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POTENTIAL ECONOMIC BENEFITS FROM  
IMPROVED MANAGEMENT AND UTILIZATION  
OF U.S. MARINE FISHERY RESOURCES

*SUMMARY ANALYSIS*

National Marine Fisheries Service  
Silver Spring, MD  
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**Preface**

A team of National Marine Fisheries Service economists was assembled in February, 1991 to assess existing and potential economic benefits yielded by the nation's marine fishery resources. A principal objective of the work was to develop estimates of the potential gains in net economic and other social values that would result from enhancement of the health, productivity and utilization of these resources. This report is a condensation of the material and analyses put together by the assessment team. Documents written by individual team members, from which this summary was drawn, are available in a separate volume.

The team consisted of NMFS staff from headquarters and field offices, and an invited consultant. The report was organized and drafted under the direction of Morton Miller (F/RE), chairman, with principal contributions from Steven Edwards (F/NEC), Steve Freese (F/NWR), Rebecca Baldwin (F/AKC) and Clem Bribitzer (F/PR). Other contributors included Richard Raulerson (F/SER), Sam Herrick (F/SWC), Peter Fricke (F/CM), William Emerson (F/TS) and Lee Anderson, (Univ. of Delaware, Consultant).

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# POTENTIAL ECONOMIC BENEFITS FROM IMPROVED MANAGEMENT AND UTILIZATION OF U.S. MARINE FISHERY RESOURCES

## Introduction

Though vast, U.S. marine fishery resources also are subject to overuse, waste and other conditions that deplete their existing value and thwart sound development. The focus of this report is on benefits that would result from public and private sector effort to eliminate the waste and create an environment that would permit full realization of potential values. The analysis is divided into four categories that relate benefits to activities that lead to improvements in fisheries management, more effective protection of the wetlands that nurture fishery resources and better protection of the public's interest in the safety and quality of the nation's supply of seafood. In order of their appearance in the report, the categories are as follows: (1) Fishery Management and Assessment; (2) Protected Species Management; (3) Fishery Habitat Protection; and, (4) Seafood Safety and Quality.

Under Fishery Assessment and Management (FAME), the report discusses the potential net economic value of commercial and recreational marine fisheries--or what might be considered optimum yield if the nation sought to maximize economic efficiency from its use of fish resources. It was reasoned that the goal of economic efficiency would add considerably to the nation's GNP (including the profitability of the commercial sectors of the U.S. fishing industry), provide consumers with greater quantities of fish and shellfish at lower prices, and curb imports that contribute to the nation's merchandise trade deficit. A more general, or qualitative, approach was taken in the assessment of potential benefits in the other categories, for which available information was deficient for purposes of numerical benefit estimates.

## (1) Fishery Assessment and Management

### Status of Fishery Resources

Various sources agree that the majority of fishery stocks under federal management are either fully exploited, or are being adversely affected by too much exploitation. A report commissioned by the NOAA administrator in the mid-1980s, for example, identified 15 management units, or species or groups of species covered by a fishery management plan (FMP), which were being overfished by domestic fleets. The term "overfished" was defined as a level of fishing mortality which prevents recovery to maximum biological yield or net economic value. Overfishing, according to the report, was most prominent in fisheries in New England and in the Gulf of

Mexico. In addition, the report designated various fisheries as "overcapitalized," a term that describes a condition where more capital is used in the harvesting process than necessary to harvest the available stock.

A more recent report, issued in 1990 by the National Fish and Wildlife Federation (NFWF), pointed out certain ominous trends in U.S. fisheries. The study reported that 50 percent of fishery stocks under Federal management were declining and that overfished stocks could require 5-20 years to recover. Taken together, the report's list of overfished or fully exploited and decreasing species/stocks comprised roughly one-third of total U.S. harvests and of gross harvest revenues in 1989.

The combined effects of overfishing, declining stock abundance and overcapitalization has had a devastating effect on the economic health of the U.S. commercial fishing industry. Economic studies have shown that after a spurt of good fortune following implementation of the Magnuson Act, commercial fishing in many of the major fisheries has experienced a lengthy downturn in productivity and profitability. Early profits, it is obvious, lead to expansion of commercial fleets, dissipation of profits and overfishing.

#### Economic Activity Associated with U.S. Commercial Fisheries

U.S. commercial fisheries make a significant contribution to the nation's economy. In 1989, commercial marine fishing and related enterprises contributed an estimated \$17 billion to the country's gross national product. About \$2 billion was attributable to commercial fish harvesting; \$4.2 billion was value added by the processing and wholesale distribution sectors; \$1.8 billion was in the retail store trade; and, about \$9 billion was contributed by retail trade in the food service industry.

The U.S. marine commercial harvest in 1989 totaled 10.7 billion pounds of fish and shellfish (4.8 million metric tons) and brought \$3.6 billion in exvessel sales, including the proceeds of joint venture operations with foreign vessels. Sales of processed fishery products the same year were worth \$6.9 billion and retail sales, for domestic and imported fishery products, reached \$28.3 billion. (Table A).

The harvesting sector of marine commercial fisheries employs about 274,000 crewmen for 93 thousand fishing craft. There are approximately 4,600 processing plants and wholesale establishments with a combined employment total of about 90,000. Taking into

account all the economic activity generated by the production and distribution of seafood, the domestic sector generates an estimated 1.5 million person-years of employment.

