

REPORT
to the
BUREAU OF COMMERCIAL
FISHERIES
on the
BRANCH OF ECONOMICS



Circular 173

UNITED STATES DEPARTMENT OF THE INTERIOR
FISH AND WILDLIFE SERVICE
BUREAU OF COMMERCIAL FISHERIES

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REPORT TO THE BUREAU OF COMMERCIAL FISHERIES ON THE BRANCH OF ECONOMICS

by

James Crutchfield (Chairman), Giulio Pontecorvo,
Walter Williams, John H. Cumberland,
and Francis T. Christy, Jr.

Circular 173

Washington, D.C.
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FOREWORD

In June 1962 a committee of five economists was formed by the Bureau of Commercial Fisheries to review its economic program. The members of the committee and their affiliations were as follows:

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Research Associate, Resources for the Future, Inc.

After a series of conferences in June, July, and September 1962, and an evaluation of the Bureau's work in the field of economics, the committee submitted the report that follows.

Walter H. Stolting
Chief, Branch of Economics
Bureau of Commercial Fisheries
Washington, D.C.

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The primary purpose of this Committee was to establish the appropriate structure and scale of economic effort in the operation of the Bureau of Commercial Fisheries. We felt that this primary charge could best be met by developing positive concepts of need, program, and staff rather than by a point-by-point evaluation of the present program and personnel. We have therefore attempted to define the role of economic analysis in the Bureau's overall task of promoting the development of the nation's fishery resources and to translate these into appropriate organizational and personnel requirements. Accordingly, the report deals with the following main subjects:

1. Relation of economic analysis to the operation of the Bureau.

2. Type of economic program that the Bureau should undertake.

3. Type of organization required to implement this program.

4. Type of personnel required.

A separate appendix is attached, which deals with statistical data requirements. We recognize that the statistical activities of the Bureau were not included specifically in the initial charge. We have found, however, that deficiencies in the present statistical data are so serious that development of a satisfactory economics program will hinge in part upon a major improvement of the quality of statistical information made available to those responsible for economic analysis.

RELATION OF ECONOMIC ANALYSIS TO THE OPERATION OF THE BUREAU

Modern economics is becoming more and more useful in the analysis of the complex issues involved in the development and management of natural resources. The growing importance of the role of the Federal Government in resource decisions has been accompanied by a greater Federal requirement for economic tools. *Resources For the Future*, in its "Report of Planning, Policy Making, and Research Activities" to the Department of Interior (April 1961), repeatedly emphasized the need for economic information and analysis in the decision-making process.

The Department's role in advancing and providing basic physical and biological information has been among its greatest contributions to natural resources management. But in the modern world such information alone is not a sufficient guide to the management of natural resources. There are large questions of what ought to be done and equally important questions of what can and cannot be done. Some of the most difficult problems involve the question of how resources can best be used and how the costs and benefits of development will be distributed among people. Ability to answer such questions depends in large measure upon an understanding of a complex political and economic system as it functions within the nation and as it is influenced by situations throughout the world. Such factors as costs, prices, the demand outlook at various price levels, the

impact of technological change on supply and demand, and the possibilities for substituting one product for another must be taken into account in both public and private resource management decisions. Events in foreign nations may be as significant to resources management in the United States as events at home. Petroleum discoveries in the Sahara, tin production in Bolivia, exports of fishery products from Scandinavia or Japan, and decisions of the Soviet Union regarding export policies for crude oil and aluminum can be important to our national security as well as to the development and use of our resources and the functioning of our economy.

Although systematic analysis of relevant information, both domestic and foreign, requires the services of the political analyst and the scientist, modern economics must be depended upon heavily. Economic data and analyses provide a foundation for policy decisions about Departmental operating programs, for advice by the Department to the President and Congress, and for policy decisions by private organizations. With the assumption by the Department of certain regulatory responsibilities, such as the administration of oil import quotas, the need for economic information and analyses as a basis for policy decisions and recommendations has increased.

We of the Committee are in strong agreement with the statements made by *Resources For the Future* and feel that increased utilization of sound economic analysis is essential if the Bureau is to deal successfully with the growing demand for its services.

