Toward Improvement In Rebuilding Fisheries

Lessons from the United States

Carl Safina, Ph.D., and Tara Duffy
Blue Ocean Institute
School of Marine and Atmospheric Sciences
Stony Brook University, Stony Brook, N.Y., USA

THE PEW ENVIRONMENT GROUP

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ABOUT THE PEW ENVIRONMENT GROUP

The Pew Environment Group is the conservation arm of The Pew Charitable Trusts, a nongovernmental organization that applies a rigorous, analytical approach to improving public policy, informing the public and stimulating civic life. www.PewEnvironment.org

Cover photo: Jeff Rotman

Foreword

How the U.S. Experience Can Inform the Reform of the Common Fisheries Policy

This report seeks to describe the process and pitfalls through the experience of the United States in enacting and amending legislation to manage its fisheries resources. Why the U.S. experience? The American legislation, known as the Magnuson-Stevens Fishery Conservation and Management Act (MSA), sought to rebuild and then stabilise the country's fishery resources. This experience of devising legislation and negotiating the many stakeholder interests—in particular, the adoption of maximum sustainable yield (MSY) as a limit rather than a target—makes it a valuable example for the present reform of the European Union's Common Fisheries Policy (CFP).

The CFP is the European Union's instrument for managing fisheries and aquaculture within its exclusive economic zone and the conduct of its fleet fishing outside EU waters. After a considerable period of negotiation, the CFP came into effect in 1983.

In 2007, the European Court of Auditors released a special report on EU fisheries, scathing in its assessment of the CFP and serving as the impetus for a fundamental overhaul. The report recognised that the policy had not attained its target and had 'not delivered sustainable exploitation of fisheries resources'. It assessed that 'the fisheries sector is characterised by economic fragility resulting from overinvestment, rapidly rising costs and a shrinking resource base: This is reflected in poor profitability and steadily declining employment'.

In 2009, the European Commission launched a reform of the CFP. In its consultation paper, the Commission asserts that more than 80 percent of assessed fish stocks in EU waters are deemed overfished and 30 percent are outside safe biological limits. Unless the reform succeeds where previous ones failed, fish stocks will be further depleted, exacerbating the crises facing the fisheries sector, with potentially disastrous consequences for fishery dependent coastal communities in Europe and in developing countries, and for the marine environment. Some scientists have even predicted the global collapse of commercial fisheries by about 2050.

One of the principal factors contributing to overfishing has been the ready acquiescence of decision-makers to short-term interests by setting total allowable catches (TACs) at levels that lead to overfishing. In the EU, TACs are proposed by the European Commission and agreed to by EU fisheries ministers. In the last 10 years, ministers agreed on fishing limits, which were on average 48 percent higher than the scientific advice. As a result, many scientists fear that a larger number of EU fish stocks will not be able to reach the level of MSY by the internationally agreed 2015, even if fishing activities were to stop outright.

The MSA can provide useful lessons on how to manage fisheries more sustainably through more conservative targets as well as clearly defined triggers and time frames. While this might entail lower catches in the short-term, it provides greater environmental, economic and social benefits in the medium- to long-term.

The debate over this reform of the CFP needs to be informed by appropriate examples and expertise; the Pew Environment Group is committed to this and believes the U.S. experience with the MSA is of particular relevance to CFP reform, by illustrating what works and what doesn't.

Summary

In 1976, the U.S. president signed legislation claiming the area and living resources out to 200 nautical miles from the coast as the country's exclusive economic zone. The legislation, the Fishery Conservation and Management Act, was intended to end foreign fishing in those waters, rebuild and then stabilise fishery resources and expand U.S. fishing capacity. As a key to stabilisation, fishery management was based on the concept of maximum sustainable yield (MSY), which assumes that the goal is to catch the maximum number of each species that could be removed on an ongoing basis. Subsequent amendments introduced the concept of optimum yield, which allowed catches to exceed the MSY because of short-term social and economic rationales. Then, in a sweeping set of amendments titled the Sustainable Fisheries Act of 1996, optimum yield was redefined with the intent of using MSY as a limit, not a debatable target. Those amendments also, crucially, introduced quantified definitions of 'overfishing' and 'overfished', created a list of overfished species and required that overfished populations be rebuilt within 10 years (with certain exceptions, mainly for long-lived and large pelagic fishes). Unintended loopholes and regulatory misinterpretation and guidance compromised the intent of the 1996 amendments to end overfishing and use MSY as a limit. Additional amendments in 2006 sought to close those loopholes, requiring an end to overfishing and prompt rebuilding. Despite a history of partial success, the 1996 amendments helped stabilise and prompt the beginning of recovery of many U.S. fishery resources. MSY has conceptual weaknesses but is not responsible for the inadequacy of fishery management. Rather, the main problems have stemmed from failures of management agencies to implement limits based on MSY. In fact, implementing and enforcing fishing management measures that use MSY as a limit, and allowing fishery resources to rebuild to population levels that would support MSY, would be a vast improvement in the United States and elsewhere. Quantifying definitions, triggers and targets is essential to making fishery management work. Enforcement is another key.

