Processors**

2.3 **Processing Employment** Currently the NMFS conducts a voluntary annual survey of all processing plants. Approximately *95% of the plants* surveyed provide responses. These surveys provide data on the *number of processors,* the annual *production* (on a volume and revenue basis), and *average monthly employment.* Processor prices are derived prices from the production data. While no formal evaluation of the data has ever been carried out, it is felt that for most species these data are accurate.

2.4 **Processing and Marketing Costs** Very little data are currently available on processing and marketing costs. This is a high priority data area necessary to evaluate net benefits of regulation and development actions.

2.5 **Product Flows** This is not technically a data area, but rather information derived from an analysis of imports, landings, production, and exports. In order to more adequately develop information in this area, more data is needed on input sources and product conversion factors. It may be particularly important to have this information on planning expansion of markets for traditional species and developing markets for underutilized species.

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2.6 Processing Employee Characteristics Few data are available on this data area. This is currently viewed as a low priority item.

2.7 Processing Capacity This is another example of an information item as opposed to a data item. Currently, the NMFS has a contract developing information on processing capacity for Massachusetts (Georgiana, et al.). The Woods Hole Oceanographic Institute recently completed another study (Smith and Peterson). These studies will have to be expanded for other areas and updated appropriately. In addition, since alternative methodological procedures may be deemed more appropriate than those used in these studies, it is probable that cost data will be required. This is due to the fact that species capacity estimates are required, and since these are multiple product plants, some optimization modeling would be necessary to generate the estimates. The NMFS is funding a study that will be initiated in July, 1980, the purpose of which is to estimate the cost structure of various types of fresh fish processing plants. The study will be completed by July 1, 1981.

3.0 Commercial Party Boat Sector

3.1 Fleet Size and Composition

3.2 Costs and Earnings The New England Council has had two studies completed on the fleet size and composition, and on the cost and earnings of the commercial party boat sector. These studies must be updated as appropriate. The NERIS also contains information on the number and physical characteristics of the groundfish party and charter boats.

3.3 Expenditures in Support Industries

3.4 Detailed Economics of Support Industries Currently, only the Southern New England marine region (Callaghan, 1976; Rorholm, 1966; Grigalunas, 1979) geographic areas have been studied at the level of detail required to track through the indirect and induced impacts associated with the commercial aspects of recreational fishery. This is necessary data because the Council is concerned with regional impacts of the plans.

3.5 Employment The New England Council has had two studies completed on the commercial party boat sector which contained data on employment (McConnell and Nicholson, 1979, and Nicholson and Ruais, 1979). These studies must be updated as appropriate.

3.6 Employee Characteristics

3.7 Sales of Recreationally Caught Fish No data are currently available on either topic area. It is generally accepted that a considerable portion of the recreationally caught fish are sold. This is especially true for species such as cod.

4.0 Consumption

4.1 Home Consumption

4.2 Restaurant and Institutional Consumption There are essentially no disaggregated data available for this topic area. The NMFS is undertaking a national study, in conjunction with the Department of Agriculture, that should determine the disposition and consumption patterns for various species. The information is important for conducting impact analyses of FMP's.

4.3 Industrial Usage Only limited data have been compiled on this topic area.

5.0 International Trade

5.1 Imports and Exports Import and export data are obtained monthly from the Bureau of Census. In addition, the Market News Branch collects import data from the Regional Customs District and publishes on a daily basis. However, a more detailed breakdown by species is required.

5.3 Transfers to Foreign Processing Vessels No data are currently available on this topic area since no transactions have taken place on the East Coast.

5.4 Foreign Production

5.5 Foreign Market Data Only limited harvesting sector data are available through FAO. Some special studies have been completed on foreign markets (Coombs, 1979). This data is important in order to ascertain the impacts of alternative TALF's and/or fee system on U.S. market development.

6.0 Local Economies

6.1 Local Economic Data As stated in 3.4 only the Southern New England Marine Region has been studied at the level of detail required to track through the indirect and induced impacts associated with direct impacts on the fishing industry. It is understood that an effort is underway at the University of Maine to disaggregate the State of Maine input/output model to separate out fisheries. At the present time the status of the Maine project is unknown.

6.2 Cultural Values Limited data are available.

Available Data—Mid-Atlantic

Data availability for the Mid-Atlantic differs from New England mainly with respect to the harvesting sector. Comprehensive data for catch and effort are generally unavailable because the NMFS port pool system has not in the past extended to the Mid-Atlantic region. This problem has been corrected somewhat. The coverage of all of New Jersey by the port pool system began in 1978. Coverage of the principal ports in other states also began in 1978. However, the extent of the coverage is not as

comprehensive as in New England at the present time. It is expected that the coverage will be extended during the early 1980's.

C. Data Deficiencies

The principal categories of commercial data which are of high priority for FMP's (and thus the focal point of this document) and in which important deficiencies exist, are listed below.

