
III. Research on the fisheries

In its fifth edition, *Our Living Oceans* (NMFS, 1999) reported (from 1995-97 data) that of 160 U.S. Exclusive Economic Zone (EEZ) fisheries whose biological status could be assessed, 34% were classified as overutilized and 47% were fully utilized. Nationwide an additional 43 fishery stocks were characterized as having “unknown” status. New management measures, based on the Sustainable Fisheries Act (Public Law 104-297), have been implemented to halt the decline in stock levels in many of these fisheries. Causes typically cited for the declines include overfishing, deteriorating environmental conditions, loss of habitat, and changing oceanographic conditions.

III.A. Social and economic research

Social and economic information has become increasingly important in addressing fishery conservation and management issues. Federal law, Executive Orders, and NMFS policy require social and economic assessments of proposed regulatory or policy changes. The U.S. fishing industry, however, is quite diverse. Competition within and between consumptive users of living marine resources, such as commercial and recreational fishers, and non-consumptive users, who value the existence of living marine resources, greatly complicates the resource allocation decisions fishery managers face. Significant diversity exists between firms within the commercial fishery, and can be seen by the variation in the sizes and types of vessels between fisheries as well as between geographic areas. In addition, oftentimes no clear distinction in an actual fishery exists between commercial fishing firms and individual recreational fishers. Instead, a continuum of activities separate two extreme forms of fisheries exploitation including recreational fishers who sell their catch, headboat and charterboat operations, meat fishers, and catch-and-release fishers. Equally important are individuals who value knowing a particular fish species exists or value the existence of species dependent on a fish stock or stocks; e.g., whales, Steller sea lions, and marine turtles. One consequence of the size and diversity of the users of living marine resources is that the goal of managing U.S. fisheries to maximize the present value of net benefits to the nation is difficult to achieve.

The application of this broad-based policy to individual fisheries is difficult because each fishery has unique biological, economic, and sociological characteristics that require different types of regulatory approaches. For example, vessel sizes, gear types, crew sizes, and processing, marketing, and distributional arrangements vary significantly among fisheries and geographic areas. Educational levels, household dependence on fishing, preferred target species, and fishing patterns differ across fisheries and fishing communities. Levels and types of social, cultural, and economic dependence on fisheries vary by community and region.

Management decisions must reflect the values as well as needs of many different groups, including commercial and recreational fishers, subsistence fishing communities, non-consumptive users, Pacific Islanders, and Native American tribes

(many of which have treaties with the United States guaranteeing certain fishing rights).

Management by NMFS must be done within an economic framework that considers economic efficiency and provides equity or fairness to all resource users. This economic framework considers the transition time associated with a proposed regulation to minimize adverse economic impacts on fishing dependent communities, firms, and individuals. Adequate consideration of these factors requires that NMFS collect and analyze sufficient information about fishing communities, commercial and recreational fishing firms or individuals, and other consumptive and non-consumptive users of our living marine resources. Without sufficient data and analyses, we will have inadequate social and economic assessments and will be unable to determine if our management policies are achieving their intended objectives.

To produce quality assessments will require new data and models on a number of sectors, including the following:

- **The U.S. commercial harvesting sector:** Detailed social and economic analyses of the majority of U.S. fisheries will be conducted in conjunction with stock assessments to determine current social and economic costs and benefits in the harvest of living marine resources, and determine methods to maximize net benefits through innovative management alternatives.
- **The U.S. recreational harvesting sector:** The recreational and commercial fishing sectors are interdependent and have much in common. Policies aimed at regulating one group almost always impact the other and often affect other sectors of the marine fishing industry. NMFS will assess the net economic and social benefits from various allocation scenarios using estimates of anglers' consumer surplus, commercial fishers' producer surplus, and, theoretically, the consumer surplus for commercial catch as well.
- **The U.S. subsistence and traditional use fisheries:** NMFS will conduct data collection to support empirical research using both qualitative and quantitative techniques of fisheries economics, including alternative sources of protein and cultural and ritual uses of the harvested living marine resources, to model and assess social, cultural, and economic factors related to community dependence on the fishery.
- **The U.S. seafood processing/wholesale sector:** The processing and wholesale sectors are an integral part of the seafood industry. As in the harvesting sector, technological innovations advance the processing and distribution of seafood. NMFS will continue to collect annual data to determine the total number of processing and wholesaling plants, the number of people employed, and the total volume and value processed. NMFS will also increase data collection to support research on social and economic relationships among fishing firms, processors, and wholesalers to better understand the cultural and other institutional influences on the

structure of seafood markets (e.g., to develop econometric models of the processing sector to determine the effect of common property resources on capital investment).