Photo: Kelvin Aitken/marinethemes.com

SHRIMP TRAWLING ACCOUNTS FOR MORE THAN 25 PERCENT OF THE WORLD'S WASTED CATCH, INCLUDING TURTLES, SHARKS AND SEABIRDS.

Introduction

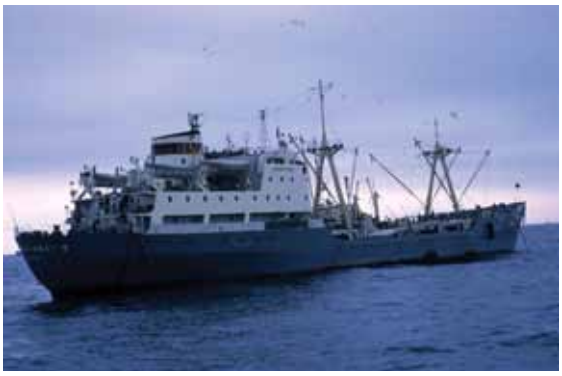

Photo: NOAA

FOREIGN TRAWLER SAILING OFF U.S. COAST, 1969.

Distant-water fishing in the 1960s and 1970s brought the fishing vessels of many countries to waters around the world. Depletion of fishery resources alarmed U.S. fishermen and lawmakers. Legislation was passed to remove non-U.S. vessels from the vicinity of the U.S. coast and its continental shelves, to boost U.S. fishing capacity and to rebuild depleted fishery resources, then conserve them. Rebuilding and conservation have not succeeded, but changes in the law brought those fundamental goals nearer. This paper describes the steps in U.S. fishery management since the enactment of federal fisheries legislation in the 1970s, what has and has not worked and why, and what is needed. Although the U.S. experience is not without its flaws, with this paper, the Pew Environment Group hopes to encourage exploration of these experiences as an aid to developing solutions applicable to the European Union and to reforming its Common Fisheries Policy.

Background: The Fishery Conservation And Management Act of 1976

In 1976, the United States enacted the Fishery Conservation and Management Act (FCMA) to:

- eliminate foreign fleets from U.S. waters,
- restore depleted populations of fish and other living marine resources exploited in fisheries,
- conserve and maintain viable populations of these resources,
- expand U.S. fishing ability.

(In later reauthorisations, the law was renamed the Magnuson Fishery Conservation and Management Act and then the Magnuson-Stevens Fishery Conservation and Management Act [Magnuson-Stevens Act].)

The FCMA was a direct response by the U.S. Congress to the enormous pressure foreign fishing fleets were putting on the living resources in nearshore waters, especially off the Atlantic coast.

The fishery management plan is, for most practical purposes, the legal fishery management instrument.

The act declared a U.S. exclusive economic zone extending three to 200 nautical miles from shore (waters within three miles are generally under the jurisdiction of coastal states). This eventually but successfully eliminated foreign fishing pressure. The measure also established eight regional fishery management councils. Their purpose is to bring together fishing interests, fishery scientists and managers to devise plans for conserving fish populations and regulating fishing activity. These fishery management plans set guidelines for managing a finfish or shellfish stock and serve as the basis for all recovery and restoration efforts. Fishery management plans are in a sense advisory; they must be approved by the federal government. In practice, however, the government approves virtually all of them. Once regulations for implementation are approved, the plans become legally binding and enforceable. Thus, the fishery management plan is, for most practical purposes, the legal fishery management instrument.

As soon as foreign fleets began withdrawing from waters within 200 nautical miles of its coasts, the United States invested heavily in building its fishing capacity. Unfortunately, this sharp increase in capacity (Safina 1994, Rosenberg *et al.* 2006) added significant pressure to already depleted living marine resources. This caused further sharp declines in commercially targeted populations of fishes and other wildlife (Safina 1994).

In the early 1990s, with many fisheries nearing commercial nonviability, managers and Congress recognised that little real progress had been made in stock restoration. Conservation nongovernmental organisations (NGOs) began to recognise that although fishery councils and managers had authority to rebuild fish populations, they were not required to do so. Short-term economic concerns nearly always took precedence over long-term thinking (and usually still does), preventing implementation of the fishing limits necessary to bring about recovery and sustainability. The irony was that short-term economic concerns were destroying the long-term economic viability of fishing communities.