New England

- Cost and Earnings for the Harvesting Sector
- Cost and Earnings for the Processing Sector
- Cost and Earnings for the Retail Sector
- Input Sources for the Processing Sector
- Consumption Data
- Imports
- Data on Local Economies
- Foreign Market Data

Mid-Atlantic

In addition to those above, the following are needed:

- Complete Vessel Landing Data
- Complete Vessel Effort Data

D. Data Collection Plan

The purpose of this section is to provide an identification of the ongoing and/or planned projects, and their estimated cost for the major studies/program that will be required in order to correct the data deficiencies cited previously. A suggested timetable for project implementation for planned projects is also provided.

It is felt that it is very premature at this time to discuss the specific methodologies and levels of precision in the data collection plan.

Cost and Earnings for the Harvesting Sector

An NMFS study was initiated in 1980, the purpose of which is to develop a financial simulation model for the otter trawl fleet in New England. The basic approach being used is an engineering one where cost profiles are being constructed for each vessel over 5 tons for various ports. (Previous attempts at direct collection of cost earnings data have been difficult.) By linking the financial simulator with the NMFS weight-out file, annual income statements and cash flows will be generated. The initial project would have a duration of 2 years (1980-1981); the cost would be approximately $43K. Thereafter, the cost model would be updated at an annual cost of $5K. A cost model for the scallop dredge vessels has recently been developed by NMFS and New England Council staff. Such systems would be extended to the Mid-Atlantic area in the 1981/1982 period at an initial cost of $50K. It is expected that the Mid-Atlantic

study will draw upon the ongoing Mid-Atlantic study of socio-economic characteristics of the fisheries of the Mid-Atlantic.

Cost and Earnings for the Processing Sector

An NMFS funded study will be initiated in July of 1980, the purpose of which would be to generate *pro forma* financial statements for processing plants in New England. As in the harvesting sector study, an engineering approach would be used and a general financial simulator would be developed. The initial period (1980-1981) cost will be approximately $40K. The model will be updated each year at an annual cost of about $5K. (The previous studies done on the processing sector (Georgiana, et al.; Smith-Peterson) do not contain the necessary data to generate the financial analysis needed.)

The study would begin in the Mid-Atlantic area in 1982-1983 period. The first year cost would be approximately $50K. Again, the Mid-Atlantic segment will draw upon the ongoing Mid-Atlantic Inventory study.

Consumption Data

Since the fish and shellfish that are landed in New England and Mid-Atlantic ports are consumed nationwide, it is clear that a national rather than a regional approach is the most appropriate here in order to determine consumer impacts of management regulations. Such a study would be aimed at determining the quantities consumed and relevant price paid by species at home and in restaurants by various groups, and by the industrial sector.

Such a study is now in the planning stages jointly with the U.S. Department of Agriculture, which conducts similar surveys for agricultural products.

The timing and costs of the national survey will largely be a function of the timing of the Agricultural survey and the increased costs to the Agricultural survey for including fishery products.

Input-Output Models

In order to determine the indirect and induced impacts of various regulatory/developmental activities, data on local economies are required. Most of the existing national and local input-output models do not have various fisheries sectors disaggregated. Two studies that did were the University of Rhode Island Southern New England Marine Studies (1965 and 1979). A companion study is needed to be undertaken for Northern New England. Certainly, some of the cost/earning data that will be generated from the harvesting sector and processing sector studies will be useful here. The northern New England study should be initiated in 1981. Based on the recently completed URI study, the Northern New England study would take two years (1981-1982) at a cost of $150K. It is understood that an attempt is underway to disaggregate the State of Maine Input-Output model at considerably less cost. The results of this endeavor are currently unknown.

A comparable Mid-Atlantic segment should be carried out during the 1982-1983 period at a cost of $175K (based on the URI cost estimate).

International Trade

(Import and Export and Foreign Market Data)

It was indicated previously that some of the U.S. import and export data (for the major species) needs to be disaggregated and that companion price data needs to be generated. In addition, it was indicated that data on world catches (volume and value), exports (volume and value), and imports (volume and value) by species/by country needs to be generated (for the major species). FAO data only contain volume data on catches and are frequently delayed. It is estimated that to generate the disaggregated U.S. data would require additional funding of $25K/year. To obtain disaggregated data on the value and volume of world catches and international trade flows would be $100K in 1981 and $20K thereafter.

Extension of NMFS Weight-Out System to Mid-Atlantic

It is currently planned to extend the complete NMFS port pool system into the New York, Maryland, Delaware, and Virginia areas. Such a system will be capable of providing data on individual vessel catches, effort, and revenues. It is estimated that the cost of this system will be small since the personnel are already available.

Table 3 presents a summary of projects, the funding required, and the project timing if the projects were done on a contract basis for the generation of needed economic data on the commercial sector.