- **The U.S. trade sector:** The U.S. plays a major role in the international seafood market, importing and exporting billions of dollars worth of seafood each year. The U.S. seafood trade market in part determines conditions in its domestic fisheries. NMFS will conduct an annual survey to determine our share of the international seafood trade market from which econometric analyses of supply and demand conditions in international markets can be developed to determine how trade agreements impact our Nation's competitiveness in this arena.
- **Retail demand for seafood:** Social and economic forces in the United States over time have influenced the current makeup of the seafood industry. Population, real per capita income, and the prices of substitutes are three factors that economic theory suggests should explain the aggregate demand for seafood. NMFS will conduct studies to gain a greater understanding of the responsiveness of consumers to changes in prices, quantities, and product quality, their willingness to substitute among various seafood products and other protein sources, their readiness to purchase imported products, and the responsiveness of fish and fishery product prices to changes in harvest levels.
- **Fishing communities:** NMFS will collect or acquire from other sources qualitative ethnographic, demographic, and economic data important for the social and economic profiling of fishing communities, including opportunity costs, social structure, and ethnohistorical data, and other data needed for the estimation of net benefits for use in input-output models and analyses of distributional effects of alternative management policies.
- **Economic impact analyses:** NMFS will collect economic data to meet the requirements of Executive Order 12866, the National Environmental Policy Act, regulatory flexibility analyses (RFAs), and fishery impact statements for the MSFCMA.
- **Social impact assessment (SIA):** NMFS will collect ethnographic, economic, and biological data related to fishing decision-making processes of captains; investment decision-making processes of owners; information flows within the fishery; and the differential effects of management policies on various subsets of the fishing industry such as absentee owners, captain-owners, and crew members, full-time and part-time fishers, fishers with different household compositions, large vessels and the undertonnage fleet, those who target single species or complexes, and those who fish different gears and species by season.
- **Overcapacity:** NMFS will assess current levels of capacity of U.S. commercial and recreational fishing fleets (i.e., charter/party vessels), deter-

mine optimal levels, and develop approaches to solving the problem of overcapacity.

- **Fisheries management:** NMFS will seek to integrate the existing biological, economic, and other social sciences information into a single bio-socio-economic framework from which information can be generated to aid fishery managers in making decisions about our living marine resources.

III.B. Seafood safety research

Intra and extramural seafood science research is aimed at continuing the integration of trophodynamic investigations relative to fishery resource health and disease threats, and differential trophic level risk evaluation effects resulting from such threats, be they to other fishery resources, marine mammals, or human consumers. Studies are focused on identifying and determining the characteristics of marine pathogens; improving methods to detect, forecast, and evaluate the ecological significance of harmful algal blooms; as well as developing and applying biological and chemical analytical methods to measure toxic contaminants to restore living marine resources and their habitats. Additionally, when needed, specific highly focused research is rapidly directed to address crisis situations dealing with animal and human health concerns, such as that needed to perform a Risk Assessment to wild shrimp stocks resulting from imported aquacultured shrimp products being infected with various shrimp viruses or re-evaluating the human exposure rate from mercury in seafoods. These research efforts are conducted primarily at the National Seafood Inspection Laboratory in Pascagoula, MS, as well as at the Northwest and Southeast Fisheries Science Centers.