Originally, the FCMA enshrined the guiding concept that 'Fisheries shall be managed to produce the maximum sustainable yield'. But in practice, this often meant restrictions on fishing; thus, lobbying pressure from commercial fishing interests resulted in amending the language to say, 'Fisheries shall be managed to produce the optimum yield, which is maximum sustainable yield as modified by social and economic considerations'. In principle, it was license for fishery managers to ignore scientific findings and scientists' recommendations on limits to catches. In practice, managers often set quotas much higher than scientists recommended, and the law allowed it.

Steps Toward Improvement: The Sustainable Fisheries Act of 1996

Some of the major loopholes in the language of the 1976 FCMA were corrected with a sweeping set of amendments, called the Sustainable Fisheries Act (SFA) of 1996. This was the first reauthorisation of the Magnuson-Stevens Act in which conservation groups were actively involved, drafting model legislation and mobilising grassroots lobbying. This effort was reflected in the results. The legislation was a major overhaul, and by adding several new components and adjusting key language, it rectified significant flaws in the existing law. These additions created clearer and more stringent guidelines for fishery management plans.

The first of several significant changes achieved with the SFA was a change in the definition of optimum. It had been defined as the fishery's MSY, as modified by economic, social or ecological factors. The word 'modified' was changed to 'reduced', and the definition now reads, in part, that optimum 'is prescribed as such on the basis of the maximum sustainable yield from the fishery, as reduced by any relevant economic, social, or ecological factor'. In principle, MSY is now an upper bound for all fisheries. And, in the case of an overfished fishery, optimum yield is the amount of fish that provides for rebuilding to a level capable of producing the MSY.

The other major improvement in the SFA addressed depletion and rebuilding and, importantly, did so with quantified triggers. It defined overfishing as the 'rate or level of fishing mortality that jeopardizes the capacity of a fishery to produce the maximum sustainable yield on a continuing basis'. Under the act, fishery managers are charged with ending overfishing, and they must implement plans designed to rebuild stocks within 10 years. In most cases, when a population falls below 50 percent of the estimated biomass (B) needed to continually support MSY (B_{MSY}), the population is defined as overfished, and it is added to a list of overfished species. (The creation of such a list was a new requirement of the SFA.) Once a species is defined as overfished or is projected to reach overfished status within two years, the regional fishery management council has one year to create a plan to recover the stock as quickly as possible but within 10 years. There are exceptions to the 10-year limit, for example, when the biology of the species or other environmental conditions dictate a longer rebuilding period, as for species such as sturgeon and rockfish that are slow-growing and slow to mature (Safina *et al.* 2005, Rosenberg *et al.* 2006). Species that are subject to an international management agreement but lack a 10-year recovery plan are also exempt from the 10-year limit. These overfishing prohibitions and recovery mandates were new under the SFA. Despite the exceptions mentioned above, these provisions are the heart of the reforms.

Ultimately, the 10-year interval was selected to balance the economic needs of fishing communities with the biology of the exploited species.

Ten years was chosen as the rebuilding interval for several reasons. First, most overfished stocks

could fully rebound within five years if all fishing ceased. Doubling this time frame ensured there was ample time to implement management plans. Ten years was also considered short enough to force managers to act, minimizing future economic, social and ecological costs (Safina *et al.* 2005). A longer time frame could also have been used to justify additional years of overfishing or other management failure or delay.

Ultimately, the 10-year interval was selected to balance the economic needs of fishing communities with the biology of the exploited species. If the fishery management council fails to provide a plan within one year of the stock being declared overfished, the secretary of commerce must develop a plan within nine months (Rosenberg *et al.* 2006). The rebuilding mandates require managers to create concrete plans to allow populations to recover in reasonable time to a biomass that can support catching the population's MSY.

Other significant accomplishments of the 1996 SFA included a mandate to minimize bycatch 'to the extent practicable'. It was the first piece of legislation to generally require reduction of these incidental catches, though the word 'practicable' weakens the directive. Fishery management councils, however, may require bycatch-reduction gear within management plans.

The act also codified the concept of 'essential fish habitat' and empowered managers to designate and protect such habitat. Thus, management plans can protect habitat, create reserves or no-take zones where spawning fish or juveniles live, and defend against development that would harm fish and fishery resources (Safina 2003). These changes clearly set the stage for management that focuses less on one species and more on an ecosystem where many species live. Still, there has been little significant progress in this area (Rosenberg and McLeod 2005).

These bycatch and habitat requirements are not quantified and thus are vague, poorly defined and usually not very effective. Courts have, however, handed down strong interpretations and decisions regarding bycatch, closing to longlining large areas off the southeastern United States where juvenile swordfish congregated and had suffered high discard mortality. As a result of litigation brought by NGOs under other statutes, such as the National Environmental Policy Act, courts also required longliners to use procedures designed to minimize bycatch of seabirds and turtles.