II-2 RECREATIONAL SECTOR

The purpose of this section is to outline the economic data needed on recreational fishing, to achieve the stated objective of maximizing net economic and social benefits from using fisheries resources. Unlike the commercial sector, however, there have only been limited previous efforts to examine data needs in recreational fishing (Centaur, 1979).

This probably results both from the difficulty in measuring recreational benefits and the lagged response to growing evidence that recreational landings are a substantial portion of landings in numerous fisheries. Much of the research and data collection currently being undertaken is directed to the question of:

1) Are recreational fisheries an important source of fishing mortality, and

2) What is the appropriate methodology to measure recreational benefits?

Current data collection in many respects is thus more developmental in nature and there are less "accepted procedures".

A. Significance of Recreational Landings

The first issue that management faces is determining whether the catch of recreational fishermen is substantial enough to merit inclusion in an FMP. The data that is needed here is simply the total catch of sport-fishermen by species and area. These figures can be compared with the commercial figures to detrmine the extent of the recreational fishery.

Currently, Human Sciences Research, Inc., under contract with NMFS, has undertaken a creel and phone survey designed to estimate the total catch of recreational fishermen for all species except shellfish. The creel interview estimates catch/fisherman and the phone survey determines total fishermen. Providing the species accounts for more than about 10 percent of total catch of recreational fishermen, reliable estimates of the total recreational catch by species will be determined.

The total numbers of New England recreational fishermen interviewed in this process is roughly 9000, the total phone interviews is roughly 28,000, and the total cost of the effort is roughly $175,000. The survey is expected to be continued in 1980.

In the Mid-Atlantic, the creel interviews number about 9000, the phone interviews about 17,000, and the cost is roughly $150,000. The survey is expected to be continued in 1980.

B. Net Economic Benefits

Net economic benefits from recreational fishing and data needed to assess them is classified and discussed with four major classifications:

i. increased consumer satisfaction when prices fall or catches rise;

ii. increased profits to producers when efficiency or output is increased;

iii. increased employment of idle resources (e.g., labor or capital) deriving from management decisions;

iv. reduced costs of enforcing management decisions.

1. Consumer Benefits

The usual economic measure of net consumer benefits is the difference between what consumers would be *willing to pay* and what they *do* pay for it (Freeman, 1979). If only five metric tons of haddock are landed and ex-vessel prices rise to say $1.20/lb., there is evidence that some people are willing to pay $1.20/lb. for fish. When landings are large and price drops to $.40/lb., those individuals that are willing to pay $1.20/lb. obtain a surplus of $.80/lb. Price and landings data are needed to determine the relationship between willingness to pay and landings.

For recreational fishermen, however, no observable market exists to determine the price of the fish. This forces researchers to find ways to infer the value of the fish. There are various methods to determine the willingness to pay, ranging from asking people what they are willing to pay to catch and consume a fish to in-

ferring it by relating travel and fishing expenses to fish caught. There can be wide divergences between the benefit estimates obtained by the different methods (Heberlein and Bishop). It is generally regarded that some variety of the travel cost method yields the most accurate measure although basic research is still analyzing this point.

Accepting the conventional wisdom that a version of the travel cost method is best, one needs the folllowing information:

1. Sportfishing trip expenses including measures of the opportunity cost of time, variable expenses of the equipment, travel expenses, etc.;

2. Number of trips taken per year;

3. Number, weight and species caught and expected to be caught;

4. Hours fishing, travel time, trip duration, party size;

5. Experience of the fishermen;

6. Gear used and location fished;

7. Population that fishes, i.e., the percent of the total population engaged in fishing.

Currently, Human Sciences Research, Inc. is also obtaining many of these data cited above. This data should provide the basis of a baseline estimate of consumer benefits associated with sportfishing. It must be recognized, however, that the estimate may have to be updated in the future to account for changes in consumer preferences or, possibly, changes in the art of measuring benefits. The data should also provide an excellent description of socio-economic characteristics of the sportfishing population.

2. Producers' Benefits

There are two distinct producers' benefits arising from recreational fishing. The first arises is one treats the individual sportfisherman as both the producer and consumer of sportfish. The producer element in this framework would be addressed in the previous consumer section because it is difficult to treat them separately. Thus, the Human Sciences Research data will be used to develop measures of producers' benefits, where producers are viewed as individual sportfishermen.

The second form of producers' benefits arise from profits generated in the commercial charter and headboat fisheries. Aspects of data needed and available for this group has been discussed in section II.B.1.0. Reiterating those comments, there are two studies in New England on the fleet size, composition, costs and earnings of the commercial party boat sector. NERIS also contains information on the number and physical characteristics of party and charter boats.

3. Regional Benefits

Regional benefits are normally considered the income and employment generated as the result of management decisions. The underlying assumption is that the region being considered has idle resources and that some percentage of the income and employment generated by a decision will result in use of these idle resources.