Much of the industry is characterized by relatively small-scale enterprises. About three-fourths of these craft are undocumented small craft of less than five net tons that carry one or two person crews as a rule. One fourth of the total, about 23,000, are larger, documented vessels that exceed five net tons and measure in overall length from about 25-30 feet to more than 300 feet. The range includes vessels that carry two or three crewmen to large factory trawlers that employ more than 100 persons as crew and processing workers. Processing/wholesale plants employ an average of about 20 persons per establishment.

The commercial fishing industry is dispersed throughout U.S. coastal areas. The heaviest concentration, in terms of landings, is in Alaska which accounted for 38 percent of the total value of U.S. domestic landings in 1989. The Gulf of Mexico area ranked second with 20 percent of the total, followed in order by New England, 16 percent; Pacific coast, 10 percent; South Atlantic and Chesapeake, each with about 5 percent; Middle Atlantic, 4 percent; and, Hawaii and Great Lakes combined, about 2 percent.

The U. S. carries out a large volume of foreign trade in fisheries products, although imports heavily outweigh exports. In 1989, imports of edible and nonedible fishery products were a record \$9.9 billion, while total exports were \$4.7 billion. The U.S. deficit in the trade of seafood is persistent. There is not a single year, at least in the post World War II era, in which a surplus was registered. The gap, in relative terms, has narrowed, however. Whereas up through the 1970s imports were seven to eight times greater than exports, recent ratios have favored imports by a two-to-one margin.

Demand for seafood in the United States rose steadily throughout the 1980s. By 1989, per capita consumption had climbed to 15.9 pounds (edible weight) of fish and shellfish, up from 12.8 pounds at the start of the decade, and consumer expenditures for seafood rose above \$28 billion. Imports have figured prominently in the U.S. market, accounting for between 49 percent and 64 percent of market supplies during the 1980s. Although dependence on imports is slowly declining, they are an essential factor in meeting demand in the U.S. market place. The increases in demand in the 1980s, for example, required more than a 50 percent increase in fishery product supplies, or 4.3 billion pounds of raw product calculated on a round weight basis. Domestic landings contributed 2.6 billion pounds, or 60 percent of the increase, and imports accounted for 1.7 billion pounds, or the remaining 40 percent.

Major factors that contributed to increased demand for seafood

in the 1980s included population gains (up 9 percent), rising "real" incomes (up 19 percent per capita) and growing interest among consumers in the health aspects of including a larger proportion of seafood in their diets. If these trends continue at the same pace, and their influence on consumption of seafood remains intact, per capita consumption can exceed 20 pounds by the year 2000, provided supplies are available. The required increment in supplies for domestic consumption will be in the order of five billion pounds. Domestic landings of edible fish and shellfish would have to increase more than 80 percent to meet the new level of demand. Or, to hold dependence on imports constant relative to total supplies, would take a 40 percent increase in edible landings.

Trends in the harvest of fish and shellfish from the U.S. Exclusive Economic Zone (EEZ) indicate that catches by U.S. vessels may have leveled. Production climbed to 11 billion pounds in 1987 and remained about the same in the succeeding two years. U.S. catches in the EEZ increased by nearly four billion pounds in the 1980s, but almost the entire gain represents replacement of foreign catches in the zone. Foreign catches in the EEZ have been reduced to near zero.

Assuming demand for seafood in the U.S. continues to rise, any failure of U.S. production to meet the new demand will result in higher prices paid by consumers and make the U.S. market for imported seafood even more attractive. Increases in the trade deficit in fisheries products would be a near certainty under these conditions. Also, higher prices would tend to attract an increase in fishing effort which, left unchecked through regulation or other means (e.g., the converting of common property fisheries to fisheries with private property rights), could lead to declines in harvesting productivity and overfishing of stocks that presently are fully exploited or already show indications of overexploitation. It is instructive that rising demand in the U.S. for seafood in the 1980s in conjunction with a successful policy goal to eliminate foreign fishing in the EEZ, continuance of open access for U.S. vessels, and advances in fishing technology, encouraged a large expansion in fishing effort and overcapitalization in U.S. fisheries.

#### Potential Gains in Net Economic Value from Commercial Fisheries

The Magnuson Act represented a profound change in U.S. policy with respect to marine fishery resources. Standards were devised and machinery put into place to bring under control vast resources that had been exploited in a near laissez-faire environment. What did not change, however, was adherence to a fundamental philosophy that U.S. marine fisheries are a common property resource open to all (domestic) users. As suggested by accepted theory and experience, open access to the nation's ocean fisheries encouraged

excess capacity (overcapitalization) and overfishing, lowered productivity, raised costs, and dissipated what are termed economic "rents," which represent the value of the resource itself (resource rents) and profits earned by fishing enterprises. Taken together, the elements of waste and inefficiency associated with open access fisheries comprise a package of foregone benefits to society. (Table B). Valuable renewable resources are depleted, economic profits disappear, capital and labor are being used that could be productive in other enterprises and thereby contribute more to the nation's GNP, and consumers are offered less product at higher prices.