The SFA also required the secretary of commerce to publish, with information provided by the National Marine Fisheries Service (NMFS), an annual report on the status of all fisheries. These reports track progress and identify new stocks in need of rebuilding and those that within two years will require rebuilding. The SFA also required that the 'best available science' be used in developing management plans and subsequent monitoring of progress, helping to ensure that plans are objective and scientifically sound (Safina 2003, Rosenberg *et al.* 2006).

A Major Impediment: Guidance That Weakened the Act's 1996 Intent

The 1996 law clearly intended to stop overfishing, limit catches to MSY or below, rebuild fishery resources and then maintain fished populations at the biomass capable of supporting MSY. Catch limits for a fish stock (or sometimes a closely related group of stocks) must achieve, 'on a continuing basis, the optimum yield from each fishery for the United States fishing industry' (SFA). Therefore, the act constrained optimum yield (the catch) at or below a stock's MSY. The idea was to keep a stock at a biomass level that is sufficiently robust to support the fishery long-term, without diminishing the resource.

Stock size will probably fluctuate even when appropriately managed. So, after passage of the SFA of 1996, NMFS staff members developed two major guidelines for estimating the status of a stock: the maximum fishing mortality threshold and the minimum stock size threshold. These concepts, respectively, placed an upper bound on fishing mortality and a lower bound on the size of a stock. Beyond these thresholds, a stock must be declared overfished if it is below the stock size threshold, and subject to overfishing if the fishing mortality rate is above the upper bound (Restrepo *et al.* 1998).

The idea was to keep a stock at a biomass level that is sufficiently robust to support the fishery long-term, without diminishing the resource.

The law clearly intended to rebuild the biomass that can support MSY and then maintain it. Unfortunately, the guidelines drawn up by NMFS to implement the law lowered the rebuilding threshold considerably and failed to require action to maintain stocks at the B_{MSY} target. The thinking was, essentially, that because B_{MSY} cannot be known with certainty, an 'envelope' or range suffices, and the lower end of that range is adequate.

> The Restrepo *et al.* guidelines defined 'minimum stock size threshold' thus:
>
> 'The stock size threshold should equal … one-half the MSY stock size, or the minimum stock size at which rebuilding to the MSY level would be expected to occur within 10 years. … Should the actual size of the stock or stock complex in a given year fall below this threshold, the stock or stock complex is considered overfished'.

This sounds reasonable. But in practice it means that, rather than keeping the target at or above the biomass that would sustain MSY B_{MSY}, the goal of management is to keep biomass above just one-half of the B_{MSY} threshold. By failing to require the maintenance of B_{MSY}, this technical guidance severely undermined the intent of the law. This technical guidance was incorporated into many fishery management plans and, in effect, became law.

The SFA had advanced the concept that '[i]n general, Councils should adopt a precautionary approach to specification of OY' (optimum yield). Precautionary approaches to estimating optimum yield should have resulted in smaller catch quotas (especially for fisheries for which inadequate data were available). But in practice, fishery management councils can adopt one-half of B_{MSY} as the minimum size threshold for many stocks.