III.C. Marine aquaculture

The importance of marine aquaculture (mariculture), both in the U.S. and throughout the world, is widely recognized. The production limits of wild stock are being reached and most of the increased global production of fisheries products for the last decade has come from aquaculture. In many countries aquaculture is progressing more rapidly than in the U.S., and one-third of the global supply of food fish now come from aquaculture (FAO, 2001). The annual U.S. trade deficit in edible fishery products is \$7 billion. In the U.S., aquaculture production (1999 statistics) has reached over 380,000 metric tons per year, with a value of \$987 million, but only about one-third of this is for marine species. In addition, an estimated 150,000 metric tons of commercially and recreationally caught fish with a value of about \$100 million originate from marine stock enhancement, primarily for Pacific salmon species. Although aquaculture accounts for 28% of the value of the total U.S. landings, it makes up only 9% of the landed volume. There is significant potential to increase U.S. marine aquaculture production. However, there are technical, environmental, and socio-economic impediments that need to be addressed by basic and applied research and through an examination of policies. NMFS has scientific expertise that can be applied to all of these



NMFS scientist studies marine biotoxins in the Utilization Research Division, NWFSC.



NMFS scientist uses image analysis to measure gut contents in larval fish. Larval feeding studies are an important component of aquaculture research.

issues. NMFS has had a long history in aquaculture research and development, stretching back more than 100 years, and has made major contributions to the progress of aquaculture both domestically and internationally. Also, NMFS has environmental stewardship responsibilities and the expertise to assess the appropriate role of mariculture and its potential impacts on wildstocks and habitat quality. Finally, NMFS has responsibilities for permitting aquaculture projects, and it is important to use good science as a basis for establishing a clear policy for permitting decisions.

In addition to food production, aquaculture can also play a role in enhancing wildstock populations, assisting in recovery plans for protected species, and can be used to produce non-food products such as ornamental fish, baitfish, and pharmaceuticals. Expanded mariculture production in the U.S. has the potential to reduce the pressure on wildstock harvest and help in the rebuilding efforts for those stocks.

To ensure that mariculture progresses in an environmentally sound manner, NMFS will concentrate its mariculture research activities in the following broad areas:

- Develop and evaluate commercially viable husbandry technologies for new candidate species.
- Conduct research on the effects of marine aquaculture on habitat and evaluate the risk to wild stocks from the introduction of cultured stocks.
- Establish, with the help of stakeholders, uniform requirements for aquaculture development in the U.S. EEZ under a Code of Conduct for its implementation.
- Develop effective enhancement strategies for aquatic species to help in the recovery of wild-stock fisheries and endangered species.
- Integrate aquaculture development with the management of wild stocks, particularly threatened and endangered species.
- Develop environmentally safe protocols for disease prevention.
- Assess the effectiveness of aquaculture as an alternative employment source for fishers in over-exploited fisheries.
- Accelerate industrial implementation of aquaculture technologies through demonstration, training, and extension projects for producers, tribes, and community groups.
- Encourage coordination and collaboration of stakeholders to achieve regional and national goals by establishing frameworks for regional cooperation among the private and public sectors.
- Assist associations of producers to prepare best management practices for their respective industries with scientific analysis and assessment of risk.

IV. Information management research

Title IV (Fishery Monitoring and Research) Section 401 (Registration and Information Management) of the MSFCMA required the Secretary of Commerce to deliver a proposal to Congress that recommended an implementation strategy for the creation of a “...standardized fishing vessel registration and fisheries information system.” This report was completed and delivered to Congress in December 1998, and outlined an approach that integrated all fisheries information required under all applicable National Marine Fisheries Service (NMFS) statutory and regulatory requirements, including but not limited to MSFCMA, the Marine Mammal Protection Act, the Endangered Species Act, and the Atlantic Coastal Fisheries Cooperative Management Act (NMFS, 1998b). It also includes all data collected under state authority for those states willing to participate. This report was developed in consultation with the U.S. Coast Guard, the states, the regional FMCs, the interstate Marine Fisheries Commissions, other key governmental and non-governmental organizations, and interested stakeholders. Drafts of the proposal were published in the *Federal Register* for public comment.