Various published estimates indicate that unrealized or wasted potential in benefits from marine fisheries is formidable. For example, the results of individual studies of six major fisheries show potential increases in net economic value that add to roughly \$0.5 billion a year, or \$18 billion in capitalized, net present value. (Table C). These fisheries are responsible for about 25 percent of the total gross harvest revenues. They include New England groundfish fisheries with potential gains worth about \$4 billion; Atlantic sea scallops, \$2.7 billion; Gulf of Mexico shrimp, \$7.7 billion; West coast groundfish, \$0.3 billion; Gulf of Alaska sablefish, \$0.5 billion; and, Alaska halibut, \$2.5 billion. These are values, or benefits, that would be realized from reducing harvesting capacity and rebuilding fishery stocks to maximum sustainable levels. In the case of New England groundfish, for example, bio-economic models suggest that compared to the fishery in 1989, harvest could be increased by 50 percent through reduced effort and stock size increases. Also, catches in the Atlantic sea scallop fishery could be maintained at only 40 percent of the present level of effort; in the Gulf of Mexico, 54 percent fewer craft could catch the same quantities now being landed; a 40 percent reduction in the groundfish trawl fleet on the west coast would yield maximum gains in value; a 92 percent cutback in vessels fishing for Alaska sablefish would increase the value of the fishery by 80 percent; and, reducing production capacity in the Alaska halibut fishery to levels consistent with resource abundance could produce benefits for society with a net present value in the order of \$2.5 billion.

For the nation's fisheries, in total, prior published estimates place the potential increases in net economic value at \$20.3 billion (Christy, 1977) to \$38 billion (Keen, 1988) in perpetuity. The latter, more recent, estimate assumes that overall there is 33 percent excess fishing effort in U.S. commercial fisheries, which may be overly conservative. In light of the findings in other studies of individual major fisheries, excess fishing effort in the nation's fisheries as a whole is more likely in the order of 50 percent. Using the 50 percent figure as the basis of its calculations, the Economic Assessment Team accordingly estimated potential benefits (resource rents) from the nation's fish resources to be at least \$1.8 billion a year, or \$60 billion

in net present value over an infinite time horizon.

The estimate of generated benefits is conservative in that it reflects mostly cost savings achieved through reduction in fishing capacity and does not take into account the full impacts of probable increases in stock sizes and catches. Also not included are the cost savings and added efficiency in harvesting associated with the termination of the need to impose regulations that reduce efficiency, positive impacts on support industries and on consumers of fishery products. By the same token, there would be costs associated with the achievement of these benefits, which would put net benefits at a somewhat lower figure. The additional costs would be associated with research, enforcement, administration, and management.

Also, it needs to be emphasized that the estimates presume the adoption of appropriate forms of fisheries management that would eliminate overcapitalization and overfishing and allow free market forces to operate more efficiently. To be specific, any gain in the net economic value of fisheries is not likely unless the doctrine of common property open-access fisheries is replaced by a management protocol based on well-defined, enforceable and transferable property rights. Otherwise, the future net economic value of the U.S. fish resources is zero, if not negative. Although profits are still being made in some fisheries, such as the sablefish fishery in the Gulf of Alaska, the profits are being plowed into new and larger vessels and other fishing capital, the end result of which will be complete dissipation of resource rents and the diminution of other economic and social values. Quite predictably, the Alaska groundfish fisheries, and other fully or underexploited fisheries across the United States, are quickly following the same path taken by historically overfished fisheries, such as New England groundfish.

#### Economic Benefits Associated with Recreational Fisheries

Although small relative to the total commercial harvest of finfish and shellfish from U.S. waters, the recreational catch of many marine fish is nonetheless significant. The size of the finfish harvest by marine recreational fishermen has been less than 10% of the total harvest of finfish and shellfish from U.S. waters (469 million pounds in 1989), but for certain species or stocks recreational fishing is the major source of fishing mortality. In some cases, such as for billfishes and other gamefish, it is the only source.

Marine recreational fishing generates considerable economic activity, and much of this has been documented. The Sport Fishing Institute, for example, published information in 1987 showing that anglers spend about \$14 billion annually in association with fishing trips. According to NMFS statistics, in 1989, 60 million

fishing trips were taken by 17 million marine recreational anglers. (Table D).

Not enough is known about the impacts of changes in the size of the fish stock and the catch rate experienced by anglers, nor is the relationship between angler success and satisfaction well understood. Lacking fairly precise knowledge of these basic relationships, there is no reliable way to estimate the potential value of improvements that enhance recreational fishing. However, the popularity of recreational fishing, as evidenced by the 60 million fishing trips anglers take annually, suggests that only a small positive change in the value per trip would add to an impressive total gain.

What is known with regard to expenditures indicates that recreational fishing has economic value, but expenditures alone describe an impact of recreational fishing rather than a net value. They are considered a cost, i.e. they are the part of gross economic value that must be given up in order to achieve a greater benefit. The difference between the greater benefit--measured in terms of maximum willingness to pay--and expenditures measures the net economic value, or consumer surplus, of the total fishing experience. According to estimates that have been made of the net economic values of certain species of sport-caught fish, the range of values is wide. Bluefish in the mid-Atlantic, for example, has been valued at \$2-\$8 per fish kept; winter flounder, \$2-\$12; and weakfish, \$3-\$15. In the Gulf of Mexico, an increase of one fish per trip for red drum was estimated to be worth \$52. (Table E). These ranges are too wide and the coverage too piecemeal, to form the basis for a reliable estimate of the potential maximum net economic value that anglers could derive from catching fish. More case studies are needed, and they must be aggregated to the population of anglers. Nonetheless, the available studies provide an inkling of the potential magnitude of such benefits. A study of sportfishing for striped bass and salmon in central and northern California waters, for example, reported that for the group of salmon/striped bass anglers as a whole, the net economic value of a doubling of the catch rate was nearly \$10 million a year.

