FINDINGS OF TWO RECENT U.S. REPORTS ON EXCESS HARVESTING CAPACITY IN FEDERALLY MANAGED COMMERCIAL FISHERIES

Joseph Terry, NOAA/NMFS Office of Science & Technology, joe.terry@noaa.gov
Minling Pan, NOAA/NMFS Pacific Islands Fisheries Science Center, Minling.Pan@noaa.gov

ABSTRACT

NOAA's National Marine Fisheries Service (NMFS) recently completed two reports on excess harvesting capacity, *National Assessment of Excess Harvesting Capacity in Federally Managed Commercial Fisheries* and *Excess Harvesting Capacity in U.S. Fisheries: A Report to Congress*. This paper presents the definitions of harvesting capacity, excess capacity, and overcapacity used in the two reports; summarizes the method used to estimate harvesting capacity; and presents some of the findings and policy recommendations in the two reports. The National Assessment was used in preparing the Report to Congress. The Report to Congress includes harvesting capacity assessments for 25 fisheries, 60 fleets, and 127 species groups; identifies and described the fisheries with the most severe examples of excess harvesting capacity; and discusses measures to reduce excess harvesting capacity.

Keywords: Fishing capacity; overcapacity: excess capacity: fisheries management; marine capture fisheries

INTRODUCTION

This report presents some of the findings and recommendations from two recently completed reports, *National Assessment of Excess Harvesting Capacity in Federally Managed Commercial Fisheries* and *Excess Harvesting Capacity in U.S. Fisheries: A Report to Congress*. The two reports are the products of a collaborative effort that included contributions by economists, other scientists, and other staff at all of the NMFS Fishery Science Centers and Regional Offices, the NMFS Offices of Science and Technology, Sustainable Fisheries, and International Affairs, the eight Regional Fishery Management Councils, and three universities. The authors of the National Assessment and the Report to Congress are listed in Table 1; however, many others contributed to the two reports.

The National Assessment was conducted in part to meet a commitment in the US National Plan of Action for the Management of Fishing Capacity, which was prepared in response to NMFS stewardship responsibilities, the FAO International Plan of Action for the Management of Fishing Capacity, and the national and international concerns that overcapacity, overfishing, and other often co-occurring undesirable outcomes of a common underlying management problem prevent the attainment of the objectives for sustainable fisheries. The report to Congress was required by the Magnuson-Stevens Fishery Conservation and Management Act (MSA) as amended in January 2007. The excess harvesting (fishing) capacity assessments in both reports are for 2004. The two reports benefitted from extensive efforts to define harvesting capacity, excess capacity, and overcapacity and to develop methods for estimating harvesting capacity. FAO and NMFS are among the organizations that contributed to those efforts over the last ten years.

Table 1: Authors of the National Assessment and Report to Congress

National Assessment
Joseph Terry, NMFS Office of Science and Technology John Walden, NMFS Northeast Fisheries Science Center James Kirkley, College of William and Mary, Virginia Institute of Marine Science Matteo Milazzo, NMFS Office of Sustainable Fisheries Steven Edwards, NMFS Northeast Fisheries Science Center Andrew Kitts, NMFS Northeast Fisheries Science Center Barbara Rountree, NMFS Northeast Fisheries Science Center Minling Pan, NMFS Pacific Islands Fisheries Science Center Carl Lian, NMFS Northwest Fisheries Science Center Juan Agar, NMFS Southeast Fisheries Science Center Graciela Garcia-Moliner, Caribbean Fishery Management Council Christopher Liese, NMFS Southeast Fisheries Science Center Sam Herrick, NMFS Southwest Fisheries Science Center Ron Felthoven, NMFS Alaska Fisheries Science Center Terry Hiatt, NMFS Alaska Fisheries Science Center George Silva, NMFS Office of Sustainable Fisheries
Report to Congress
Matteo Milazzo, NMFS Office of Sustainable Fisheries Joseph Terry, NMFS Office of Science and Technology John Walden, NMFS Northeast Fisheries Science Center