The proposed fisheries information system included information from both commercial and recreational fisheries (the vessel registration component was recommended to apply to only commercial vessels). The current development of the fisheries information system is based on integrating data collection and data management systems required by NMFS, and linking them with existing state/Federal cooperative statistics programs around the country (i.e., the Atlantic Coast Cooperative Statistics Program (ACCSP); Gulf coast (GulfFIN); Pacific coast (Pacific RecFIN and PacFIN); Hawaii and Pacific islands (WestPacFin); and Alaska (AkFIN)). Linking regional systems will identify and satisfy mutual information needs for states and the Federal government. In addition, gaps in information needs not yet met by these programs will be identified through consultation with industry and policy makers. The proposal recommended the following:

- Standardization of vessel registration and information collection systems contents as required by SFA and other state and Federal enabling legislation, to include:

Establishing standardized units of measurement, nomenclature, and formats for the collection, submission and management of data;
establishing procedures for requiring commercial and recreational fishers and ex-vessel purchasers to participate in collection and reporting of fisheries information;

Inclusion of all species and all commercial fishing vessels (including charter fishing vessels) within the geographic areas of authority of the FMCs; and

Assessing the desirability or necessity of creating a vessel registration system for recreational fishing vessels (not including charter fishing vessels).

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- Integrating information collection programs under existing FMPs and integrating other state, tribal, and Federal fishery information systems to reduce/avoid duplication and minimize paperwork and other burdens on affected parties.
 - Improving stakeholder and industry participation in effectively implementing new, integrated systems.
 - Identifying costs and possible funding mechanisms and schedules associated with implementing the recommendations for the system.
 - Modifying several statutory impediments to enable implementation of the system.

Major Fishery Research Goals and Objectives

All Federal agencies operate in an environment of increasing demands competing for limited resources. To meet this challenge, NMFS is increasing its partnering activities with other NOAA line offices and their programs (e.g., Sea Grant, National Undersea Research Program, Coastal Ocean Program), other Federal, state and local agencies, universities, Native American tribes, Pacific Islanders, the commercial and recreational fishing industries, environmental groups, and international organizations. NMFS is committed to strengthening existing relationships and building new ones.

The major fishery research goals and objectives are driven by the goals and objectives in the *NOAA Fisheries Strategic Plan* (FSP), published in May 1997. To facilitate cross reference, the corresponding FSP strategy or foundation number follows each fishery research objective found below.

GOAL 1: Provide scientifically sound information and data to support fishery conservation and management. (Ongoing)

Objective 1.1: Periodically assess stocks to ascertain whether changes in their status due to natural or human-related causes have occurred. These stock assessments require adequate fishery monitoring and resource surveys. (FSP Strategy 1.1.1)

Objective 1.2: Use stock assessments to predict future trends in stock status. Forecasts will take into account projected biological productivity, climatic information, economic markets, and other social forces that will affect levels of fishing effort. (FSP Strategy 1.1.2)

Objective 1.3: Determine and reduce the level of uncertainty associated with stock assessments through improved data collection and advanced analytical techniques. (FSP Strategy 1.2.1)

Objective 1.4: Use stock assessment workshops, peer reviews, and other fora to ensure that our information and advice are developed through an open and collaborative process. (FSP Strategy 1.2.2)

Objective 1.5: Communicate our scientific information and advice, along with the associated uncertainties, to the Councils, other management authorities, and the public. (FSP Strategy 1.1.3)

Objective 1.6: Collaborate with the Councils and other management authorities to explore and develop fishery management regimes and alternative governance systems that will effectively control exploitation and promote sustainability. (FSP Strategy 1.1.4)

Objective 1.7: Provide guidelines to assist the Councils in assessing and specifying Maximum Sustainable Yield (MSY) for managed fisheries. (FSP Strategy 1.1.5)

Objective 1.8: Work with the Councils to develop objective and measurable criteria for each managed stock to determine if the stock is overfished or approaching an overfished condition. (FSP Strategy 2.1.1)

Objective 1.9: For each stock which is overfished or approaching an overfished condition, we will develop, in collaboration with the Councils, measures to eliminate or prevent the overfishing. (FSP Strategy 2.1.2)

Objective 1.10: Conduct additional research to provide needed information to refine initial EFH designations and to help the Councils minimize the adverse effects of fishing on EFH, as mandated by the SFA. (FSP Strategy 2.3.1)

Objective 1.11: Establish an inventory of living marine resource habitats (tied to *Our Living Oceans* series) and implement measures to monitor the trends in habitat availability. (FSP Strategy 7.3.3)

Objective 1.12: Support recommendations provided by the NRC (NRC, 1999a) and the Report to Congress (EPAP, 1999) by establishing criteria to define and delineate marine, estuarine, and riverine ecosystems for management purposes, and identify indicators for assessing the status and detecting changes in the health of such ecosystems. (FSP Strategy 7.3.2)

Objective 1.13: Define the key aspects of vital habitat functions and increase our understanding of how they affect marine and anadromous species and how they are affected by human activities. This will involve the development of new methods of evaluating the quality and productivity of restored habitats, as well as improved restoration and creation technologies, including contaminant remediation, to ensure that created habitats are beneficial to fish populations. (FSP Strategy 7.3.1)

Objective 1.14: Incorporate assessments or indices of climate variability into stock assessments.