As to the future, once growth of the human population is factored in--particularly within the coastal zone--the prospect for even greater fishing effort by anglers within this decade promises to place growing pressure on fish stocks. Forecasts indicate a 15 to 20 percent growth in the number of marine anglers in the U.S. over the number in 1985. In some areas, according to the forecasts, the growth could exceed 30 percent.

#### Summary and Conclusions Re: Fisheries Assessment and Management

1. Although the commercial fishing industry contributes significantly to regional economies and to the nation's

supply of seafood, the bonanza in U.S. commercial fisheries expected from the Magnuson Act has not come to fruition. Conditions in some fisheries have in fact worsened, with overcapitalization, and overfishing contributing to declines in fishery stocks. Overall, there have been no significant gains in the total catches in the EEZ, although catches by U.S. vessels in some areas have increased as a result of the virtual elimination of foreign fishing in the U.S. zone.

2. The potential maximum net economic value of the nation's total finfish and shellfish resources is, at minimum, \$1.8 billion a year, or \$60 billion in net present value in perpetuity. The estimate represents benefits that are the result of cost savings in commercial fishing that would result from improvements in the management of fishery resources. Not included are the impacts of better management on the value of recreational fishing; nor has the value of potential increases in the size of fish stocks been included in the estimate.
3. Experience demonstrates that continuation of an open-access policy and a regulatory system that strives to achieve production targets at seemingly any cost--including strangling the efficiency of fishing enterprises--results in a zero, if not negative, expected value of net economic and other social benefits.
4. Putting in place the appropriate institutional arrangements for maximizing net benefits to the nation requires comprehensive biological and economic research of the dynamics of fish resources, fisheries and markets.

Table A.

**Economic Activity Associated with U.S. Commercial Fisheries**

Harvesting sector<sup>a</sup>

1. Catch
  - a. Landings (all ports): 9 billion pounds worth \$3.5 billion in 1989
  - b. Joint venture: 1.7 billion pounds worth \$0.1 billion in 1989
2. Craft: 23.3 thousand vessels five net tons and over and 69.6 thousand other craft
3. Employment: 273.7 thousand fishermen earning an estimated \$1.4 billion<sup>b</sup>

Seafood trade (excluding joint ventures)<sup>c</sup>

4. Exports
  - a. Edible: 1.4 billion pounds worth \$2.3 billion in 1989
  - b. Total: \$4.7 billion in 1989
5. Imports
  - a. Edible: 3.2 billion pounds worth \$5.5 billion in 1989
  - b. Total: \$9.6 billion in 1989
6. Duties on fishery imports: \$0.2 billion in 1989

Domestic seafood sector (excludes harvesting sector)<sup>d</sup>

7. Employment: 1.5 million person-years earning \$12.7 billion in 1986
8. Contribution to GNP (value-added): \$17.2 billion in 1989

Consumer demand<sup>e</sup>

9. Consumption: 3.9 billion pounds, or 15.9 pounds per capita in 1989
10. Expenditures: \$28.3 billion in 1989

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<sup>a</sup> Source: Fisheries of the United States 1989; Only about 0.5% of the landings and value is attributable to freshwater fisheries.

<sup>b</sup> Calculated as 45% of landings value based on 1986 data reported by the National Fisheries Education and Research Foundation, Inc.. (See footnote d for reference.)

<sup>c</sup> Source: Fisheries of the United States 1989

<sup>d</sup> Source: National Fisheries Education and Research Foundation, Inc. 1989. Economic Activity Associated with Fishery Products in the United States. Kearney Centaur Division, A.T. Kearney, Inc., Washington, D.C.

<sup>e</sup> Source: Fisheries of the United States 1989

Table B.

**Estimates of Potential Net Economic Values in Fisheries<sup>a</sup>**

Fishery	Category of Value	Annual Amount (\$M)	Capitalized Value (\$M) <sup>b</sup>
Pacific halibut in Canada (Cook 1990)	resource rents	\$5	\$170
U.S. Pacific ground-fish trawl (Huppert and Squires 1987)	resource rents	\$14	\$470
Western Australia rock lobster (Meany 1979)	resource rents	\$24	\$800
New England yellowtail flounder (Gates and Norton 1974)	resource rents	\$28	\$930
Pacific salmon (Crutchfield and Pontecorvo 1969)	resource rents	\$169	\$5630
Icelandic groundfish (Arnason 1986)	resource rents	\$185	\$6170
All North Atlantic fisheries (Crutchfield 1979)	resource rents	\$370c	\$12,360
All U.S. fisheries (Christy 1977)	resource rents	\$610	\$20,333
All U.S. fisheries (Keen 1988)	resource rents	\$1130	\$37,670
Southern bluefin tuna in Australia (Geen and Nayar 1988)	total rents in the harvesting sector	\$10	\$330
Maine lobster (Rothschild <u>et al.</u> 1977)	total rents in the harvesting sector	\$21	\$700
British Columbia salmon (Dupont 1990)	total rents in the harvesting sector	\$140	\$4670

Table B. (continued)

<sup>a</sup>This table summarizes the published literature that was readily available to us and, therefore, omits studies that are reported in the gray literature. Gilbert's (1988) analysis of potential resource rents in New Zealand's ITQ fisheries is not summarized here because he failed to report estimates of economic gains. The values reported by the authors were inflated to equivalent values in 1989.