The assessments in the Report to Congress are for 25 U.S. commercial fisheries (24 federally managed commercial fisheries and 1 fishery managed by the Atlantic States Marine Fisheries Commission). With the exception of the Alaska fishery for Pacific halibut, each fishery is defined in terms of a fishery management plan (FMP). For each fishery, there were assessments by fleet and species group, where a species group can refer to one or more individual species. Fleets are defined by vessel or gear type and fishery; and species groups are determined by the individual species or species groups for which separate harvest quotas or harvest guidelines were established. For example, the species groups for which total allowable catches (TACs) existed in 2004 were used for the Alaska groundfish fisheries. The term "fleet" refers to a specific part of a fishery. Specifically, "fleets" refer to mutually exclusive sets of trips and not to mutually exclusive sets of fishing vessels (or boats). For example, in the case of the Atlantic highly migratory species (HMS) pelagic longline fleet (1) the fleet refers to the fishing trips for which Atlantic HMS fish were caught with pelagic longline gear; (2) the assessment of harvesting capacity for that fleet is for those trips and not for the other fishing activities of the vessels that made those trips; (3) some fishing vessels used multiple types of gear to catch HMS fish and therefore were in multiple HMS fleets; and (4) some of these vessels made landings without HMS fish and therefore were in other fisheries also. In addition, multiple species often were caught together. As a result, many fishing vessels contributed to the catch and therefore to the estimates of harvesting capacity, excess capacity, and overcapacity for multiple species groups, fleets, or fisheries. Because many fisheries included multiple fleets and species groups, the Report to Congress includes excess harvesting capacity assessments for 25 fisheries, 60 fleets, and 127 species groups.

The National assessment includes three additional fisheries. However, because there were substantial problems with the landings data and other data for the three U.S. Caribbean fisheries, the estimates for those fisheries were not included in the Report to Congress. An additional 17 federally managed commercial fisheries were excluded from both reports for one or more of the following reasons: (1) adequate data were not available for 2004; (2) neither a commercial quota nor its proxy was available for

2004; (3) given the biological characteristics of the species in a fishery or the characteristics of the management regime, assessing overcapacity in terms of a commercial quota did not make sense; (4) although the fishery was managed under an FMP, most of the management authority had been delegated to one or more states; and (5) the fishery did not exist/occur in 2004.

The National Assessment presents estimates of harvesting capacity, excess capacity, overcapacity, and overharvest by fishery and species group, as well as estimates of harvesting capacity and excess capacity by fleet. In additions, information on the overfishing and overfished status of the harvested stocks and evaluations of five generic approaches for reducing harvesting capacity are included in the Report to Congress, respectively, to put the excess harvesting capacity estimates in a broader fishery management context and to meet the MSA requirements for that report. A stock that is subject to overfishing has a fishing mortality (harvest) rate above the level that provides for the maximum sustainable yield; and a stock that is overfished has a biomass level below a biological threshold specified in the FMP that includes that stock. As with many modeling exercises, the lessons that were learned or reinforced in conducting the assessments and preparing the two reports probably are at least as valuable as the estimates that were produced. Some of those lessons are discussed in this paper. The views expressed below do not necessarily reflect those of NMFS.

TERMS AND CONCEPTS

NMFS organized the reports to examine several dimensions of excess harvesting capacity. Based on the definition of capacity used for the U.S. Census Bureau's Survey of Plant Capacity Utilization, which is used to estimate capacity for most U.S. industries, NMFS developed the following definition of harvesting (or fishing) capacity:

> **Harvesting capacity** is the maximum amount of fish that the fishing fleets could have reasonably expected to catch or land during the year under the normal and realistic operating conditions of each vessel, fully utilizing the machinery and equipment in place, and given the technology, the availability and skill of skippers and crew, the abundance of the stocks of fish, some or all fishery regulations, and other relevant constraints.

With this definition, harvesting capacity is a measure of the constrained ability of one or more specific vessels to catch or land fish. Therefore, the number, size, and horsepower of fishing vessels are some of the determinants of harvesting capacity, but they are not measures of harvesting capacity.

NMFS defines the term "excess harvesting capacity" to mean "too much" harvesting capacity and uses the following three measures or indicators of excess harvesting capacity:

- **Excess Capacity:** capacity in excess of actual harvests
- **Overcapacity:** capacity in excess of the quotas
- **Overharvest:** harvest in excess of the quotas

For each of these three measures of excess harvesting capacity, the capacity, actual harvests, and harvest quotas are for the commercial fisheries. Therefore, the total harvests and harvest quotas could be substantially greater than the commercial harvests and quotas for stocks that are also subject to recreational or subsistence fisheries. For a stock without a commercial harvest quota, the commercial target catch level or harvest guideline level was used as a proxy for the commercial harvest quota.

