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America's Blueprint for Sustainable Fisheries

The History and Future of the Magnuson Stevens Fishery Conservation and Management Act

By Michael Conathan and Avery Siciliano September 2016

Center for American Progress



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Contents

- 1 Introduction and summary**
- 4 A timeline of federal fisheries legislation**
- 10 Key changes in the Magnuson-Stevens Reauthorization Act**
- 15 Rebuilding America's fisheries**
- 30 Policy recommendations**
- 33 Conclusion**
- 34 About the authors and acknowledgments**
- 35 Endnotes**

Introduction and summary

“The most valuable food fishes of the coast and the lakes of the U.S. are rapidly diminishing in number, to the public injury, and so as to materially affect the interests of trade and commerce.”

– Congressional Resolution 22, establishing America’s first Commissioner of Fish and Fisheries, February 9, 1871¹

One hundred and thirty-five years ago, Congress first acknowledged that perhaps the ocean’s cornucopia of seafood was not bottomless. In passing a joint resolution establishing the Office of Commissioner of Fish and Fisheries, Congress laid the first brick in a road that would ultimately lead to a new discipline of science that helps inform and manage America’s multibillion-dollar commercial fishing industry.

The United States oversees the largest exclusive economic zone, or EEZ, in the world, covering 4.4 million square miles of ocean, an area larger than that of all 50 states combined.² From turquoise Caribbean waters to the nutrient-rich currents coursing through the Bering Sea, U.S. fisheries span a variety of oceanographic regions and ecosystems. And thanks to strict science-based management measures, Americans can make a strong case that their fisheries are better managed than those of any other nation in the world.

Globally, the Food and Agriculture Organization of the United Nations, or FAO, estimates that more than 58 percent of the world’s commercial fisheries are fully exploited and one-third are overfished.³ This is troubling enough in its own right, but even more so when considering that the health of ocean ecosystems—including the number of thriving fish stocks—is a leading indicator of how resilient the oceans will be against environmental pressures such as climate change and ocean acidification.⁴ And when fish are managed effectively, they not only provide ecological benefits but economic and social returns as well.

Specific legislation has governed U.S. federal fisheries management for decades: The original Fishery Conservation and Management Act celebrates its 40th anniversary this year, and the Magnuson-Stevens Fishery Conservation and Management Reauthorization Act of 2006, or MSRA, has now been in effect for 10 years. In recognition of these anniversaries, this report provides a timeline of formative fisheries legislation and reflects in depth on the past decade of fisheries management in the United States. It then highlights successes and challenges in rebuilding fish stocks and ending overfishing in domestic waters. Finally, it provides recommendations for ensuring that U.S. fisheries continue to rely on ever-improving scientific data to lead the world in sustainability measures while sustaining coastal communities and economies over the next decade. Specifically:

- **Regulators should work to account for changes in fishery dynamics that fishermen around the country are already experiencing as a result of climate change, including ocean acidification and warming.** To the extent that legislative amendments are necessary to permit such action, Congress should act to grant regulators such authority. Climate change will affect each region's fisheries differently and the law must be strong yet flexible in managing geographically shifting fish stocks and changes to species composition, particularly in adjacent regions, including by facilitating discussion between regional management councils.
- **Ecosystem-based management should be prioritized as a tool to facilitate holistic, science-based fisheries management.**
- **To increase accountability and data collection, NOAA should aggressively pursue the development and deployment of electronic monitoring systems for fishing vessels, particularly in lieu of continuing to rely on the use of costly and contentious on-board fishery observers.** It should also promote the use of technology, such as Global Fishing Watch—designed by Oceana, Google, and Skytruth—and Eyes on the Sea, developed by the Pew Charitable Trust.
- **Congress should appropriate additional funding for ocean observation and baseline research to facilitate data collection and stock assessment science.** In addition, the next reauthorization of the MSA should include provisions for an outside review of fishery management plans and the corresponding status of fish populations.