Objective 1.15: Monitor climate change on inter-annual, decadal, and centennial scales and its impact on currently sustainable fisheries.

GOAL 2: Through conservation engineering research contribute to efforts to reduce bycatch and adverse effects on EFH, promote efficient harvest of target species, and to improve the data from fishery surveys. (Ongoing)

Objective 2.1: Identify and assess the magnitude of incidental takes of protected marine species. (FSP Strategy 6.1.1)

Objective 2.2: Establish sustainable levels of takes for all protected marine species and continue to improve the estimates of these levels through ecologically sound research. (FSP Strategy 6.1.2)

Objective 2.3: Work through domestic and international cooperative relationships with industry and environmental groups, including take reduction teams, special task forces, and other needed scientific collaborations. (FSP Strategy 6.1.3)

Objective 2.4: Explore, develop, and implement new technologies and practices for reducing detrimental interactions. When such technologies could reduce detrimental effects both to and from protected species in other nations these technologies will be made available to those nations. (FSP Strategy 6.1.5)

Objective 2.5: Establish a standardized reporting methodology to assess the amount and type of bycatch occurring in each fishery covered by an FMP. (FSP Strategy 3.4.1)

Objective 2.6: Work in cooperation with the fishing industry and gear manufacturers to improve gear selectivity, design and field test new gear designs and modifications, and evaluate gear regulations. (FSP Strategy 3.4.2)

GOAL 3: Through economic and ecological research on marine communities and ecosystems, provide scientific data and information to increase long-term economic and social benefits to the Nation from living marine resources. (FY 2003)

Objective 3.1: Collect data and develop integrated bio-socio-economic models to measure net benefits to the Nation from living marine resources. (FSP Strategy 3.1.1)

Objective 3.2: Assist the Councils in reviewing optimum yield (OY) levels for consistency with economic theory and with the revised definition in the Sustainable Fisheries Act. (FSP Strategy 3.2.1)

Objective 3.3: Develop an integrated multi-disciplinary scientific framework to collect sufficient economic, biological, and social data to support recommendations made by the NRC on developing a national policy for individual fishing quota programs (NRC, 1999b). (FSP Strategy 3.3.3)

Objective 3.4: Study new candidate species for culture through their complete life cycle to determine which are economically and biologically suitable for commercial culture or wild stock enhancement. (FSP Strategy 4.1.1)

Objective 3.5: Determine the bio-economic requirements for the siting of aquaculture operations in the U.S. EEZ. (FSP Strategy 4.4.1)

Objective 3.6: Work with the aquaculture industry to develop, identify, evaluate, and transfer technologies that are appropriate to both economically efficient aquaculture production and environmental protection. (FSP Strategy 4.5.1)

Objective 3.7: Evaluate the impacts of climate change on biological, social, and economic conditions in fishing communities and commercial and recreational sectors.

GOAL 4: Improve the fishery information system. (FY 2003)

Objective 4.1: Develop implementation strategy and annual operational plans for creation of a national fisheries information system as described in the December 1998 Report to Congress (NMFS, 1998b). (FSP Strategy 3.3.2)

Objective 4.2: Develop implementation strategy and annual operational plans for executing the days-at-sea requirements identified in the NMFS Data Acquisition Plan (NMFS, 1998c).

GOAL 5: Improve the effectiveness of external partnerships with fishers, managers, scientists, conservationists, and other interested groups. (Ongoing)

Objective 5.1: Promote a cooperative network of partners in the coordination of fisheries research.

Objective 5.2: Develop infrastructure for long-term, continuous working relationships with partners to address fisheries research issues.

Objective 5.3: Sponsor symposia and conferences for partners to exchange information and identify major fisheries research initiatives.

Objective 5.4: Solicit partners' views on fisheries research needs.