<sup>b</sup>These capitalized values are net present values in perpetuity, calculated by dividing the annualized values by a social discount rate of 3%. (See text for choice of discount rate.)

<sup>c</sup>Crutchfield (1979) refers to dissipated resource rents of about \$100 million. This figure was calculated by a working group in about 1967. At the time of his paper, he stated that this figure was equivalent to \$2-3 billion, but details of the extrapolation were not given. Therefore, we chose to inflate the original estimate with the same methodology used for other studies.

Table C.

**Estimates of the Potential Net Economic Value of U.S.  
Commercial Fish Resources**

Fishery	Potential Maximum Resource Rent (\$M/yr)	Net Present Value (\$B)
Case Studies		
New England groundfish	120	4.0
Atlantic sea scallops	80	2.7
Gulf of Mexico shrimp	230	7.7
West coast groundfish	14 <sup>a</sup>	0.5
Gulf of Alaska sablefish	16 <sup>b</sup>	0.5
Alaska halibut	74	2.5
	Total 534	18
Entire U.S. fishing industry	1,800 <sup>c</sup>	60

<sup>a</sup>Includes intramarginal rents.

<sup>b</sup>Includes producer surplus in the processing industry.

<sup>c</sup>Calculated by multiplying total gross landings revenues in 1989 by 50%, or the presumed level of excess capacity in the combined commercial fisheries. See the text for our choice of this level of overcapacity.

Table D.

**Economic Activity Associated with U.S.  
Recreational Fisheries, 1985**

Anglers' behavior

1. Participation: 13.7<sup>a</sup> to 17<sup>b</sup> million anglers
2. Effort: 71<sup>b</sup> to 136<sup>a</sup> million trips, or 155.2<sup>a</sup> million days
3. Catch:<sup>b</sup> 425 million finfish weighing 717 million pounds
4. Expenditures:<sup>d</sup> \$12.1 billion on only fishing-related goods and services

Recreational fishing sector<sup>c</sup>

5. Employment: 156 thousand person-years earning \$2.3 billion<sup>e</sup>
6. Contribution to GNP (value-added): \$5.2 billion

Consumption of catch:<sup>b</sup> 3-4 pounds per angler

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<sup>a</sup>Source: FWS (1988)

<sup>b</sup>Source: NMFS (1986a)

<sup>c</sup>Source: SFI (1987)

<sup>d</sup>Source: SFI (1987). As should be done, expenditures on food, restaurants, and lodging were subtracted because these are unrelated to marine recreational fishing. Nevertheless, this figure overestimates expenditures on strictly marine and estuarine fishing because it includes purchases of capital, such as boats and trailers, that are also used in freshwater, and it includes purchases of tackle and bait were not divided between freshwater and saltwater uses.

<sup>e</sup>See adjustments and caveats expressed in footnote c.

Table E.

**Selected Estimates of the Net Economic Value  
(i.e., Consumer Surplus) of Sport-Caught Finfish**

Species/fishery	Commodity	Value <sup>a</sup>
Mid-Atlantic:		
a. bluefish	a. average value per fish kept	\$2-\$8
b. winter flounder	b. average value per fish kept	\$2-\$12
c. weakfish	c. average value per fish kept	\$3-\$15
Chesapeake Bay striped bass (Bockstael <u>et al.</u> 1987)	a. increase in catch rate by approximately one fish per trip over the season	\$10-\$16
North Carolina Outer Banks (Smith and Palmquist 1990)	25% increase in catch rate of all species per trip	\$71
South Atlantic king mackerel (Arndorfer and Bockstael 1986)	increase of one fish per trip over the entire season	\$280-\$510
Gulf of Mexico mackerel (Milon 1989)	a. 25% increase in catch rate per trip	\$2-\$11
	b. 50% increase in catch rate per trip	\$5-\$27
Gulf of Mexico red drum (Green 1989)	a. increase of one fish per trip	\$52
	b. increase of one fish per trip over the entire season	\$1535
Salmon or striped bass in San Francisco Bay area (Thomson and Huppert 1987)	a. double the catch rate over season	\$41
	b. prevent a 50% reduction in catch rate over the season	\$33

<sup>a</sup>Values are in nominal dollars as reported by the authors.

## (2) Protected Species Management

The National Marine Fisheries Service has a legislative mandate to conserve and protect marine mammals, turtles, and depleted species of salmon. (see The Marine Mammals Protection Act of 1972 (MMPA) and the Endangered Species Act of 1969 (ESA)). The economic value of activity with respect to protected mammals is especially difficult to ascertain because for the most part these values are generated outside the realm of the market place. Values associated with work in depleted salmon species, on the other hand, are less difficult to estimate, because salmon are currently fished and the impacts can be characterized by observable changes in market and recreational fisheries. The following comments are intended to provide a perspective into the magnitude of potential economic benefits that can be associated with NMFS activity in carrying out its responsibilities under MMPA and ESA.