One attempts to determine total economic activity generated and this requires some form of an input-output model. The discussion presented in the commercial sector on input-output models is applicable here. An example of an analysis is contained in *Economic Activity Associated with Marine Recreational Fishing* (Centaur).

The input-output model combined with data obtained by Human Sciences Research would be sufficient to estimate regional impacts of management decisions.

4. Regulatory Benefits

One area of management relates to the cost of enforcing regulatory decisions. License fees, creel limits, and seasonal closures are among the numerous methods that are used to limit the harvest of recreational fishermen. The cost of enforcing these regulations should be considered when making the choice of which type of management tool to use.

There are, to the best of our knowledge, no studies that adequately address this aspect of management. It is an area for which some information should be developed after appropriate data collection. One could expect such a study to cost less than 50 K.

III BIOLOGICAL DATA NEEDS FOR FISHERY MANAGEMENT

A. Introduction

As noted in previous sections, various fishery management plans (FMP) either have been developed or are currently under development by the New England and Mid-Atlantic Fishery Management Councils. Although the need or motivation for fishery management is most often associated with economic or social considerations, the scope of management is highly dependent upon our knowledge of the biology of the resource and our operational understanding of how the fishery is prosecuted. For many plans, objectives relating to the harvesting and utilization of the subject stock or stocks of fish have been adopted, and management measures to achieve those objectives either have been or are in the process of being identified. While it is probable that objectives will differ among FMPs according to the economic and social context of the fishery, our understanding of the biological parameters of the resource and operational characteristics of the fishery will very often constrain the set of objectives which are meaningful and achievable.

This discussion of biological data needs in fishery management will, therefore, include those types of data which support the definition of management objectives, permit the identification of consistent management

measures, or provide a basis for evaluating biological impacts of management options. Three categories of relevant "biological" data supporting fishery management are identified below, and the implications of the availability of such data to the development of a management system are discussed.

B. Classes of Biological/Operational Fishery Data

Basic Descriptive Data Biological data in this category are typically collected independently of a fishery management program; although, such data are essential to the initial development of management programs. These data may include descriptions of stocks, habitats, spawning and migratory behavior, generalized spatial and temporal interspecies relationships and trophic relationships, the generalized age structure of the fishable stock, and natural periodicity in population abundance. Data of this type have traditionally been gathered in the interest of basic scientific inquiry; although, species specific research interests at all levels have been focused by considerations for the economic significance of the resource.

Data in this category provide management agencies with a basis for launching management programs. These data assist in delineating the management unit and identifying problem areas arising from the manner in which the fishery is being exploited. Although cause and effect relationships influencing the distribution, abundances, and availability of species under consideration can likely only be qualitatively inferred from these data, management objectives addressing basic conservation principles can be meaningfullly defined. That is, an objective to increase the probability of future successful recruitment may be reasonably addressed with management measures calling for the closure of spawning or nursery areas. It is recognized that a management program based upon such descriptive biological data could be expected to exert only loose control on the fishery, and objectives incorporating specific biological or economic goals could not be defined.

Analytical Biological Data Data in this category provide management with the first quantitative basis for analyzing cause and effect relationships, defining biological optimality, and evaluating short-term economic impacts. These data typically are collected in support of a higher level of management decision-making through the use of standard fishery analysis techniques (generalized equations describing growth, production, and population change over time). Included in this category are data on length at age, length/weight relationships, estimates of natural and fishing mortality, and the way in which fish recruit to the fishable stock (i.e., are subject to being caught). Also included are

catch and effort data from the commercial sector of the fishery, catch data from the recreational sector, annual indices of relative abundance (typically from research surveys) and length frequency data from recreational fishing, and commercial and research survey operations.

These data support the overall assessment of the resource and provide insight into MSY, the long-term relationship between production and exploitation (a function of applied effort), variation in annual recruitment to the fishable stock and the expected short-term impact of various catch or effort based management scenarios. Such information allows for the establishment of management objectives which contain specific biological goals. Such goals may include a desired spawning stock size or range, an appropriate long-term average level of catch, or an appropriate level of exploitation. Various management measures consistent with these objectives might include controls on catch (quotas) to achieve stock rebuilding or stock maintenance, controls on effort to encourage long-term stability or increased average harvest from the fishery, or controls on harvesting practices (size of retention by gear or cull size) to enhance productivity and the probability of reproductive success.

Operational Data Data on various aspects of the operation of a fishery are essential to both the design and analysis of management strategies. While this category of data supports both biological and economic analyses, certain kinds of operational data are of particular importance in estimating key biological parameters, and in correctly specifying the transition between management action (measures implemented at the industry level) and the expected or desired biological effects (consistent with the management objectives). Data in this category include seasonal, geographical catch and by-catch patterns, effective effort (sensitive to technological and efficiency changes), gear selectivity and efficiency, gear-induced mortality, and gear-related impacts on the habitat.