We feel that the economic functions to be performed by the Bureau fall into two categories: (1) Basic research designed to provide a more thorough understanding of the structure and performance of various fishing industries and of the fishing industry in general and (2) service functions designed to provide a flow of current relevant information to the industry, to the Director, and to the various branches of Government. It appears to us that in the past, primary emphasis has been given the latter group of functions. There is a danger that a disproportionately large amount of time might then be diverted to collecting facts and figures hurriedly to meet "brush-fire" problems. This mode of operation leads to (1) excessive concern with ad hoc problems rather than to matters of more general interest to the industry and the public and (2) lack of a fund of basic research information, thereby making it necessary to "start from scratch" on each problem rather than to build on the information already available from earlier research.

We feel that a major structural change is required to achieve the objectives outlined above. Specifically, the role of basic economic research needs to be strengthened substantially, not only because of the inherent value of such work, but also because it is essential in providing the necessary background of understanding from which information can be drawn to meet current problems.

We recognize the necessity of performing so-called service functions for an industry

characterized by small-scale, highly competitive units. In addition, we are cognizant of the responsibilities imposed on the Bureau by statutory requirements relating to cooperatives and to the transportation of fishery products. We feel, however, that in the long run, the most effective service to both the public and the industry will be achieved only if economic analysis is permitted to operate on a sustained basis, free from the interruption of day-to-day pressures. Equally important, we feel that a properly designed program of research and current economic analysis will provide a far broader and more relevant range of statistical and factual information on all phases of the American fishing industry than is possible under the present program. In brief, the continuing program of economic analysis within the Bureau should provide a basis for anticipating trouble spots and for providing the types of economic information required to meet current problems from data collected in the course of the normal program. More important, it should provide a depth of knowledge about the basic structure of the industry sufficient to permit more effective and timely interpretation of factual data.

We therefore recommend a twofold division of economic effort in the Bureau: (1) basic economic research and (2) current economic analysis drawing on the fruits of the research program for guidance in providing relevant information of the greatest current value to both Government agencies and industry. Specific suggestions on the content of both types of program are set forth in the following sections.

ECONOMIC PROGRAMS THAT THE BUREAU SHOULD UNDERTAKE

ECONOMIC RESEARCH PROGRAM

There are many ways in which the long-run economic research activities of the Bureau could be broken down. We suggest that such studies be divided into two categories--those related to the fishing industry in its relation to the general economy, and those dealing with problems within specific fisheries or segments of fisheries.

Studies Related to the Fishing Industry and the Nation's Economy

Two examples of general studies are as follows:

Relation of fisheries to regional and national economies.--Studies of the relation between fisheries and the regional and national econ-

omies should point up the importance of fisheries to the nation, to various regions, and to local areas. How much labor is employed by the fishery? How much capital is invested? How much of the region's income is generated by the fishery? Has the importance of the fishery income to the region or area changed, or will it change in the future so that the area might become depressed? What are the alternative regional opportunities for the use of labor and capital, and how are they changing? Such studies as these would help the Bureau to determine the kind and amount of services in which it should invest and the location for the investment.

Long-run demand and supply for fishery products.--Studies of long-run demand and supply for fishery products should not be studies of "market conditions," which are superficial and useful only in the immediate

period. Rather, the studies should concentrate on understanding the nature of the demand for fishery products. How significant, for example, is the growing importance of "convenience foods"? How are tastes changing and what will these changes mean for particular fisheries? How do fishery products compete with poultry and meat over the long run? How do fishery products compete with each other? Is the competition between kind of processing and ease of preparation, or is it between species of fish? Such studies require careful economic analysis of income and price elasticities of demand. They are essential if the Bureau is to anticipate future aggregate and specific demands for fishery products and hence the degree and areas of pressure on supplies.

Studies of Specific Fisheries or Segments of Fisheries

Four examples of specific studies are as follows:

Studies of the efficiency of the fisheries.--Such studies, in conjunction with technical staff personnel in other branches, should be aimed at full evaluation of present and prospective methods and equipment in terms of engineering efficiency and of economic efficiency. It is vitally important that the influence of regulation on the economic efficiency of some major fisheries be thoroughly analyzed. The experience with quota regulation in the halibut fishery and with seasonal closures and gear restriction in salmon fishing, for example, provide valuable lessons in appraising the effects of other prospective control programs.

Analysis of major technological changes in the fisheries.--A study of technological changes would involve analysis of the impact on the American fishing industry of long-range fishing by large factory ships and mothership operations. The possibility of successful adoption of these capital-intensive methods by American firms must be thoroughly explored in view of the present world situation. The development of products such as fish protein concentrate and the utilization of a wide variety of fish for this purpose is another example of a major technological change, the economic effects of which should be analyzed as fully as possible in advance of full commercial development.