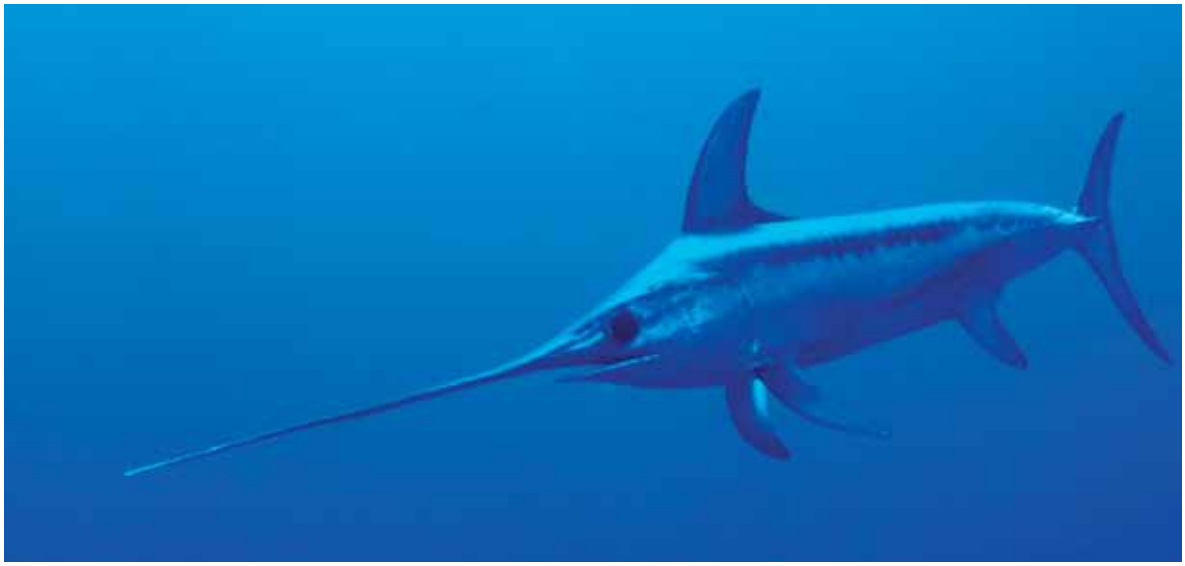

Photo: Steve Drogin/marinethemes.com

NORTH ATLANTIC SWORDFISH ARE NOW CLASSIFIED AS REBUILT—THE ONLY LARGE PELAGIC FISH IN THE WORLD WHOSE POPULATION IS BIGGER NOW THAN A DECADE AGO.

Effectiveness of the Sustainable Fisheries Act of 1996

The SFA was drafted with the clear intent of ending overfishing and mandating rebuilding of overfished populations within a fixed period. The reauthorization of 2006 was in many ways an attempt to address loopholes found in the 1996 legislation. So before considering the 2006 law, it is worth understanding how the 1996 legislation performed. Managers, scientists and policymakers alike see mixed success.

Rosenberg *et al.* (2006) extensively reviewed the state of U.S. fisheries nearly a decade after the SFA became law. By 2005, NMFS had identified 74 stocks of economic importance in need of rebuilding plans. Of the 74 stocks, 67 had rebuilding plans implemented, and biomass had increased in nearly half the stocks. Additionally, three—Atlantic sea scallops, Pacific whiting and Pacific lingcod—were declared rebuilt to the targets specified in their plans (Rosenberg *et al.* 2006). A few others—such as Atlantic black sea bass, scup and summer and yellowtail flounder—increased in biomass to the point that it was possible to raise the allowed catch (Safina *et al.* 2005).

At the time of the review by Rosenberg *et al.*, only 14 percent of the 74 stocks were no longer considered overfished. One of the biggest pitfalls was continued overfishing in

45 percent of the stocks, sometimes as much as five years into the 10-year rebuilding plans. This overfishing was challenged, but a court ruled—rather nonsensically—that the statute allowed overfishing to continue during the rebuilding period, as long as the act's rebuilding requirements were met by the end of the period. Continued overfishing has hindered progress toward recovery and caused further decline in the biomass of some stocks (Rosenberg *et al.* 2006). Overall, a combination of legislative loopholes and mismanagement have hindered much of the progress that Congress had intended with the legislation (Safina 2003, Safina and Chasis 2004, Rosenberg 2007).

Significantly, North Atlantic swordfish are now classified as rebuilt—the only large pelagic fish in the world whose population is bigger now than a decade ago. The areas closed in the southeastern United States to protect undersized juveniles from bycatch mortality likely played a significant role in the swordfish rebuilding. Those areas were closed because the 1996 law mandated that bycatch be reduced to the extent practicable, and conservation groups successfully sued the government, claiming that NMFS could reduce swordfish bycatch by closing areas where fishing boats were discarding high numbers of dead juveniles smaller than the legal minimum size.

Reauthorization and Changes in 2006

In 2006, Congress passed an additional reauthorization act, the Magnuson-Stevens Fishery Conservation and Management Reauthorization Act. This measure authorized funding through 2013 and requires the fishery management councils to:

- establish annual catch limits that prevent overfishing and rebuild overfished stocks,
- establish annual catch limits that end overfishing by 2010 for all stocks experiencing overfishing, and by 2011 for all other stocks,
- keep annual catch limits lower than the limits recommended by their scientific and statistical committees.

Further, one of the biggest conservation steps taken was revision of the rebuilding provisions to make clear that overfishing must be halted immediately once rebuilding plans are in place. This effectively overturned the earlier court ruling that allowed overfishing to continue during rebuilding periods.

It remains to be seen whether the 2006 reauthorization of the Magnuson-Stevens Act will finally end overfishing in U.S. ocean waters. These amendments hold much promise, but effective implementation must yet be accomplished. NMFS guidelines contain a loophole that allows managers to set target 'annual catch limits' equal to the level that triggers the definition of overfishing, rather than requiring, in all circumstances, an adequate buffer to account for scientific and management uncertainty.

Benefits Gained by Improving U.S. Legislation

Photo: NOAA

DOUBLE-RIGGED SHRIMP TRAWLER OFF THE COAST OF BRUNSWICK, GA., IN 1968.