The multispecies character of many of the commercial fisheries in the Northeast makes species or stock specific management unrealistic. Because management measures are typically applied at the industry level, their design must simultaneously address the expected effectiveness in achieving the objectives for the target species/stock, as well as the expected impacts on other co-harvested or optionally harvested species/stock(s). Data in this category are essential in analyzing the broad spectrum of biological, economic, and social impacts resulting from the implementation of a fishery management system in a multi-species industry context. Possible controls on catch, effort, gear, area or season all require detailed data on operational characteristics and fishery practices in their design and mode of implementation. Operational considerations relating to the definition of management units are discussed separately in this volume (Marchesseault and Anderson, *The Definition of Fishery Management Units*).

C. Integrative Analysis

Although fishery management techniques employing various categories of biological data are discussed elsewhere in this volume (Sissenwine and Kirkley, *Fishery Management Techniques: A Review*), a brief overview of the relationship between biological data inputs, analytical techniques, management objective definition, and strategy design is provided below and illustrated in Table 4.

Various techniques are presently used to assess the status of fish stocks and, where possible, predict the consequences of various levels of harvest. Basic biological data supporting the analysis of fish species include information on natural mortality, the relationship between length and age, and the relationship between length and weight. These data support a technique known as yield per recruit analysis (Y/R). This level of analysis provides information on the expected yield of an individual fish over its average life in the fishery. Additionally, the technique provides information on relative expected yield from the fishery over time as a function of the age at which fish are initially subject to capture. Objectives supported by this analysis would include increasing yield per recruit, and could be achieved through the specification of a minimum size or an appropriate mesh.

Data on the catch of a species in a fishery are useful to biological analysis at two levels. First, simple catch data, when combined with data on applied effort, can be used to support surplus production analysis of the fishery. Surplus production models provide insight into the level of effort that should be applied in order to achieve the maximum long-term yield from a fishery. This type of analysis supports objectives which identify long-term stock abundance goals. Practical limitations to this approach, including effort standardization problems and insensitivity to non-equilibrium conditions, exist and are thoroughly discussed in the fisheries literature.

When data on the age composition of catches and estimates of recent fishing mortality rates exist, the technique of cohort analysis may be used to estimate the strengths of past recruiting year classes and evaluate the cohort structure of the population over time. The technique is useful for investigating possible stock/recruitment relationships. Moreover, when combined with estimates of current recruitment (typically from research survey data), the technique serves as the basis for estimating the short-term impact of catch on stock size. This level of analysis supports objectives which call for the short-term stabilization or restoration of stocks.

As our understanding of the mechanisms which control recruitment, the variability in natural mortality, migratory and seasonal behavior, species interactions, and other important biological parameters improve for the stocks under management, more demanding objectives become appropriate. As we are better able to track populations through time and predict the biological con-

sequences of various harvesting strategies, multiple-year objectives sensitive to industry growth and economic trends will become increasingly meaningful.

Finally, a major obstacle confronting the development of fishery management programs, particularly on a multiple-year basis, is the treatment of uncertainty in biological and economic parameters in the identification and evaluation of management strategies. Whether this uncertainty is associated with our ability to measure critical parameters or to predict change in them as a result of the application of management measures, it is essential that the decision-maker be aware of both the level and nature of risks which may be associated with the selection of a management option. From a biological and operational perspective, key data are being scrutinized to provide a basis for structuring the impact of uncertain variables into the management analysis process. Correspondingly, techniques are being developed to handle uncertainty in key parameters on a continuing basis, and translate this uncertainty into useful management information.

D. Regional Data Collection Programs—An Overview

In the Northeast region biological and operational data of potential use to the development of fishery management programs are being principally collected by either the National Marine Fisheries Service or appropriate state agencies. Both NMFS and the various state agencies have data collection programs which address the collection of fisheries statistics, as well as basic information relating to the biology/ecology of various marine species.

For more than 100 years NMFS has collected, assembled and published fishery statistics on the volume and value of catch, employment, processing and other data on the fisheries of the U.S. The data collected range from annual surveys to monthly summaries to detailed fishery trip records.

However, in the New England and Mid-Atlantic regions the NMFS Northeast Fisheries Center also conducts major research programs on fishery resource abundance, species composition, age structure, and the environment which supports these resources. Major NMFS programs include:

- Assessment of the distribution, abundance, productivity and harvestable surplus of fishery resources in the Northeast region.

- Assessment of productivity of food chains in relevant marine ecosystems.

- The impact of pollutants on the marine environment, and on the behavior, physiology and biochemistry of marine organisms.

- Analysis of the specific physical and chemical environment of the northwest Atlantic, and how it affects fishery production.

- Gear research.

Complementary research and data gathering programs are conducted by the states. For example, biological data typically collected by the Massachusetts Division of Marine Fisheries include: abundance indices of finfish in state waters, recruitment estimates of winter flounder, lobster catch and effort data, and various biological parameters of near shore shellfish populations. The states of Rhode Island and Maine conduct similar routine data acquisition programs.