Analysis of foreign trade position of the fisheries.--Studies must be undertaken to discover areas of competitive advantage and disadvantage. The whole problem of tariff and quota restrictions must be approached on the basis of economic knowledge of the particular

fishery in question. To carry on these studies properly, the Bureau must have at its disposal information on conditions within foreign fisheries. The Bureau must know the degree of capital intensiveness, labor intensiveness, and other aspects of the cost patterns involved in the fishery operations of our competitors. It seems particularly important that Bureau efforts in the foreign trade field be concentrated on behalf of fisheries in which our comparative advantage is greatest.

Micro-economic analysis or industry studies.--It is necessary that the Bureau conduct a series of professional industry studies. These studies should be modeled after the work done by industry analysis specialists in the general field of economics. Excellent studies in depth of the structure, policies, and performance of such industries as petroleum, aluminum, rayon, cigarettes, and many others could be used as models. On the basis of these studies, causal relations between the structural organization of individual fisheries and the quality of their economic performance can be established. The investigation of specific industries can draw heavily on such studies as the comparative advantage with respect to foreign competitors, technological efficiency, and some aspects of the supply and demand studies. These industry studies can provide the essential structural knowledge of major fisheries that is required to deal effectively with periodic special problems. The information from these industry studies will also throw light on such aggregate problems as the relation between the fisheries and the general rate of economic growth of regions and of the national economy. Such industry studies will also provide specific guides for the improvement of the competitive position of American fisheries where this is possible.

This approach will provide more information than is currently available to the Director from the commodity studies and at the same time will give greater depth and understanding in the interpretation of statistical data.

CURRENT ECONOMIC INFORMATION

In addition to the research activities, a continuing flow of current information on fisheries of the United States is required. The statutory requirements with respect to transportation and fishery cooperatives fall primarily in this area, though the former may raise research questions as well. Beyond this, we feel that the day-to-day need for current statistical and other factual material could best be met along area rather than commodity lines.

The two concepts, of course, are not mutually exclusive. A Pacific Northwest specialist, for example, could hardly neglect the need for detailed knowledge of the salmon and halibut fisheries, and the Gulf coast specialist must have detailed knowledge of the shrimp fishery. There are, however, dangers in concentrating on the major species to the possible neglect of others that are important in the aggregate. In a positive vein, we believe there are advantages in having current economic work extend over a range of fisheries, inevitably inter-related, in a geographic area. This division of effort, together with the broadening effect

of the longer range economic research program, would appear to offer maximum opportunity to anticipate trouble spots and to marshal quickly and to interpret correctly the data required to formulate Bureau policies.

It should be apparent that not all current analysis and information can be limited to a regional framework. Some work of this type will therefore continue to be interregional in scope, particularly where industrywide problems are involved. There would still appear to be a need for continuing analysis along commodity lines in a few cases.

ORGANIZATION REQUIRED TO IMPLEMENT THE BUREAU'S PROGRAM

We feel that the program outlines in the preceding sections cannot be performed effectively without substantial changes in organization.

BROAD RECOMMENDATIONS

First, we recommend that the economic work of the Bureau be raised to division status.

Many of the important functions performed by the Bureau are essentially economic in nature. Decisions on services and support for the industry require full knowledge of supply and demand situations, the cost structure of the industry, and the links between the technology of the industry and its costs. Agreements on international regulations should take into account their economic impact upon all segments of the fishing industry. Although we fully recognize the vital importance of biological information and technical services, we feel that resource decisions in the future will become increasingly dependent upon economic facts and tools. We believe, therefore, that the Director should have direct access to the best possible economic advice and, conversely, that economists should be able to participate fully in the decision-making process.

The requirements for professional economic analysis are as demanding as those in the fields of biological and technological research, and the end product is of equal importance to the fulfillment of the Bureau's public responsibility. Division status for economics would be consistent with practice in some other Government bureaus and with the fishery operations of other national governments and the United Nations.

Second, we note the need for coordination and integration of existing segments of eco-

nomic analysis in the Bureau. We suggest, for example, that work such as that of the Trade and Tariff Unit in the Branch of Foreign Fisheries and Trade and the Bureau's marketing research work be included in the proposed Division of Economics.