Although a long-term target catch level, such as the part of the maximum sustainable yield (MSY) or maximum economic yield (MEY) that would be available to the commercial fisheries, could have been

used, there are two reasons why the short-term target catch level—commercial quota (CQ) or its proxy—was used as the reference point to calculate overcapacity. First, it provides a measure of overcapacity that is more useful for some management purposes, particularly if there are substantial differences between the current stock conditions and those associated with the long-term target catch level, and if it will take many years to attain those conditions. Second, it would be very difficult to estimate harvesting capacity for the stock conditions associated with a long-term target catch level if it will take many years to attain those conditions or if they have not been observed for many years. If the stock conditions associated with a long-term target catch level are the current stock conditions, the short-term and long-term target catch levels are equal.

Harvesting capacity and excess capacity for a fleet can and probably should be assessed for all species combined, just as the capacity of a group of automobile plants is assessed for all automobiles combined and not by type of automobile. However, the same is not true for overcapacity, which is defined for each species group with a target catch level (e.g., the CQ or its proxy); where as noted above, a species group can refer to one or more individual species. This species group–specific capacity concept appears in the draft report by the NMFS National Task Force for Defining and Measuring Fishing Capacity, various FAO technical consultation reports and related reports, and the U.S. National Plan of Action for the Management of Fishing Capacity. Both the objective of preventing overfishing by species group and the belief that it is practical to prevent overfishing by controlling only the level of harvesting capacity have contributed to the popularity of this species group–specific concept.

This objective is reasonable but the belief is not well founded. There are several common fishery characteristics that make it impractical to prevent overfishing by reducing the level of harvesting capacity without also controlling the use of the harvesting capacity that exists. It is not practical because the required reduction in harvesting capacity would result in catch levels substantially below the target catch levels for most species and, therefore, the cost of preventing overfishing would be unnecessarily high in terms of the other management objectives. The characteristics include: (1) multispecies vessels that could readily and substantially change the species composition of their annual catch; (2) part-time vessels that could become full-time vessels; (3) latent vessels (i.e., those that could have participated in a fishery but did not) that could become active vessels; (4) vessels that are able to catch more than they are willing to catch; (5) fluctuations in the overfishing levels and harvesting capacity; (6) uncertainty concerning actual harvesting capacity; and (7) multiple conservation and management objectives.

To account for substantial differences in the sizes of fisheries, the findings are presented in terms of: (1) the rates of excess capacity, overcapacity, and overharvest by fishery and species group and (2) the rates of excess capacity by fleet. The three relative measures of excess harvesting capacity are defined and discussed below.

- **Excess capacity rate:** excess capacity as a percent of capacity, which is the percentage reduction in harvesting capacity that would have eliminated excess capacity in 2004 or the percent of harvesting capacity that was redundant with respect to the actual commercial harvest in 2004.
- **Overcapacity rate:** overcapacity as a percent of capacity, which is the percentage reduction in harvesting capacity that would have eliminated overcapacity in 2004 or the percent of harvesting capacity that was redundant with respect to the commercial quota in 2004.
- **Overharvest rate:** overharvest as a percent of the commercial harvest, which is the percentage reduction in commercial harvest that would have eliminated commercial fishery overharvest in 2004 or the percent of the commercial harvest that was redundant with respect to the commercial quota in 2004.

The overcapacity and overharvest rates, respectively, would be negative if the harvesting capacity estimate and the harvest were less than the commercial quota. In these cases, the overcapacity and

overharvest rates, respectively, indicate the percentage increases in harvesting capacity and harvest that would have been required to take the commercial quota or its proxy in 2004.

Each of these three measures of excess harvesting capacity provides different information. A high excess capacity rate indicates that the actual harvest in 2004 could have been taken by much smaller fleets and, therefore, at a lower cost. A smaller fleet could have consisted of fewer vessels, fishing vessels that on average had less harvesting capacity, or both. The cost reductions could have included lower operating costs and annual fixed costs as well as reduced costs associated with, for example, bycatch, impacts on habitat, unsafe fishing practices, and fishery management. A high excess capacity rate does not indicate that there was either overcapacity or overharvest. It should be noted that typically there will be some excess capacity in each fishery; therefore, it is important to focus on situations with *high* excess capacity and not just any excess capacity.

A high positive overcapacity rate means that the fleets had the ability to harvest much more than the 2004 commercial quota. Therefore, much smaller fleets could have taken the commercial quota. Although a high positive overcapacity rate commonly is accompanied by a high excess capacity rate, a high positive overcapacity rate can occur either without high (or even any) excess capacity or without overharvest. Smaller fleets could have taken the commercial quota and had the types of cost reductions mentioned in the previous paragraph. If the actual harvest was less than the commercial quota, the excess capacity rate was greater than the overcapacity rate.