Despite limited success, the rebuilding mandates have created several positive outcomes. Although only a few of the stocks in need of strict management have been fully restored to levels that can support MSY, biomass is increasing in nearly 50 percent of stocks. Several federally managed species are supporting increasingly stable and sustainable fisheries (Rosenberg *et al.* 2006, Worm *et al.* 2009). And slowly but surely, the amended Magnuson-Stevens Act has incorporated language referring to multispecies fisheries and the habitat and ecosystem impacts of fishing. But real-world progress on these issues has been minimal (Rosenberg 2007, Safina 2009).

Fishery data are gained primarily from landings reported by fishing fleets and secondarily through scientific surveys. One result has been the accumulation of large data sets of fishery and ecosystem trends, often spanning decades (Prager and Rosenberg 2008, Worm *et al.* 2009).

The availability of these rich data sets has facilitated interpretation of trends and responses in wild stocks. However, major data gaps remain, hampering scientists' ability to assess the status of a majority of the populations being fished. The phrase 'best available science' in the law has guided the development of more comprehensive and statistically sound data collection and analysis tools (Sullivan *et al.* 2006). It dictates the need for comprehensive peer review of analytical tools used to develop fishery management plans, as well as any new tools. Extensive peer review and the use of multiple tools to analyze a stock's status have also made it easier to implement appropriate measures at times when such measures are strongly opposed by fishing communities (Prager and Rosenberg 2008). The review process is strengthened by panels of internationally recognized fishery experts, not involved with the particular stock assessment or the fishery itself, who apply innovative tools as they become available. The required use of best fishery management tools has helped ensure that fishery data can be better analyzed and interpreted (Bundy *et al.* 2008). Thus, fishery management plans can often be based on sound estimates of biomass, which is essential to estimating how a stock is likely to respond to management actions.

The United States has made significant progress in legislation and management. However, weaknesses remain from which we can learn to design better policy.

Points for Improvement and Going Forward

1. **The 1996 amendments' greatest flaw was their failure to mandate that fishery management plans immediately end overfishing upon their implementation**. Rosenberg *et al.* (2006) emphasized that overfishing often continued more than five years into the 10-year rebuilding period, greatly limiting the chances of a plan's success. Strong pressure from commercial interests to maintain high catch quotas often resulted in little or no progress within the 10-year plan. However, the 2006 amendments may go a long way toward improving the success of management plans—if the two-year limit on overfishing is not exceeded.

2. **Managers, fearing severe economic consequences and lawsuits, often do not apply effective restrictions** (Safina 2003). Despite the best efforts of scientists and policymakers to weigh the future conservation and socioeconomic benefits of fishing restrictions, short-term economic concerns in fishing communities drive the failure of some management plans. Additionally, delays are common in the creation of management and rebuilding plans. Managers and agencies that miss the two-year deadline for the creation of a fishery management plan are not subject to fines, budget cuts or any other penalty. Fishery management plans under development are subject to a public comment period, opening the door to contentious arguing among groups with conflicting objectives. Although stakeholder input is generally desirable as a way to hold managers accountable, public disagreement about how to proceed can delay progress for several years. Fishery managers' inaction from the mid-1970s through the 1990s resulted in a resounding lack of progress in rebuilding or stabilizing stocks. For example, the New England groundfish industry was in a state of sharp decline in the 1980s and '90s. Despite enactment of the Magnuson-Stevens Act nearly two decades earlier, lax regulation from loose interpretation of the Act resulted in the commercial near-extinction of such species as cod, haddock and Atlantic halibut (Safina 1994).

3. **The 1996 Sustainable Fisheries Act introduced definitions, triggers and constraints that were quantified.** Therefore, councils were required to develop fishery management plans within one year of a stock being declared overfished, to implement these plans promptly and to meet the 10-year recovery time limit. The actions of these councils are under the scrutiny of the secretary of commerce as fishery management plans are reviewed biennially to see whether revisions are necessary (Rosenberg *et al.* 2006). However, managers often allowed overfishing to continue under these rebuilding plans and failed to allow a majority of stocks to recover to levels that could support MSY. In 2006, Congress mandated that within two years of a stock's being declared overfished, councils must adopt a fishery management plan, plan amendment or proposed regulation that would immediately end overfishing. In addition, the 2006 Magnuson-Stevens Act reauthorization required that fishery management plans include a mechanism

Photo: George McCallum/marinethemes.com

ATLANTIC HERRING IS AN IMPORTANT PREY FISH IN THE GEORGES BANK-GULF OF MAINE ECOSYSTEM.

for specifying annual catch limits so that overfishing will not occur. This requirement goes into effect in fishing year 2010 for fisheries declared subject to overfishing, and in fishing year 2011 for all other fisheries.