Third, as a result of our concern with the problem of improving and broadening the statistical work of the Bureau, particularly in the field of economics, we recommend that an Office of Statistics, reporting directly to the Director, be created.

It should be pointed out that our recommendations generally involve a reordering of functions rather than the creation of new functions and that they thus can be implemented within present budgetary limitations.

SPECIFIC RECOMMENDATIONS

We recommend that the Division of Economics be divided into two branches--(1) the Economics Laboratory and (2) the Branch of Current Economic Analysis, the latter being organized primarily along regional lines. This subdivision continues the basic organization of the Bureau on a line-and-staff basis. It is intended that the basic economic research carried on within the Bureau, of the type and scope indicated in our section on programs, be done by the Laboratory group. The operational aspects of the economic activity of the Bureau indicated in our section on current economic information will be carried on by the group involved in regional analysis. This division of duties will serve to insulate the staff in the laboratory from the direct pressure of providing particular answers to particular questions, and thus will permit it to proceed with more fundamental economic analysis.

Laboratory

It is our view that the laboratory should be considered a research team. We do not think it desirable, at this time, that the laboratory staff be specialists; rather, they should comprise a flexible group dedicated to general economic analysis. If there were to be any specialization within the laboratory, it probably would lie in the area of foreign trade and the analysis of other economies and other nations' fishing efforts. Material prepared in the laboratory should be of a quality that would be suitable for publication in professional journals. For this reason, it seems highly desirable that laboratory personnel participate actively in professional economic meetings and activities.

Branch of Current Economic Analysis

The Branch of Current Economic Analysis should be organized to meet and deal with operational problems and to provide a regular flow of information regarding regional fisheries. As indicated above, we feel that this arrangement offers definite advantages over the Commodity Section concept. It would, moreover, provide an excellent basis for close liaison with the regional offices.

We recommend strongly that an economist ultimately be attached to each of the five regions of the Bureau. Each regional economist would presumably receive basic training in the National office. This program would acquaint the regional analyst in Washington with the detail of the particular fisheries operating in his region and also, through his counterpart, would provide a steady flow of current information on local developments, which he is fully capable of interpreting. Staffing for economics work in the regional offices would also facilitate better integration of the operations of the Economics Division with those of technologists and biologists in the field. We recognize, however, that first priority should go to building a strong Economics Division in Washington.

The regional economists in the Branch of Current Economic Analysis should be well versed not only in the economics of the fisheries in their particular regions but also in other dimensions of the fisheries as well. Regional specialists, regularly in the field, could do much to facilitate identification of potential problems and to develop the necessary information for action by the Director. Establishing a Branch of Current Economic Analysis will also provide improved services to Congress and industry by improving the flow of the information between Washington and the various regional offices.

A major responsibility of the analyst in this Branch should be the preparation of annual summaries of fishing activity in his areas, structural changes in the fisheries, and reviews of relevant literature both here and abroad. It should be emphasized that these summaries should not be simply enumerations of catch statistics and descriptive material. They should be analytical in content, with emphasis on causal aspects of the developments and problems discussed. It is expected that developments in the fishing industry would be related to general problems of regional economic development.

The materials prepared by the regional analyst will not be as fundamental in a technical sense as those prepared in the Laboratory. Nevertheless, it is envisioned that the regional analysts' material would be publishable as more popular expositions of conditions in the fisheries and that they would draw for these expositions upon the more sophisticated economic analysis carried on within the Laboratory.

Division Chief

The functions of the Division Chief, to a large extent, are specified by the Bureau's overall organizational pattern. Liaison with other Departmental and Government economists, interpretation of Division research findings to the Director and other staff members, and advising the Director on economic aspects of international trade problems affecting the fisheries and of regulatory programs are clearly of this nature. In view of the inherent staff limitations, it is vital that the head of the Economics Division be freed of routine administrative duties as far as possible in order that he may function primarily as a staff economist to the Director.

SUMMARY

In summary, the proposed content and organization of the economic studies of the Bureau are designed to accomplish three objectives: first, the emphasis would be shifted toward analysis of problems vital to the long-run welfare of the industry but not normally dealt with by industry itself; second, the professional level of the economic analysis would be of the same high quality as the biological and technological analysis currently carried on within the Bureau; third and finally, it would provide for a continuous flow of current and more relevant economic information from the field and closer integration of related

economic, biological, and technological problems largely dealt with in the Regional Offices. The end result should be a corresponding

increase in the effectiveness with which the Bureau anticipates and adjusts to developments in the industry.