A high positive overharvest rate indicates that the fleets had and used the ability to harvest much more than the commercial quota. This can occur only if there is overcapacity and the use of that capacity is not adequately controlled. If there was a high positive overharvest rate, much smaller fleets would have had the types of cost reductions mentioned above. Perhaps more importantly, smaller fleets, better control of the use of their harvesting capacity, or both would have prevented overharvest and the costs associated with overharvest. If the commercial quota was set sufficiently below the overfishing level, a high overharvest rate did not result in overfishing. In addition, in the case of a stock that is taken in multiple fisheries, there can be overfishing for that stock without overharvest in each fishery.

ANALYTICAL METHOD

NMFS used data envelopment analysis (DEA) to estimate harvesting capacity. DEA is a mathematical programming approach that has been used to estimate capacity for a variety of industries. With adequate data, DEA can be used to estimate: (1) the potential or technically efficient harvest level for a specific trip and vessel when variable and fixed inputs limit harvest; (2) the potential or capacity harvest level for a specific trip and vessel when only fixed inputs limit harvest; and (3) the level of variable input use required to take the capacity harvest level. Examples of fixed inputs are vessel length, engine horsepower, and gross tonnage. Examples of variable inputs are days at sea, number of sets, and crew size.

Trip-level catch and effort data and data on the physical characteristics of fishing vessels were used to estimate harvesting capacity by species groups, trip, and quarter (or other multi-month period). In addition, technically efficient catch and the capacity levels of the variable inputs were estimated by trip if trip-level variable input data (e.g., crew size, days at sea, and number of sets) were consistently available for a fishery. Such data were not available for the Alaska, Northwest, and Southwest fisheries. Typically, the capacity estimates by trip were summed over all trips to generate annual estimates for each vessel, and the annual estimates by vessel were then summed to generate the aggregate estimates of harvesting capacity presented in the two reports. The physical characteristics of fishing vessels (e.g., length, horsepower, gross tonnage, engine type, refrigeration capability, and hull type) and trip characteristics

(e.g., catch by species or species group, crew size, days at sea, number of sets, target species, fishing gear, area, and quarter) were used either as variables in the DEA models or to stratify trip-level data (e.g., group all observations pertaining to vessels fishing in a particular resource area, with similar gear, during a given season, and having the same basic physical characteristics, such as a wood hull and diesel engine).

Two estimates of harvesting capacity were provided for each fishery, fleet, and species group if data on variable inputs were available. As a matter of convenience, these two estimates are simply referred to as the "higher" and "lower" capacity estimates.

1. The higher estimate, which is the usual DEA measure of capacity output, provides an estimate of what the harvest would have been if all estimated technical inefficiency had been eliminated and if variable inputs had been fully utilized (i.e., used at the level required to attain capacity output). There was technical inefficiency if more could have been produced without increasing inputs.
2. The lower estimate provides an approximation of what the harvest would have been if the variable inputs had been fully utilized but if the estimated technical inefficiency had not been eliminated. Therefore, the lower estimate is based on the actual level of technical efficiency, not the estimated potential level of technical efficiency.

The lower capacity estimate (LCE) can be approximated by adding the difference between the higher capacity estimate (HCE) and the estimate of technically efficient output (TE) to actual catch (C)—that is, LCE = (HCE – TE) + C. Although a different algorithm was used to produce the lower capacity estimates, the two algorithms produce comparable estimates. For the purposes of estimating the efficient and capacity levels of output (catch) in the two reports, we used inverse output distance functions, radial expansions of outputs, and the framework of Färe (1984) and Färe et al. (1989) with variable returns to scale.

The lower estimate is provided to address the concern that the higher estimate may overstate the amount of fish a given fleet could have expected to harvest under the normal and realistic operating conditions of each vessel. The reason for this concern is that, with the higher estimate, all of the differences in harvest levels among trips of a specific type are attributed to technical inefficiency and differences in the levels of variable and fixed inputs when, in fact, some of the differences in harvest levels could have been due to unobserved factors, including differences in skill levels among skippers or crews, unobserved differences in fixed inputs, weather conditions, mechanical failures, luck (being at the right place at the right time to catch an unusually large amount of fish), temporal or spatial differences in fish stocks, catch measurement/reporting errors, and differences in normal and realistic operating conditions.