### Basis for Value of Benefits

Marine mammals were originally exploited for commercial purposes, but today are primarily the source of what are termed non-market benefits. Methods to estimate non-market economic values categorize them as **current consumptive use value** (e.g. subsistence hunting, bycatch take in commercial fisheries), **non-consumptive use value** (e.g. whale watching), **option value** for future use, and **existence value**. The passage of legislation which severely restricts or forbids most commercial uses of marine mammals is a strong indication that our society values existence and non-consumptive use of marine mammals over the commercial or other consumptive use options.

Little work has been done on estimating the value of many of the nation's marine resources, and no comprehensive estimate exists for the value of marine mammal populations. Table 1 lists those marine mammal populations which are currently threatened, or endangered, or are likely to result in restrictions of commercial fisheries under the MMPA once the exemptions have expired in 1993. Most of the value estimates currently available are from oil spill assessments or from wildlife institutes where the results represent the cost of obtaining an animal and, as such, underestimates the full economic value of the animal. One study found that the annual aggregate benefit to protect marine mammals off California would be \$201.2 million (Hageman, 1985). However, from a strict interpretation of the existing legislation, an economic value approaching infinity could be inferred for marine mammal populations.

The apparent high value society places on marine mammals combined with a lack of information on basic population sizes and population dynamics, could lead to stringent measures of protection that impose other costs on society. Further research to enhance management of these endangered resources could contribute to

avoidance of unnecessary costs. Effective research could provide direct economic benefits by reducing conflicts between marine mammal populations and fisheries, and thus lowering the probability of future reductions or closures in fisheries. Table 2 lists those commercial fisheries, by region, that could be severely restricted or closed entirely to protect marine mammal resources. Gross revenues for those combined fisheries, excluding the value added by processing, exceeded \$1.18 billion, in 1989. While this number overstates the net potential revenue losses for commercial fishing, there would be additional adverse economic impacts imposed through the loss of the indirect and induced revenues generated in support industries.

### Concluding Observation

Because of the mandates of the ESA, the MMPA and the Fishery Conservation and Management Act of 1986, NMFS is faced with the dual responsibility of conserving one public good (the protected species) and managing the wise exploitation of another public resource (the fish and shellfish stocks). In order to ensure the optimal return to the public, NMFS must have accurate estimates of the populations and the trade-offs involved.

The estimates provided here represent potential losses by commercial fisheries if research on marine mammal populations and their interactions with commercial fisheries is lacking. Because one marine mammal species can interact with more than one commercial fishery and vice-versa, it is impossible at this time to attribute impacts on a less aggregated level. In addition to preventing unnecessary losses by commercial fisheries, research on marine mammals and protected species will enhance our ability to fulfill the ESA and MMPA, and increase non-consumptive use value. Because living marine resources are part of a complex ecosystem and subject to other management actions, the benefits described here could be reduced by adverse actions elsewhere, and similarly, these benefits can not be directly added to impacts from other enhancements.

Table F. Common names of marine mammal Species that are currently threatened, endangered, or who may require restriction of commercial fishing activity under the proposed regime to govern the taking of marine mammals, by region.

EAST COAST & GULF	WEST COAST	ALASKA
Beaked whale	California sea otters	Steller sea lions
Bottlenose dolphin	Harbor seals	Northern fur seals
Pilot whale	California sea lions	Harbor seal
Harbor porpoise		Spotted seal
Florida manatee		Pacific walrus
Striped dolphin		Harbor porpoise
False killer whale		Dall's porpoise
Right whale		Belukha whale
		Killer whale

Sources: Legislative draft Environmental Impact Statement for the proposed regime to govern the interactions between marine mammals and commercial fishing operations (in progress).  
 Personal communications: Lewis Quierolo, NMFS F/AKR and Richard Raulerson, NMFS F/SER, 3/91

Table G. Commercial fisheries that are likely to be closed or restricted, under the proposed regime, due to interactions with marine mammals.

EAST COAST & GULF <sup>1</sup>		WEST COAST	ALASKA
Gulf of Maine gillnet groundfish		Salmon gillnets	Trawl groundfish in BS/AI
Gulf of Mexico trap spiny lobster		Salmon pens in NW	Trawl groundfish in GOA
Mid-and South Atlantic purse-seine menhaden		Driftnet swordfish	Gillnet salmon
Gillnet and longline swordfish		Driftnet abalone	Longline groundfish
Gillnet and longline shark			Longline halibut
Longline tuna			
Trawl atlantic mackerel			
Gillnet king and Spanish mackerel			
Gillnet mullet			
Trawl shrimp			
Florida trap spiny lobster			

<sup>1</sup> All fisheries listed except for the purse-seine menhaden and trap spiny lobster refer to East Coast fisheries and do not include the Gulf of Mexico.

Sources: Legislative draft Environmental Impact Statement for the proposed regime to govern the interactions between marine mammals and commercial fishing operations (in progress).  
Personal communication. L. Quierolo and R. Raulerson, NMFS.