PERSONNEL REQUIRED TO IMPLEMENT THE BUREAU'S PROGRAM

BUREAU PERSONNEL REQUIREMENTS

It is apparent that the changes in program and organization recommended in the preceding sections will require the services of several professional economists of the same level of academic training and experience as are found in other key research personnel in the Bureau.

Supervisors

We feel that the Division Chief, his deputy, and the Director of the Laboratory should be professional economists holding doctoral degrees in the field. In general, the requirements for the Chief of the Branch of Current Economic Analysis will not be as demanding in terms of professional academic training as will those for the Director of the Laboratory. He should, however, have complete familiarity with economic analysis so that he can translate the work carried on by the Laboratory into the area of regional analysis. Furthermore, he should be able to develop a high level of economic performance from his regional analysts. At lower levels, independent direction of projects would require personnel with either a Ph.D. or M.A. plus experience in related work.

Staff Members

Personnel should be recruited primarily on the basis of their technical proficiency in terms of formal training in economics. Work experience, although desirable, does not provide fully the necessary technical equipment for upgrading the economic work of the Bureau unless accompanied by continued technical education. If these substantial qualifications for top positions are established, recruiting at lower levels should center on persons with some opportunity or hope of reaching a higher level within the operation. This recommendation does not mean that many aspects of the economic work cannot be carried out at a lower level, but that the professional personnel should be considered in terms of their opportunities for promotion and advancement, both professionally and administratively, within the Division of Economics itself.

It should be stressed that the matter of incentives is vital to recruitment of economists at these levels. Staff members should be encouraged to participate in professional meetings outside the sphere of the fisheries proper, to publish in the general field of economics as well as in their specific work areas, and to participate in policy formation at the same level as their counterparts in the physical aspects of fisheries. Preservation of their professional identity as economists is essential to their ability to contribute specifically to the economics of the fisheries.

A final consideration necessary to provide the proper environment and the incentive for the recruitment and maintenance of a competent staff is the need for continuing education and training. As indicated above, the staff should be in touch with the main currents of economic thinking. This contact can be maintained by participation in professional meetings. But in addition to publication and to participation, qualified staff members should have the privilege of continual on-the-job graduate training in convenient local universities. Annual seminars of perhaps 7 to 10 days' duration should be organized. These meetings would deal primarily with developments in fishery economics and in other areas that might have applications in the analyses of the fishing industry. They would enable biologists, technologists, and economists to discuss the significance to the Bureau of technological changes and innovations in thought in all three areas.

USE OF OUTSIDE SERVICES

The Bureau has traditionally made use of outside services of skilled technicians for one purpose or another. The Economics Division should share with the rest of the Bureau in the use of such services. Both contract research and consulting services enable the Bureau to draw on particular skills and additional manpower otherwise beyond the scope of its continuing program. In general, it would appear desirable to use these limited funds to supplement the basic research activities of the Economics Division, and to provide for training and orientation of the regular staff to carry on the work where this is required.

SUMMARY AND DISCUSSION

In this report the Committee has emphasized the following points: (1) Economic analysis is of such importance to the Bureau that an Economics Division should be established at a level equal to Biology and Technology and (2) basic economic research is the type of endeavor that should produce the most meaningful flow of economic information. In light of this, we have suggested an organizational plan, including (1) a basic research unit partially insulated from the day-to-day activities of the Bureau, which we believe will facilitate the production of meaningful and timely economic studies, and (2) a Branch of Current Economic Analysis. We have also suggested the professional requirements needed by certain key individuals in the proposed division.

We should like to stress the fact that the success of our recommendations depends largely upon staffing these key positions with qualified individuals. In short, the hopes for our program rest in good measure upon the hiring of economists capable of performing basic economic research at a sophisticated level. We believe the basic organizational changes recommended (independent of the people chosen for the key positions) will aid the Bureau because of the emphasis placed upon economic analysis and its contribution to effective performance of the Bureau as a whole. Our organizational plan will move the Bureau toward this goal, but success depends upon the competence and incentive of the individuals who make up the staff.