The states very often provide additional, specific research on species of particular local economic importance. For example, Maine Division of Marine Resources has become the primary agency for herring research (of a basic biological nature) in New England. In addition, Maine conducts specific research on the distribution and abundance of shortnose sturgeon and northern shrimp. Research by the State of Rhode Island has focused on indigenous bay scallop populations as well as other shellfish and crustacean populations. Of specific interest to Massachusetts have been anadramous species and indigenous flounder populations.

All states have cooperated closely with NMFS to provide for the collection of fisheries statistics through both routine and special sampling of landings from various fisheries. Additionally, Maine, Massachusetts, and Rhode Island have committed their resources to augmenting NMFS research survey cruises, by providing intensified, complementary coverage in state waters. Although not specifically noted here, states in the Mid-Atlantic region also conduct research of specific regional interest, as well as provide data and information on fisheries conducted in that area.

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Table 1
Data Priorities for New England Region

Data Topic Area****	Atlantic Fisheries	Pollock	Redfish	Silver Hake	Other Hake	Sea Scallops	Herring	Red Crab***
1.1 Number of Vessels & Gear	1*	1*	1*	1*	1*	1*	1*	
1.2 Detailed Vessel Inventory	1*	1*	1*	1*	1*	1*	1*	
1.3 Costs & Earnings	1*	1*	1*	1*	1*	1*	1*	
1.4 Employment	1*	1*	1*	1*	1*	1*	1*	
1.5 Income Level & Distribution	1*	1*	1*	1*	1*	1*	1*	
1.6 Age, Education & Experience	2	2	2	2	2	2	2	
1.7 Cultural Characteristics	2	2	2	2	2	2	2	
1.8 Capacity Considerations	1*	1*	1*	1*	1*	1*	1*	
1.9 Landings & Effort	1*	1*	1*	1*	1*	1*	1*	
2.1 Production & Prices	1*	1*	1*	1*	1*	1*	1*	
2.2 Number Processors, etc.	1*	1*	1*	1*	1*	1*	1*	
2.3 Processing & Mkting Costs	1*	1*	1*	1*	1*	1*	1*	
2.4 Product Flows	1*	1*	1*	1*	1*	1*	1*	
2.5 Processing Employment	1*	1*	1*	1*	1*	1*	1*	
2.6 Processing Employee Char.	2	2	2	2	2	2	1	
2.7 Processing Capacity	1*	1*	1*	1*	1*	1*	1*	
3.1 Fleet Size & Composition	1	1	1	**	**	NA	NA	
3.2 Costs & Earnings	1	1	1	**	**	NA	NA	
3.3 Expenditures in Support Ind.	1	1	1	**	**	NA	NA	
3.4 Detailed Economics of Supp. Ind.	1	1	1	**	**	NA	NA	
3.5 Employment	2	2	2	**	**	NA	NA	
3.6 Employee Characteristics	2	2	2	**	**	NA	NA	
3.7 Sales of Rec. Caught Fish	2	2	2	**	**	NA	NA	
4.1 Home Consumption	1	1	1	1	1	1	1	
4.2 Rest./Inst. Consumption	1	1	1	1	1	1	1	
4.3 Industrial Usage	2	2	2	2	2	2	1	
5.1 Imports	1*	1*	1*	1*	1*	1*	1*	
5.2 Exports	2	2	2	2	2	2	1	
5.3 Transfers to Foreign Ships	3	3	3	**	**	3	3	
5.4 Foreign Production	1	1	1	1	1	1	1	
5.5 Foreign Market Data	2	2	2	2	2	2	1	
6.1 Local Economic Data	2	2	2	2	2	2	2	
6.2 Cultural Values	2	2	2	2	2	2	2	
Expenditures in Comm. Support Industries	1	1	1	1	1	1	1	

   *   Within priority category 1 those data topic areas marked with an asterisk are the most important.

  **   Currently unimportant, but may soon become more important.

 ***   Single industry study.

****   Detailed descriptions of each data topic area will be found in Section 5.3.1.

     NA - Not Applicable

     It is recognized that this listing may change in the future.