#### References and Sources:

Economic appendix to NPFMC 1990 SAFE. NPFMC. Anchorage, AK.

Hageman, R. 1985. Valuing marine mammal populations: benefit valuations in a multi-species ecosystem. NMFS, NOAA, Southwest Fisheries Center Admin. Rpt. LJ-85-22.

Legislative draft Environmental Impact Statement for the proposed regime to govern the interactions between marine mammals and commercial fishing

### **(3) Habitat Protection - Protection of the Coastal Environment**

There are approximately 11 million acres of coastal wetlands in the contiguous United States (excluding the Great Lakes), which provide habitat for the nurturing of important species of fish and shellfish and numerous other wildlife. In addition, wetlands contribute significantly to environmental and water quality, support agricultural production, enhance the quality of recreation and generate immeasurable aesthetic values. Although fisheries contribute only a part of the total value of wetlands, the part that is linked to fisheries is formidable. Marine fisheries that are dependent on coastal habitats, including wetlands, account for over half the value of U.S. commercial fish landings and a significant portion of the recreational catch. Thus, solely with respect to the affected marine fish populations, there are considerable economic benefits to society associated with the restoration, preservation and enhancement of coastal wetlands.

Estimates of the value of wetlands appear in studies that focus on specific geographic areas. One study of an area in Louisiana, for example, put the value of an acre of coastal wetland in Terrebonne Parish at \$590 with respect to commercial fishing, trapping, recreation, and storm wind protection. (see Farber, S. and Costanza, R. The Economic Value of Wetlands Systems. Louisiana State University. 1990). Another study estimates that the coastal wetlands in general are worth between \$3,154 and \$4,139 per acre for commercial and marine recreational fishing (see Miller, H.C. A First Approximation of Coastal Wetland Values. National Wildlife Federation. 1989; and another cites that an acre for commercial and recreational fishing purposes is worth \$2,276 for the West Coast of Florida and \$9,811 on the East Coast of Florida (see Bell, F.W. Application of Wetland Valuation Theory to Florida Fisheries. Florida State University. 1989).

The estimates are imprecise but they nonetheless imply large values and benefits associated with wetlands conservation. Losses in wetlands are occurring at an alarming rate. Despite aggressive programs, the United States is losing about 20,000 acres of coastal wetlands a year.

### **(4) Seafood Safety and Quality**

Federal and state agencies have a long history of involvement in efforts to safeguard and improve the safety and quality of seafood in domestic and world markets. Seafood has an important niche in U.S. food markets, but at the same time is vulnerable to physical and economic hazards that can threaten the health and welfare of consumers. Given the scope and size of the market, the potential for problems is large. Suppliers distribute, in live

weight equivalents, close to 10 billion pounds of seafood annually in the U.S. (about 4 billion edible weight pounds), which places this country fourth among the leading seafood-consuming nations of the world. (Those ahead of the U.S. in consumption are, in order, Japan, the Soviet Union and mainland China). Supplies, moreover, originate with diverse producers throughout the U.S. and in more than 100 foreign countries.

Hazards in the consumption of seafood can be byproducts of natural occurrences, poor hygiene and storage practices by producers and distributors, or economic fraud. Among the better known natural hazards are occurrences of ciguatera fish poisoning in snapper and other reef fishes, dangerous toxins in molluscan shellfish, and contamination from chemicals present in various species caught in polluted waters. Improper production practices have led to outbreaks of salmonellosis and botulism, among other threats to public health, and fraudulent practices such as mislabeling or other misrepresentations of the content of packages pose an economic as well as a potential health risk for consumers.

State and Federal agencies, and private industry as well, can be effective in reducing risks in the consumption of seafood. Fishery regulations can be tightened, environmental degradation reduced, product labeling improved, seafood inspection expanded, and consumer awareness on the care and handling of fish and seafood increased. Options to achieve these goals should be developed and the alternatives subjected to comparative benefit-cost analysis. The aim of the following discussion is to cite information needs and describe some of the variables pertinent to evaluations of activity designed to address issues in seafood safety and quality.

### **Risk Identification**

Incidence of illness: The Center for Disease Control, which is administered by the Public Health Service, monitors and reports on the incidence of seafood-related illness in the United States. Although the Center is considered to be the best source for this type of information, the reports underestimate the number of cases, by what may be a significant margin. The reason is that the data are dependent on consumer/physician voluntary participation and the extent to which state and local health departments collect and report such data. Whatever the true dimensions of the problem, it is confidently expected that the risk of illness will increase with the rising trend in the demand for seafood in the United States, and continuing degradation of the environment, unless, of course, effective measures are taken to prevent these mishaps.

Species at risk: The species of fish and shellfish associated with seafood-borne illness number less than 10 percent of the approximately 500 species available to the U.S. consumer that are normally associated with seafood-borne illnesses, but these include some of the more popular products. For example, raw molluscan

shellfish such as clams, oysters, mussels, and scallops, are potential sources of paralytic shellfish poisoning and other pathogens. Reef fish such as snapper and barracuda may have ciguatera, a naturally occurring poison which is responsible for about 40 percent all reported outbreaks of seafood borne-illness. Another 40 percent of all outbreaks of seafood-borne illness is traced to scombroid poisoning caused by the improper handling and storing of pelagic fish such as bluefish, tuna, mahi-mahi and mackerel. Potentially dangerous quantities of mercury have been found in swordfish, and PCBs in bluefish, as well as other organic and inorganic contaminants released to the environment from the use of herbicides and pesticides or by industrial leakages, have been found in a variety of species of fish and shellfish.