SUMMARY AND DISCUSSION

In this report the Committee has considered the following points: (i) Economic analysis of such importance to the Bureau that Economic Division, Bureau of Economic Analysis, should be given a level equal to Biology and Chemistry; (ii) basic economic research; (iii) applied research; (iv) a basic research program; (v) a research program in the field of the development of the human sciences; (vi) the protection of the physical and biological sciences; and (vii) a research program in the field of the development of the human sciences.



The Committee has also considered the following points: (i) Economic analysis of such importance to the Bureau that Economic Division, Bureau of Economic Analysis, should be given a level equal to Biology and Chemistry; (ii) basic economic research; (iii) applied research; (iv) a basic research program; (v) a research program in the field of the development of the human sciences; (vi) the protection of the physical and biological sciences; and (vii) a research program in the field of the development of the human sciences.

SERVICES

The Committee has also considered the following points: (i) Economic analysis of such importance to the Bureau that Economic Division, Bureau of Economic Analysis, should be given a level equal to Biology and Chemistry; (ii) basic economic research; (iii) applied research; (iv) a basic research program; (v) a research program in the field of the development of the human sciences; (vi) the protection of the physical and biological sciences; and (vii) a research program in the field of the development of the human sciences.

APPENDIX

FISHERY STATISTICS FOR ECONOMIC RESEARCH

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CURRENT DEFICIENCIES AND THEIR REMEDIES

At the present time, some features of U.S. fishery statistics, particularly those relating to economic aspects of the industry, are deficient both in substance and coverage. Some statistical programs of the Bureau are highly accurate and complete. In other programs, however, some of the data need improving in relevance, organization, and accuracy.¹ Although the causes of the present situation are complex and numerous, the solution demands the hiring by the Bureau of thoroughly trained professional statisticians familiar with latest scientific techniques in sampling surveys and statistical inference. A second and related requirement is an upgrading of the quality of the sometimes incomplete data collected largely by the individual States.

Because of the overriding importance of comprehensive, reliable statistics for economic research in the fisheries, highest priority should be given to a basic reorganization of the statistical program of the Bureau. Without specifying its exact position within the structure of the organization, we recommend that a separate Office of Statistics should be established, serving the needs of personnel engaged in both biological and economic fields.

The essential point is that the chief or head of this office be a thoroughly trained professional statistician of highest caliber. Ideally, he should have earned a Ph.D. degree in statistics and should have established his professional competence through publication of

¹As one indication of fishery statistics inadequacies and problems arising from their tabulation and interpretation, see Neal Potter and Francis T. Christy, Jr., 1962. Trends in natural resources commodities (published for Resources for the Future, Inc.). Johns Hopkins Press, Baltimore, p. 297-310.

books or articles in professional statistical journals. It is essential that he be trained in modern scientific sampling and survey methods.

CRITERIA AND OBJECTIVES FOR FISHERY STATISTICS

Although there is evidence that some segments of the U.S. fishing industry are in serious economic difficulties, by and large the industry remains an unknown area of the U.S. economy. Although some fishery statistics are collected, the fact is that insufficient data are available to indicate even the relative significance of the fishery industry in the U.S. economy. In the national income statistics, fisheries are included in a miscellaneous category, "Agricultural services, forestry, and fishing." Unlike the case of agriculture, manufacturing, trade, government, and mining, there is no census of fishery industries.

Any meaningful study of the fishing industry implies its evaluation as an integral part of the national economy. This is essential in measuring the efficiency of the industry in terms of production per unit of input. A number of implications for statistical programs are inherent in this objective. Fishery statistics should be collected in forms consistent with and comparable to statistics of other sectors of the economy. This consistency should be observed as far as possible in definitions, concepts, classification, coverage, and level of detail.

Economic analysis of the fishing industry views it as one sector of the economy that, like all others, purchases a variety of inputs in order to produce outputs and earn income. In order that the efficiency of this process may be analyzed and improved, it is necessary

to organize a systematic measurement of the purchases of labor, materials, equipment, and all other inputs into fisheries, as well as systematic measurement of total production and total revenues.

The emphasis placed by the economist upon knowledge of both inputs and outputs results from the fact that he measures economic efficiency and productivity in terms of output per unit of input both expressed in terms of value. Likewise, emphasis is placed upon comparison of fisheries with other industries and with the total economy, because of the importance of comparing efficiency and productivity in one industry with that in others. The result should indicate where aid is justifiable and necessary to an industry and how productivity may be increased.