Table 2
Data Priorities for Mid-Atlantic Region

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Data Topic Area**	Mackerel	Tilefish	Dogfish	Am. & Hick Shad & Herring	Shark	Butter-fish	Fluke	Other Flounder	Blue-fish	Surf Clam & Ocean Quahog	Scup	Squid
1.1 Number of Vessels & Gear	1-1*	1	1	1	1	1	1	1	1	1	1	1
1.2 Detailed Vessel Inventory	1-5*	1	1	1	1	1	1	1	1	1	1	1
1.3 Costs & Earnings	1-6*	1	1	1	1	1	1	1	1	1	1	1
1.4 Employment	2	2	2	2	2	2	2	2	2	2	2	2
1.5 Income Level & Distribution	2	2	2	2	2	2	2	2	2	2	2	2
1.6 Age, Education & Experience	3	3	3	3	3	3	3	3	3	2	3	3
1.7 Cultural Characteristics	3	3	3	3	3	3	3	3	3	2	3	3
1.8 Capacity Considerations	1-2*	1	1	1	1	1	1	1	1	1	1	1
1.9 Landings & Effort	1-3*	1	1	1	1	1	1	1	1	1	1	1
2.1 Production & Prices	2	2	2	2	2	2	2	2	2	2	3	2
2.2 Number Processors, etc.	2	2	2	2	2	2	2	2	2	2	3	2
2.3 Processing & Mkting. Costs	2	2	2	2	2	2	2	2	2	2	3	2
2.4 Product Flows	2	2	2	2	2	2	2	2	2	2	3	2
2.5 Processing Employment	2	2	2	2	2	2	2	2	2	1	3	2
2.6 Processing Employee Char.	2	2	2	2	2	2	2	2	2	1	3	2
2.7 Processing Capacity	2	2	2	2	2	1	2	2	2	2	3	1
3.1 Fleet Size & Composition	1-4*	NA	NA	1	1	NA	1	1	1	NA	NA	NA
3.2 Costs & Earnings	2	NA	NA	2	2	NA	2	2	2	NA	NA	NA
3.3 Expenditures in Support Ind.	3	NA	NA	3	3	NA	3	3	3	NA	NA	NA
3.4 Detailed Economics of Supp. Ind.	3	NA	NA	3	3	NA	3	3	3	NA	NA	NA
3.5 Employment	2	NA	NA	2	2	NA	2	2	2	NA	NA	NA
3.6 Employee Characteristics	3	NA	NA	3	3	NA	3	3	3	NA	NA	NA
3.7 Sales of Rec. Caught Fish	2	NA	NA	2	2	NA	2	2	2	NA	NA	NA
4.1 Home Consumption	3	3	3	3	3	3	3	3	3	3	3	3
4.2 Rest./Inst. Consumption	3	3	3	3	3	3	3	3	3	3	3	3
4.3 Industrial Usage	2	2	2	2	2	2	2	2	2	2	2	2
5.1 Imports	2	2	2	2	3	2	2	2	2	2	2	2
5.2 Exports	2	2	2	2	3	2	2	2	2	2	2	2
5.3 Transfers to Foreign Ships	2	2	2	2	3	2	2	2	2	2	2	2
5.4 Foreign Production	2	2	2	2	3	1	2	2	2	2	2	1
5.5 Foreign Market Data	1-7*	3	1	3	3	1	2	2	1	3	2	1
6.1 Local Economic Data	2	2	2	2	2	2	2	2	2	2	2	2
6.2 Cultural Values	3	3	3	3	3	3	3	3	3	3	3	3

* Under mackerel, relative ranking within priority category 1 is indicated by number after hyphen (i.e., item ranked 1-1 is most important, 1-2 second most important, etc.)

** Detailed descriptions of each data topic area will be found in Section 5.3.1.

NA - Not Applicable

Table 3
Summary of Projects, Funding Required, and Funding Sources
to Supplement Existing Economics Data on Commercial Sector

Project	Period	Funding Required	Funding Source
Cost/Earnings for New England Vessels	1980-1981	$43K	Funded NMFS
Update of Cost Study - N.E.	1982-1985	$5K/year	New
Cost/Earnings for Mid-Atlantic Vessels	1981-1982	$50K	New
Update of Mid-Atlantic Cost Study	1983-1985	$5K/year	New
Cost/Earnings for New England Processing Sector	1980-1981	$40K	Funded NMFS
Update Cost/Earnings for New England Processing Sector	1983-1985	$5K/year	New
Cost/Earnings for Mid-Atlantic Processing Sector	1982-1983	$75K	New
Update Cost Study for Mid-Atlantic Processing Sector	1984-1985	$5K/year	New
National Home, Restaurant and Institutional Consumption Add-on	As soon as possible		To be funded by NMFS
Input/Output Marine Model - Northern New England	1981-1982	$150K*	New
Input/Output Marine Model - Mid-Atlantic Area	1982-1983	$175K*	New
U.S. Import/Export Disaggregated Data	1981-1985	$5K/year	New
Establish World Catch and Trade Flows System	1981	$100K	New
Update World Catch and Trade Flows	1982-1985	$20K/year	New

*Based on URI estimates.

SOURCES OF DATA   SUPPORTING ANALYSES   ASSESSMENT TECHNIQUES   MANAGEMENT STRATEGIES IMPACTED

Natural Mortality

Growth Equations
(length & weight)

Yield per Recruit Model

Research Vessel Survey

Aging — Age/Length

Length/Weight Freq.

Abundance Indices

Catch-at-age

Recruitment Est.

Commercial Catch

Length/Weight Freq.