Production level risks: Problems occur at the harvest level but are not confined to the various species that make up commercial catches. Risk of contamination occurs in aquaculture production in which drugs to treat disease, or chemicals to treat parasites and maintain water quality, are regularly used. At risk, too, are large quantities of fish and shellfish caught and consumed by recreational and subsistence fishermen in all waters of the United States and its territories. Approximately one-fifth of the fish and shellfish eaten in the United States is derived from recreational fishing or subsistence fishing. Imported fish and shellfish products also can pose a significant product quality and safety risk. Imports account for about half the supplies of seafood in the U.S. market and in 1989 were shipped from 135 countries. The Food and Drug Administration (FDA) has the basic responsibility for the safety and wholesomeness of food imports. During 1989, 3,150 imported lots with a value of approximately \$223 million were detained by the FDA, and either destroyed or returned to the sender.

### **Economic Implications of Increased Risk**

When an outbreak of illness associated with the consumption of a particular seafood occurs, consumer demand is prone to decline, at least temporarily. Sales drop, despite a fall in market prices. Industry revenues shrink at all market levels and employment declines. The chain of adverse circumstance, however, affects much more than the product identified as the source of the outbreak. As a result of incomplete or inaccurate reporting, consumers may associate the problem with a range of seafood and broad sectors of the industry can suffer. For example, an outbreak of ciguatera in barracuda may cause a reduction in the demand for snapper, another species associated with ciguatera.

Additional social costs can accrue as a direct result of the outbreak, such as a loss in production due to employee illness and expenditures by government to determine and eliminate the cause of the outbreak.

There are few available studies that address issues in the economics of seafood safety and quality. In general, these studies focus on narrow or small markets. None attempt to estimate impacts on a national scale. All, however, indicate that significant revenue losses and other social costs occur with an outbreak. For example, the closure of oyster seed beds in New York state caused a reduction in sales of shucked clams. The New York State clam study cited a loss of 9 percent in industry revenues attributed to the oyster problem which caused illness for 443 persons. The social costs of the outbreak, according to the study was the equivalent of \$3.2 million, in 1989 dollars. (see Brown, J.W. and Folsum, W.D. Economic Impact of Hard Clam Associated Outbreaks of Gastroenteritis in New York State. NOAA Technical Memorandum NMFS-SEFC-121). In another case, an incidence of contaminated canned salmon in 1982 caused \$250 million in revenue losses for the industry, according to the Pacific Seafood Processors Association.

There is a total void with respect to studies that address losses associated with the consumption of recreational harvested fish or shellfish, or from economic fraud. Bluefish is one the more popular target recreational fish species and is also vulnerable to scombroid poisoning and contamination by PCBs. In terms of weight, bluefish account for more than one-fourth of the Atlantic Coast recreational fisheries catch. Safety problems in bluefish, therefore, put a considerable sector of the human population at risk. In addition, the considerable amount of economic activity generated by the recreational bluefish fishery could be seriously curtailed if fishing for the species declines. It has been estimated that the economic activity associated with marine recreational fishing for bluefish was somewhere between \$80 million and \$117 million in 1985.

Although no studies have been done of the consequences of economic fraud per se in the production and distribution of seafood, there is ample evidence that the opportunities for fraudulent practices are abundant. Anecdotal information points to cases of misbranding, incorrect weights and measures, using food additives to absorb water, and overbreeding or glazing. A relatively recent GAO study on seafood safety reported that in 1986 eight FDA district offices had 1,514 adverse samples (an adverse sample is one where the FDA found one or more problems), 15 percent of which were misrepresented products. NMFS's National Seafood Inspection Laboratory, in Pascagoula, MS, over a three-year period of performing inspections, estimated that 59 percent of the samples labeled cod, 57 percent of the samples labeled haddock, 56 percent of the samples labeled flounder or sole, and 51 percent of the product labeled red snapper were not as represented.

#### **Concluding Observation:**

Problems associated with seafood quality and safety have potentially serious economic and social consequences. Seafood has

assumed a growing role in the U.S. diet as consumers have become more aware of the beneficial health aspects of seafood consumption. Consumers purchased approximately four billion pounds (edible weight) of seafood in 1989, for which they paid in excess of \$28 billion. Per capita consumption of seafood purchased in commercial channels was a record 15.9 pounds per capita, and an additional quantity was consumed by way of recreational fish catches. There are no markets, per se, that register the value of recreational fish, but it is estimated that anglers spend in the order of \$14 billion annually for goods and services related to this recreational activity. Thus, both the status of public health, as well as important sources of national economic activity are exposed to risk if the quality and safety of seafood are not maintained. Although some of the problems may result from natural occurrences that are difficult, if not impossible, to control, others can be effectively addressed. Experience indicates that improvements in seafood quality and safety could avoid potentially large economic and other social losses. The challenge is to choose cost effective solutions that will optimize the potential benefits.