Also, because of the economist's concern with fisheries as one component in a national economy and with means of comparing the contribution of this industry with others, he is interested not only in measures of physical output, but especially in the value figures that provide the only consistent common denominator of comparison between otherwise non-comparable outputs of dissimilar industries. Consequently, heavy emphasis must be placed upon development of price and value data. Because the industry is a complex one, involving many levels of activity, it is also important to collect data relating each stage of operations--fishing, wholesaling, retailing, preparation, and distribution--so that all linkages of fisheries with other sectors of the economy may be identified and measured.

INTEGRATION OF STATISTICAL SYSTEMS

Because of growing recognition of the importance of examining each industry in terms of its 'sales and purchases' interconnections with each other industry in the economy, new types of economic models and accounting systems have been developed. One of the most operational and useful of these national social accounting systems is the input-output, or interindustry sales and purchase model.

Aside from its promising applications for analysis and projection, the interindustry sales and purchase (ISP) model is a powerful device for organizing all available statistical data concerning all the sectors of a national economy, cross-checking for accuracy, and revealing areas of the economy where information is missing. In fact, this approach is so promising as a framework for data and analysis that it has now been adopted by the Department of Commerce Office of Business Economics

as a continuing program to produce inter-industry accounts that will be consistent with and complementary to the national income statistics. The result should be improved Federal statistics in which census data will be integrated more closely with national income accounts and provide more detailed information on the structure of the U.S. economy. The first table will be based largely upon the 1958 Census of Manufactures, with intercensus adjustments followed by new tables after each succeeding census is completed.

Unfortunately, at the present time there are not sufficient data collected to permit separate identification of the fishing industry in census statistics or the ISP table. Consequently, fisheries are usually grouped into miscellaneous categories with other activities for which data are scarce. The first ISP table constructed by the Federal Government was for the year 1947. The U.S. economy was sectored into 192 activities, and fisheries were combined with other natural-resource-based activities into sector EM 10, Fisheries, Hunting, and Trapping. In the new 72-sector 1958 ISP table, fisheries are included with forestry in Sector 10, Forestry and Fishery Products.

In the U.S. Standard Industrial Classification system, provision is made for recognizing fisheries as a separate activity with identifiable subactivities:

Major group	Group	Industry
09		Fisheries
	091	Fisheries
		0912 Finfish
		0913 Shellfish
		0914 Whale products
		0919 Miscellaneous marine products
	098	Fishery services
		0989 Fishery services

This present SIC classification is not necessarily an ideal one, but it does illustrate the method of setting up a detailed, comprehensive classification system relating the fishery industry in a consistent way with the rest of the economy. In the national income accounts, fisheries are included in a miscellaneous category, line 4, Agricultural services, forestry, and fishing.

A CENSUS OF FISHERY INDUSTRIES

The procedure that would probably be most satisfactory and efficient in the long run would be to establish a separate quinquennial census

of fisheries based upon the same statistical standards of accuracy and completeness observed in existing censuses. This procedure, although expensive, would have the advantage of drawing upon the statistical expertise of census experts and of utilizing the existing data collection facilities of the Federal Government. Although a comprehensive quinquennial census would provide exhaustive survey and bench mark information, continuing annual surveys, utilizing modern sampling procedures where feasible, would also be essential. All of these surveys should be linked in a consistent conceptual framework, so that all data from the census, annual surveys, and market reports from Federal and State sources are comparable. Coordination with current Bureau of Census statistical procedures and personnel might present challenges, but such coordination has been achieved in census work in other sectors, such as agriculture, manufacturing, and government.

STATISTICAL PROBLEMS

If this procedure is adopted, a number of special problems will have to be resolved. It would not be desirable or appropriate to suggest detailed solutions at this point, but the nature of the problems can be indicated.

The first major problem is the design of the statistical program. This problem requires decisions on technical issues concerning coverage, classification, degree of detail, and frequency of collection. Fortunately, on the problem of classification systems, the United Nations Food and Agriculture Organization has taken impressive first steps in developing a comprehensive system that can be accepted as a guide in setting up national classification systems and that if followed by all nations will assure international comparability of fishery statistics.² This is clearly significant in an industry with international dimensions and in which promising signs of international cooperation have appeared.