4. **Too often, catch levels have been set at the overfishing level, thus failing to properly account for scientific and management uncertainty**. As a consequence, actual catches have frequently exceeded authorized catch levels with the result that overfishing occurs. To meet the new requirements, catch levels will almost always need to be set below the overfishing level to reflect scientific and management uncertainty. The 2006 amendments also call for accountability measures to ensure that catch limits are not exceeded, and imposes consequences if they are. It is also important to quantify a mandatory probability of success in meeting the rebuilding schedule for overfished species. This point was overlooked in the 1996 SFA.

A federal court decided that plans must provide at least a 50 percent probability of success in meeting the target fishing mortality rate.

Managers and lobbyists soon found that this loophole allowed them to fulfill the letter of the law whilst violating the rationale of mandated recovery. Consequently the first 'recovery plan' (for summer flounder) set catches at levels that had only an 18 percent chance of meeting the fishing mortality level set under the rebuilding plan. Litigation was necessary to close that loophole. A federal court decided that plans must provide at least a 50 percent probability of success in meeting the target fishing mortality rate. The court decision could have gone the other way, fundamentally undermining the legislation's entire rebuilding mandate. But in reality, an 80 percent or higher probability is closer to what is really needed to ensure that rebuilding occurs and is timely.

5. **Although the review process under the direction of fishery management councils is considered one of the greatest strengths of the Magnuson-Stevens and Sustainable Fisheries acts, several weaknesses remain.** The debate between opposing groups, and even among the scientists making recommendations based on the same fishery data, can be heated, time-consuming and costly. No changes to fishery quotas are made during this review process. The rebuilding mandate of 1996 states that all fishery management plans must be created within a year of a fishery being declared overfished, but often a full year is needed to draft a plan, and additional time is needed to implement regulations (Rosenberg *et al.* 2006, Rosenberg 2007). Consequently, Congress lengthened the time for the council review process to two years.

6. **Currently, management plans are adopted in a linear process. Councils propose the plans to the secretary of commerce for review**. The secretary can partially approve a plan and send it back for revisions. But revisions could take years, leaving no plan (or an inadequate one) in place. In practice, then, the secretary must choose between accepting the management plan at hand or no plan at all. There is little room for discussion at this point, which is why faulty plans are often approved (Rosenberg *et al.* 2006).

7. **Every two years, the secretary of commerce must review the progress of fishery management plans, a process that is inefficient at best**. The plans for fisheries that show no rebuilding can be revised, but doing so can reset the 10-year rebuilding time frame—a major incentive to create inadequate plans as a delaying tactic. Revised plans are often fashioned around stocks whose biomass has fallen even lower than it was when the original plan was drafted. Fishery management plans are also reviewed by courts when a lawsuit is filed, but only to ensure that the plans are meeting legal obligations. Increases or declines in stock abundance—in other words, whether the plan is working—are rarely factored into this type of review (Prager and Rosenberg 2008). The opinions of independent fishery experts such as those used in reviewing fishery management plans are almost entirely absent from the latter stages of U.S. fisheries management. The emphasis should be on expert review of whether the plan is working and if it is not, revising it to work.

Current legislation lacks guidance on considering predator-prey dynamics or ecosystem resilience.

8. **A major weakness of the Magnuson-Stevens Act is its focus on managing single stocks in isolation**. Many scientists now see this as a fundamental conceptual flaw in fisheries management. They advocate management within an ecosystem of many species, their relationships and their habitats. The current emphasis on managing fish to support MSY focuses on how much we can remove, rather than how much we should leave, and how other species might be affected (Safina 2009). Current legislation lacks guidance on considering predator-

prey dynamics or ecosystem resilience, and gives only weak consideration to habitat alteration caused by fishing gear or changing environmental factors (Hildreth 2008, Safina 2009). On a positive note, several species with similar life histories are sometimes managed within a single fishery management plan, bringing managers closer to considering species within their ecosystem. Additionally, several states have developed marine protected areas, which can be a very successful form of ecosystem-based management (EBM) (Worm *et al.* 2009). On the other hand, although there is wide consensus that fisheries management must move to ecosystem-level concepts, scientists have yet to articulate a clear vision of that kind of management. Certainly this is a frontier for fisheries management.

9. **Because fisheries managers interpreted the rebuilding mandate in the 1996 amendments in a way that allowed for lax initial restrictions, much time elapsed with little apparent rebuilding**. The success of a fishery management plan relies on the speed with which overfishing ceases (Rosenberg 2007, Worm *et al.* 2009). Thus, it is imperative that ending overfishing become a main objective of all fisheries management. Consequently, many scientists called for a federal mandate to immediately end overfishing of stocks declared overfished (Safina 2003, Rosenberg *et al.* 2006, Rosenberg 2007). As previously noted, Congress took until 2006 to require that overfishing be ended immediately under a rebuilding plan. Moreover, the 2006 Magnuson-Stevens Act reauthorization requires annual catch limits that end overfishing in fishing year 2010 for all fisheries experiencing overfishing, and in fishing year 2011 for all other fisheries. Rebuilding plans should also be kept to time frames shorter than 10 years, where possible. This reduces the chances of further overfishing and is economically more beneficial to fishing communities in the long run than allowing further overfishing (Rosenberg *et al.* 2006).