V P A

Catch by Area

Dynamic Analytic
Model

Commercial Effort — Effort Standard.

Surplus Production
Model

Stock Separation/
Delineation

Tagging/ Meristics,
Morphometrics,
Genetics, Parasites

Fish/Stock Movements

Specifies relative total yield
to the fishery as a function of
size/age at entry.
Given information respecting
selectivity, allows specificat-
ion of mesh regs. to achieve a
given minimum size.

Specifies next years stock size
resulting from range of current
years catch quotas.
Allows specification of short-
term stock stabilization/ rest-
oration strategies.

Additional to current/following
year strategies addressed by
V P A, allows long-term predic-
tion of biologic/economic
impacts implied by specified
management strategies.

Provides advice respecting
effort control to promote long-
term stock equilibrium. Is in-
sensitive to variations in
recruitment implying possible
overfishing if too liberal or
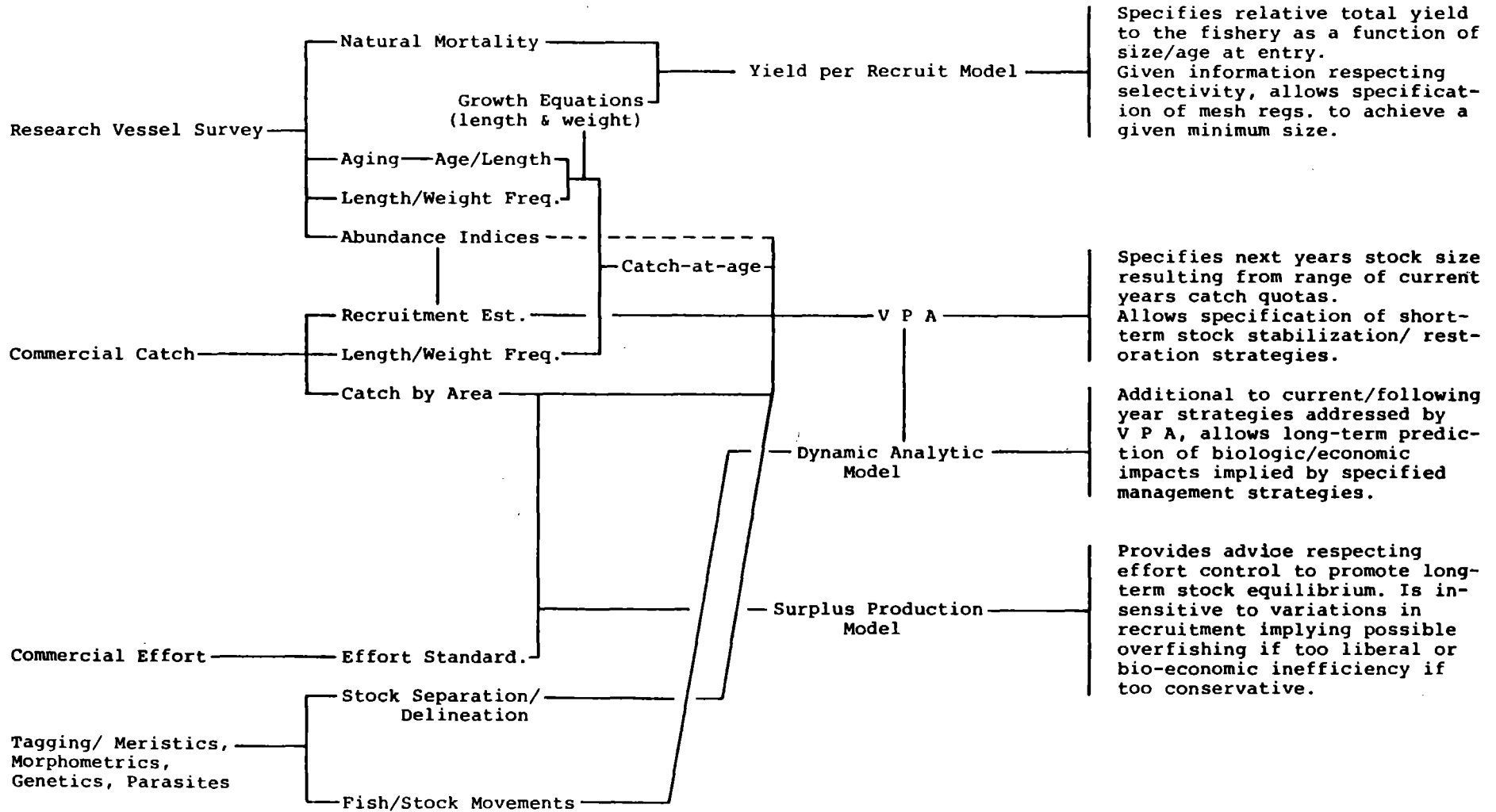bio-economic inefficiency if
too conservative.

Figure 1. Generalized fisheries biological information flow diagram.