The potential for the higher estimate to overstate harvesting capacity, as defined above, is greater when trip-level data are used to estimate harvesting capacity and either much of the harvest is accounted for by trips in which only one species is harvested or the differences in catch per trip among vessels reflect differences in normal operating conditions. The higher and lower estimates are not intended to bracket the range of feasible harvesting capacity estimates; they are intended to allow for a more complete assessment of excess capacity and overcapacity by providing a range that accounts for different underlying assumptions about the vessels' ability to increase their harvest. In the absence of other potential sources of bias, actual harvesting capacity would tend to be somewhere between the higher and lower estimates because the underlying assumptions for the higher and lower estimates, respectively, are too lenient and too restrictive relative to the definition of harvesting capacity presented above. Larger but more speculative estimates of harvesting capacity could have been produced using either estimates of what capacity would have been in the absence of the management measures that constrained landings per trip, the number of trips, or both in 2004 or estimates of what capacity would have been if no stocks had been overfished in 2004.

For the fisheries without consistently available variable input data, it was not possible to provide estimates of the technically efficient harvest levels, estimates of the levels of variable input use required to harvest at the capacity level, and the lower estimates that were reported for most fisheries. This makes it more difficult to evaluate whether the harvesting capacity estimates for those fisheries are reasonable approximations of harvesting capacity as defined above. Because only the higher estimates are available for all fisheries, many of the comparisons among fisheries are based on just the higher estimates of harvesting capacity.

Both the lower and higher harvesting capacity estimates were included in the assessments for the fisheries in the Northeast, Southeast, and Pacific Islands Regions and for the Atlantic highly migratory species fisheries. For that group of fisheries, excluding the U.S. Caribbean, DEA models were used to generate harvesting capacity estimates for 59 species groups. The lower capacity estimates ranged from 52 percent of the higher capacity estimates for Southeast Atlantic Spanish mackerel to 99 percent or more for several species groups. The mean and median values of the lower estimates as a percent of the higher estimates for the 59 species groups were 84 percent and 87 percent, respectively. Variable input data and therefore the lower estimates of harvesting capacity were not available for the Alaska, Northwest, and Southwest Region fisheries.

Both reports include 11 basic terms of reference and constraints for the estimates that are intended to put the estimates in the appropriate context and to clarify the nature of the estimates, thereby increasing the probability that the estimates will be interpreted appropriately. Brief summaries are as follows:

1. The capacity assessments address commercial fisheries exclusively, and do not cover the for-hire charter and private angler recreational sectors.
2. Processing capacity was not estimated and was not used explicitly to estimate harvesting capacity. However, to the extent that processing capacity limited catch per trip, the number of trips, or both, it was implicitly accounted for in the estimates of harvesting capacity.
3. The estimates for a specific fishery are based exclusively on data for vessels that participated in that fishery in 2004. Therefore, these estimates do not address the latent capacity of vessels that could have fished in that fishery in 2004 but, for whatever reason, failed to do so.
4. The estimates are for harvesting capacity as defined in this report; they are not estimates of what the fishermen would have chosen to catch given the conditions and constraints they faced and their objectives in 2004.
5. Because the estimates all use 2004 data, they do not capture changes in resource, environmental, market, or regulatory conditions that took place after 2004.
6. The estimates are for the fish stock conditions in 2004. There was no attempt to estimate what excess harvesting capacity would have been or would be for alternative stock conditions, such as the fully recovered stock conditions for a stock that was overfished or recovering in 2004.
7. Many fishing vessels contributed to the catch and, therefore, to the estimates of harvesting capacity, excess capacity, and overcapacity for multiple species groups, fleets, or fisheries. The species-specific and fleet-specific estimates are of what catch would have been in 2004 if the catch for a specific type of trip had been greater than it actually was in 2004, but if neither the species composition of each trip nor the number of trips of each type had changed.
8. With the exception of the Pacific Coast and Alaska groundfish fisheries, the assessments are in terms of landings, not total catch, and therefore discards are not included in the estimates. If the commercial quotas were in terms of total catch and if at-sea discards accounted for a significant part of the total catch, overcapacity and overharvest could be underestimated substantially.

9. Estimates of overcapacity and overharvest require, by definition, a commercial quota or a functional equivalent. However, some federally managed fisheries lack such quotas for some commercially important species, and therefore overcapacity and overharvest could not be assessed for those species and aggregate overcapacity and overharvest rates could not be assessed for those fisheries.
10. With two principal exceptions, the estimates of harvesting capacity for each fishery are based on the actual number of trips each fishing vessel took in 2004 and not on either the number of trips that were taken in other years or the potential maximum number of trips each vessel could have taken in 2004 if the number of trips had not been limited by fishery management measures such as hard harvest quotas.
11. NMFS planned and conducted the assessment to minimize regional disparities and ensure as much comparability as possible; however, the many differences among the fisheries and sometimes within a single fishery with respect to industry structure, fleet makeup, management approaches, and the availability and quality of data inevitably decreased the comparability of the estimates, both among fisheries and within some fisheries.