In addition to the technical problems of classification, the matter of statistical design requires decisions on fundamental questions of priority and objectives. In part, these questions center around the extent to which the data needs of the biologists coincide with those of the economists and the degree to which a single program can meet the needs of both

groups. Much of the information required by the biologists is of actual or potential interest to economists as the underlying basis for developing cost functions for the fishing industry. Economists, however, will require extensive data relating to cost, price, effort, earnings, efficiency, and landings, which probably will exceed the needs of the biologists. Because of the extensive area of overlapping data needs, there is clear need for intensive examination by experts of the possibilities for economies in data collection through a joint biological-economic statistics program. Related to this problem is the need for statistics on sport fisheries. A cooperative joint statistical program designed to meet the various needs of both biologists and economists in sport and commercial fisheries might yield better data for all groups at much lower total cost than separate, unrelated efforts. This problem merits intensive examination by experts from all the groups concerned.

A major obstacle to the improvement of data is the present division of responsibility between Federal and State agencies in fishery statistics procedures. If fishery statistics are to be improved to the degree necessary to support productive economic research, it is inevitable that the Federal Government must play a much more commanding role. Significant opportunities exist for Federal sponsorship of improvements in accuracy, timeliness, consistency, and comprehensiveness of data collection in the field of fisheries.

In order to deal effectively with the wide range of technical, procedural, and jurisdictional problems, an essential first step is a series of conferences to explore broadly the interests of all groups concerned. These would include economists, survey statisticians, sampling experts, and biologists, preferably those concerned with sport as well as commercial fisheries. Both Federal and State interests should be considered. After fundamental policy questions of objectives, level of overall effort, and areas of coverage and priority have been answered, intensive work by committees of specialists will be necessary to advise on matters of statistical design and procedure.

COLLECTION AND TREATMENT OF STATISTICAL DATA

After decisions have been made upon the type of statistical data required for economic analysis, statistical programs must be designed to implement their collection and treatment. Significant opportunities exist for improvement of present techniques.

²United Nations, Food and Agriculture Organization, Reports and Papers of the Expert Meeting on Fishery Statistics in the North Atlantic Area, Edinburgh, Scotland, September 22-30, 1959, especially Standard International Fishery Classification for Statistical Purposes, Supplementary Working Paper SP/5.

It is necessary, first, to spell out the differences among the various methods of data gathering. Essentially there are three techniques: (1) A complete census--in this method an attempt is made to count the total populations; (2) random sample (using the term random broadly to include those methods of sampling such as stratified sampling in which each member of the population may not have an equal chance of being counted)--a method that relies upon probability techniques to estimate the total population from a counting of less than the total population; and (3) nonrandom sample--a method in which the counter uses neither probability techniques nor a full enumeration in order to estimate the total population.

It is obvious that given the same level of competency for all data gatherers, a complete enumeration will provide data with the lowest margin of error. In general, however, for large populations such a census will be extremely costly. Hence, in the usual situation in which funds are limited, some method of sampling will be used to make estimates of the total population. Both methods of sampling discussed above may at any given time be appropriate. Nonrandom samples, for example, may be useful in the following situation. Assume that there are thirty tuna canneries in an area but that three of them produce 90 to 95 percent of the total output. In such a case the data collector may feel justified in concentrating upon the production of the three major factories and simply extrapolating for the remainder. In a situation in which the total population is not so conveniently concentrated, however, a random sample properly designed will give much more reliable results than a

nonrandom sample. Only with random sampling can the enumerator state statistically his confidence in his estimate of the total population. In general, therefore, we recommend the use of random sampling techniques.

The combination of a periodic census with full bench mark data, and indices based upon sampling for intervening years would meet most statistical needs. The important point is that where technical competence is combined with modern survey and data processing methods, statisticians can select from a full range of techniques those most appropriate to each problem.

Recruiting an expert chief statistician and staff and establishing a scientific data collection program in fisheries will require a large budget. This, however, is an essential measure, and insistence upon highest professional qualifications, especially for the head of the office, will ensure that the funds spent will yield maximum results.

Fortunately, much of the pioneering conceptual work on fishery statistics has been undertaken and is being refined in the continuing international conferences sponsored by the United Nations Food and Agriculture Organization. Evidence of growing world need for improved statistical data is accumulating in the reports and proceedings of national and international conferences. It is well within the capabilities of the United States to build upon these existing achievements and to take a constructive leadership role in national and international development of fishery statistics for economic research.

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