10. **Some have suggested that to immediately end overfishing for stocks not currently covered under a fishery plan, fishery managers should develop a default management plan.** Under such a plan, fishing would probably be reduced until enough data were gathered to appropriately analyze the status of the stock. This would halt or slow the decline in biomass, contributing to the effectiveness of plans subsequently implemented (Rosenberg *et al.* 2006, Worm *et al.* 2009).

11. **Moving from single-species management toward EBM requires considering species as part of food webs in a complex ecosystem, with humans as integral players** (Leslie *et al.* 2008)**.** Managers, however, rarely consider ecosystem services (Rosenberg and McLeod 2005). It may be possible to work toward EBM by implementing small-scale ecosystem approaches to management. These could include protected habitats or closed areas, spatially defined fishery management areas and mixed zoning, and considering incidental catches within the framework of management goals (Young *et al.* 2007, Safina *et al.* 2009). Application of EBM is currently outside the competence of the fishery management councils. It could require major interagency

Photo: Jeff Rotman

DRAGGER/TRAWLER CREW SORTS CATCH OF COD, BLACKBACK (WINTER) FLOUNDER AND LOBSTER NEAR GLOUCESTER, MASS.

cooperation and planning. Apart from reviewing a council's single-stock assessments, involvement of outside experts and agencies could help develop EBM approaches, turning fisheries assessment into an interdisciplinary science and relieving some of this burden from policymaking agencies (Rosenberg and McLeod 2005). This could go a long way toward improving the social and ethical consequences of fishing and better equip managers with the skills to integrate ocean management in the future (Bundy *et al.* 2008). However, making the process more complicated is an unlikely route to success. Alternatively, the development of an entirely new agency with responsibility for EBM goals may be the key to EBM's successful implementation (Rosenberg and McLeod 2005, Leslie 2005, Young *et al.* 2007, Bundy *et al.* 2008, Hildreth 2008).

12. **The evaluation of fishery management plans often focuses on process rather than progress** (Rosenberg *et al.* 2006; Prager and Rosenberg 2008). Ensuring incremental progress is essential to avoiding the kind of large setbacks that some stocks have undergone since 1996, and reviews should also be used to build a database of effective and ineffective approaches.

13. **Fisheries managers would increase the likelihood of success if they adopted a suite of tools and tailored them toward particular fisheries or ecosystems.** Multiple management techniques have helped increase fish biomass in a few areas in the United States (Worm *et al.* 2009). Subsidy reform could help decrease the pressure on some fisheries and alleviate financial hardship when strict catch quota restrictions must be implemented quickly (Safina 2009). In

addition, programmes that help consumers shift their demand from unsustainable fisheries to those that are better managed could relieve fishing pressure (Safina 2003).

14. **Management plans have been slow to incorporate new findings on the deleterious evolutionary effects of overfishing**. Considering evolutionary forces helps more accurately estimate a population's reproductive and growth capacities, which probably decline under intensive fishing pressure (Conover and Munch 2002). The rapidly increasing body of literature on using aquaculture to enhance stocks should also be considered. If done poorly, as it often has been, aquaculture can worsen problems. If done wisely, it may be an important component of restoration in certain severely depleted species, depending on the particulars of the case (Safina 2009). Some of these concepts are more applicable to an ecosystem-based approach; others can readily be applied to single-stock assessment. It will be important to develop ways of including them in management plans.

15. **Ever since the sweeping reforms of the SFA of 1996 and subsequent reforms in 2006, the failure to rebuild stocks has largely resulted from interpretations of the legal language that favor the short-term demands of commercial fishing interests**. Future success will depend on effective implementation of the relatively recent mandate to promptly end overfishing, including requirements that catch limits be:

- based on the science and define MSY and B_{MSY} as strict limits,
- set below the overfishing level to account for uncertainty,
- enforced.

The United States has considerably improved the way scientists and managers collect, analyze and interpret data. U.S. fisheries have become a better example of applied science (Rosenberg 2007). Through major shifts in the thinking of fishery managers, we may see the small successes of the past evolve into great advances in the recovery of our living marine resources. The United States has learned many lessons and made many instructive mistakes on its road to improvement. Learning from these mistakes can prevent other nations from repeating them.

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PEW ENVIRONMENT GROUP

Square du Bastion 1A,
1050 Brussels, Belgium
Tel. +32 2 2741620
www.pewenvironment.eu