MAJOR FINDINGS AND RECOMMENDATIONS

Quantitative Findings

Excess capacity and overcapacity rates vary considerably among regions and fisheries, and even among fleets and species groups within individual fisheries. There were high rates in some fisheries and components of those fisheries, but much lower rates in other fisheries and components of fisheries. The lower harvesting capacity estimates could be generated for 17 of the 25 fisheries, 41 of the 60 fleets, and for 59 of 127 species groups because variable input data were not available for the other 8 fisheries, 19 fleets, and 68 species groups. Overcapacity (based on the higher estimates of capacity) and overharvest could be calculated for 23 of the 25 fisheries and for 114 of 127 species groups because species group-specific and aggregate commercial quotas or their proxies were not available for the other 2 fisheries and 13 species groups. Finally, due to the absence of variable input data and species group-specific commercial quotas, overcapacity estimates based on the lower capacity estimates could be calculated for only 16 fisheries and 57 species groups. Overcapacity rates were not calculated by fleet because most commercial quotas were not fleet-specific.

1. The higher excess capacity rate ranged from 17 to 59 percent by fishery, from 0 to 71 percent by fleet, and from 0 to 79 percent by species group.
2. The higher excess capacity rate was at least 45 percent for 12 of 25 fisheries, 20 of 60 fleets, and 36 of 127 species groups in 2004.
3. The higher overcapacity rate exceeded 30 percent for 8 of 23 fisheries and 32 of 114 species groups in 2004.
4. Based on the higher capacity estimates, there was some overcapacity for 17 of 23 fisheries and for 61 of 114 species groups in 2004.
5. The lower excess capacity rate ranged from 1 to 51 percent by fishery, from 1 to 65 percent by fleet, and from 0 to 79 percent by species group.
6. The lower excess capacity rate was at least 45 percent for 1 of 17 fisheries, 4 of 41 fleets, and 13 of 59 species groups in 2004.
7. The lower overcapacity rate exceeded 30 percent for 3 of 16 fisheries and 13 of 57 species groups in 2004.

8. Based on the lower capacity estimates, there was some overcapacity for 6 of 16 fisheries and for 28 of 57 species groups in 2004.

Overharvest occurred for some but not all fisheries and species groups with high rates of overcapacity. For other fisheries and species groups with high rates of overcapacity, effective management of the use of harvesting capacity or other factors prevented overharvest, but often did not prevent all the other often co-occurring undesirable outcomes. The following summary is based only on the higher estimates of harvesting capacity for each fishery and species group.

1. 11 of the 25 fisheries had at least one species group that was overharvested in 2004.
2. The overcapacity rate exceeded 30 percent for 5 of those 11 fisheries and for 3 of the 14 fisheries without an overharvested species group.
3. There was overcapacity for 61 of 114 species groups but overharvest for only 20 species groups.
4. The overcapacity rate exceeded 30 percent for 13 of the 20 species groups that were overharvested and for 19 of the 94 species groups that were not overharvested.

Four Links Between Overcapacity and Overfishing

Four links between overcapacity and overfishing were identified. They are discussed below.

A common underlying management problem: Overcapacity and, when it occurs, overfishing are just two of the often co-occurring undesirable outcomes of a common management problem that prevents the attainment of the objectives of sustainable fisheries. The other undesirable outcomes include high levels of bycatch, adverse impacts on habitat, substandard vessel safety, lower product quality, poor economic performance, less viable fishing communities, non-compliance with regulations, and a fishery management regime that is unnecessarily complex, contentious, and costly.

The common underlying management problem is that, in the absence of well-defined and secure harvest privileges, the race for fish typically is used to allocate the allowable catch among competing fishermen, and the race for fish provides incentives for individual fishermen to increase harvesting capacity, to contribute to overfishing, and to take other actions that prevent the attainment of the objectives of sustainable fisheries. The severity of the undesirable results of this problem can be increased by inadequate information, monitoring, and enforcement, which, in part, can be due to the underlying problem. Basically, without well defined and secure harvest privileges, the interests of individual fishermen are not aligned with the objectives of sustainable fisheries and fishermen do not have sufficient incentives to support investments in the conservation and management of fishery resources.

Overcapacity can contribute to overfishing: Although overcapacity is not the root cause of overfishing, high levels of overcapacity can contribute to overfishing. In addition, overfishing for a specific stock cannot occur in the absence of overcapacity for that stock unless either recreational and subsistence fisheries contribute to overfishing for that stock or the commercial harvest quota exceeds the overfishing level. Often when there is overcapacity, it will be necessary to use management measures to restrict catch, and at any point in time, the greater the overcapacity, the harder it will be to design and enforce management measures that will prevent overfishing. There are three reasons for this: (1) more restrictive measures will be required; (2) fishermen will have a greater incentive to circumvent any measure that increases their costs or decreases their revenues; and (3) there will be a greater incentive to use political pressure to redefine (increase) the allowable catch levels.

In some fisheries with high rates of overcapacity in 2004, there was overfishing. However, in other fisheries with high rates of overcapacity, overfishing was prevented by effective management controls on the use of harvesting capacity. Specifically, 12 of the 25 fisheries in the Report to Congress had at least one stock that was subject to overfishing in 2004. The overcapacity rate exceeded 30 percent for 4 of the 12 fisheries with overfishing and for 4 of the 13 fisheries with no overfishing. Similar results with respect to overcapacity and overharvest were presented above.

Overfishing can contribute to overcapacity: The management response to overfishing often is (or should be) to reduce the harvest quota. When the harvest quota is reduced, overcapacity will increase unless harvesting capacity is reduced by at least the same amount.

Overfishing and overcapacity can have a common solution: Harvest privilege-based management programs (HPBMPs), for example, individual transferable quota (ITQ), community quota, and harvesting cooperative programs, have a strong track record for reducing overcapacity. This is principally because such programs address the common underlying management problem that can result in overcapacity, overfishing, and other undesirable outcomes. Therefore, such programs can assist in decreasing overcapacity, eliminating overfishing, and reducing the severity of the other undesirable outcomes listed above. This occurs in part because, with an effective HPBMP, fishermen generally will be more willing and able to accept and adapt to quota reductions or other management actions taken to rebuild stocks and prevent/end overfishing of target and non-target species.

Other Policy Findings and Recommendations

The following policy findings and recommendations are based on almost two decades of efforts by NMFS to better understand and effectively address the problems resulting from ineffective controls on the level and use of harvesting capacity.

NMFS recommends that the capacity estimates be used with caution. The excess capacity and overcapacity rates do not indicate if or by how much capacity should be reduced, how to reduce capacity, or the urgency for reducing it. These determinations generally will be more difficult for (1) multispecies fisheries, (2) rebuilding stocks, (3) stocks subject to sharp environmental fluctuations, (4) stocks with significant recreational catch, and (5) international stocks with significant foreign harvests. With an effective HPBMP in place, the need for such determinations will be substantially reduced, if not eliminated.

For a variety of reasons, the optimum level of harvesting capacity typically is not the level at which the excess capacity or overcapacity rate or both are equal to zero. Those reasons include (1) the multiple biological, ecological, economic, and social objectives of fisheries and ecosystem management (2) the multiple objective of individual fishermen; (3) fluctuating stock, regulatory, and market conditions; (4) the difficulty in changing the level of harvesting capacity each time those conditions change; and (5) fishing vessels that participate in multispecies fisheries and multiple fisheries. Because the optimum level is difficult, if not impossible, to determine, NMFS does not propose establishing quantitative capacity targets or ceilings.

Some excess capacity and overcapacity typically will remain even in well-managed fisheries. However, an effective HPBMP will eliminate the race for fish and move the level of harvesting capacity in the right direction. Thus, excess capacity and overcapacity may persist in HPBMP fisheries, but generally at appropriate or acceptable levels.

Buyback programs do not address the common underlying management problem and, therefore, at best can result in only temporary reductions in excess harvesting capacity, unless they are part of a larger capacity reduction program that either includes or leads to an HPBMP that eliminates the perverse incentives produced by the race for fish. In addition, the presence of latent capacity tends to increase the costs or decrease the effectiveness of buybacks. Therefore, NMFS does not view stand-alone buybacks as an effective measure to prevent or eliminate excess harvesting capacity.

Unless the rules to obtain and renew a permit, to upgrade a fishing vessel, and to transfer a permit to a replacement vessel are sufficiently restrictive and are made more restrictive over time, a license limitation program will not reduce capacity or capacity will tend to increase after any initial reduction. However, such a program can lead to a HPBMP that will address the underlying management problem.

Conventional harvest restrictions, which have been used to control both the level and use of harvesting capacity and to meet other management objectives, are often more effective in a management regime that includes an effective HPBMP.

The MSA and NMFS emphasize the need to focus on the most critical undesirable outcomes -- stocks that are subject to overfishing (i.e., actual harvest exceeds the overfishing level) or are overfished (i.e., in need of being rebuilt). The reason for this emphasis is that virtually all the objectives of sustainable fisheries depend on ending and preventing overfishing and rebuilding overfished stocks. NMFS recognizes that, except when other fisheries or incidental catch are responsible for the overfishing or when the commercial quota is too high, overfishing for the stocks taken by a federally managed commercial fishery cannot occur unless there is overcapacity in that fishery.

Fishery management would be improved by:

1. Recognizing that efforts to address the often co-occurring undesirable outcomes individually without addressing the common underlying management problem often have increased the severity of those outcomes and are likely to fail; and
2. Initiating or accelerating efforts to identify and implement feasible HPBMPs that reflect fishery-specific conditions, objectives, and fishery management capabilities and that will assist in ending/preventing overfishing, recovering overfished stocks within mandated schedules, controlling the level and use of harvesting capacity more effectively, and decreasing the severity of the other often co-occurring undesirable outcomes by addressing the common underlying management problem.

NMFS is doubtful that all capacity reduction programs should include a mandatory prohibition on the redeployment of vessels removed from one fishery to other fisheries. As a general comment, restrictive provisions of this nature require a careful assessment of all the public and private costs and benefits.

It is possible, but typically not practical, to prevent overfishing by controlling the level of harvesting capacity without also controlling the use of harvesting capacity.

Effective control of the level and use of harvesting capacity requires the authority, technical capability, resources, and political will to design, implement, and enforce effective management measures, where, success in meeting these requirements will principally depend on the incentives fishermen, fishery managers, and others involved in the fishery management process have to invest in the conservation and management of fishery resources.

CONCLUSIONS

The completion of the National Assessment and the Report to Congress, respectively, met an obligation included in the U.S. National Plan of Action for the Management of Fishing Capacity and met a new requirement of the MSA. The two reports contributed both to critical, ongoing and collaborative efforts to control the level and use of harvesting capacity more effectively in the U.S. and elsewhere, and to the goal of having a clear and consistent NMFS and U.S. message concerning the importance of those efforts, which involve NMFS, the Regional Fishery Management Councils, all participants in the Council/NMFS fishery management process, and our fishery management partners in the rest of the world.

The importance of addressing the common underlying management problem that results in various often co-occurring undesirable outcomes, including excess harvesting capacity, is highlighted in both reports. In addition to providing estimates of excess harvesting capacity by fishery, fleet, and species group, the National Assessment concludes that, as with many modeling exercises, the lessons that were learned or reemphasized in conducting the assessments and preparing the report probably are at least as valuable as the estimates that were produced.

The two reports indicate that the excess capacity, overcapacity, and overharvest rates vary considerably among regions and fisheries, among fisheries, and even among fleets and species groups within individual fisheries. High rates of excess capacity and overcapacity were accompanied by stocks that were subject to overfishing in 2004 in some but not all federally managed commercial fisheries. In other fisheries with high rates of excess capacity and overcapacity, effective management of the use of harvesting capacity or other factors prevented overfishing, but often did not prevent all the other often co-occurring undesirable outcomes.

REFERENCES

FAO. 1999. International Plan of Action on the Measurement of Fishing Capacity, Rome.

Färe, R. 1984. “On the Existence of Plant Capacity.” *International Economic Review*, 25 (1), pp. 209-213.

Färe, R., S. Grosskopf, and E. Kokkelenberg. 1989. "Measuring Plant Capacity, Utilization and Technical Change: A Nonparametric Approach." *International Economic Review* 30 (3), pp. 656-66.

NMFS. 2004. United States National Plan of Action for the Management of Fishing Capacity. Silver Spring, MD. 26p. http://reefshark.nmfs.noaa.gov/f/pds/publicsite/documents/procedures/01-113-01.pdf

NMFS. 2008. Excess Harvesting Capacity in U.S. Fisheries: A Report to Congress. Silver Spring, MD. 59p. http://www.nmfs.noaa.gov/msa2007/docs/042808_312_b_6_report.pdf

NMFS. 2008. National Assessment of Excess Harvesting Capacity in Federally Managed Commercial Fisheries. Silver Spring, MD. 444p. http://www.nmfs.noaa.gov/msa2007/docs/052208_nat_assess_cap_appx_c.pdf