- **Using the MSA's strong international provisions, the Obama administration should finalize regulations aimed at curtailing illegal, unreported, and unregulated fishing abroad.** The next administration should continue to enhance and develop these regulations, including expanding the national seafood traceability program to include all species imported to the United States.
- **U.S. leaders and government officials should press the International Maritime Organization to expand application of its vessel monitoring and registration standards to include all fishing vessels operating on the high seas.**

While the authors recognize that recreational fishing is a critical component of U.S. fishery management, they have chosen to focus exclusively on the effect of the MSRA's reforms on America's commercial fishing sector. They have also deliberately chosen not to address aquaculture under the auspices of this report. They expect to address both of these vital issues in future products.

In 2011, former NOAA Administrator Jane Lubchenco stated, "rebuilding all U.S. fish stocks would generate an additional \$31 billion in sales impacts, support an additional 500,000 jobs and increase dockside revenues to fishermen by \$2.2 billion, which is more than a 50 percent increase from the current annual dockside revenues."⁵ Ensuring that U.S. fisheries remain on track to achieve these projections without compromising the long-term health of fish populations or other aspects of our ocean ecosystems must remain a priority for champions of sustainable fishing in Congress, the executive branch, and coastal communities nationwide.

A timeline of federal fisheries legislation

The American commercial fishing industry has seen the benefits of rebuilding depleted fish stocks firsthand. In 2014 alone, U.S. commercial fishermen harvested 9.4 billion pounds of seafood, creating a domestic seafood industry that generated \$153 billion in sales and supported 1.4 million full- and part-time jobs.⁶ American fishermen and the fisheries regulation that guides them have paved the way for a thriving seafood industry built on science, accountability, and sustainability. Forty years ago, however, the U.S. fishing industry had a different story.

Before 1976, a lack of regulation and the absence of catch limits had led to rampant overfishing in the Northern Hemisphere.⁷ Foreign vessels—which under international law, had free rein to operate up to just 12 miles from shore—were responsible for much of this harvest. In the Cold War days of the 1970s, fishermen and their congressional representatives were incensed by the sight of Soviet factory trawlers among those ships vacuuming fish from the ocean so close to American soil.⁸ As fishermen tried to outcompete their foreign rivals, the combined forces of economics and patriotism ultimately inspired legislative action.

Two senators—Warren Magnuson (D-WA), a savvy veteran of 32 years in Congress’s upper chamber, and Ted Stevens (R-AK), a second-term member representing America’s Last Frontier—understood the importance of thriving domestic fisheries to America’s economy and the health of ocean ecosystems. Together, they worked with their House counterparts, led by Rep. Gerry Studds (D-MA), to pass the Fishery Conservation and Management Act of 1976.⁹ This watershed legislation first and foremost focused extended U.S. jurisdiction over fishery resources to 200 nautical miles offshore. This boundary is now customary international law, but at the time it had not yet been enshrined; the United Nations Convention on Law of the Sea would not make this the international standard until its entry into force in 1982.¹⁰ Yet a handful of other nations had set the precedent: The U.N. convention followed action by Chile and Peru, among other countries, which set similar boundaries as far back as 1947.¹¹

After effectively banning foreign fishing fleets, the act also established a unique framework to manage this newly domesticized resource. It divided the nation's waters into eight specific regions, each overseen by a fishery management council composed of a diverse range of fishery stakeholders, including fishermen themselves. The councils were tasked with developing fishery management plans for approval by the National Oceanic and Atmospheric Administration, or NOAA, a new science-based agency that had been established in 1970.¹² The seven national standards, later expanded to 10, attempted to marry the competing interests of conservation and resource exploitation by stressing the importance of the long-term ecological and economic viability of American fisheries.¹³

The 10 national standards for U.S. fishery management

Listed below are the 10 national standards contained in the current Magnuson-Stevens Fishery Conservation and Management Act.

1. Conservation and management measures shall prevent overfishing while achieving, on a continuing basis, the optimum yield from each fishery for the United States fishing industry.
2. Conservation and management measures shall be based upon the best scientific information available.
3. To the extent practicable, an individual stock of fish shall be managed as a unit throughout its range, and interrelated stocks of fish shall be managed as a unit or in close coordination.
4. Conservation and management measures shall not discriminate between residents of different states. If it becomes necessary to allocate or assign fishing privileges among various United States fishermen, such allocation shall be (a) fair and equitable to all such fishermen; (b) reasonably calculated to promote conservation; and (c) carried out in such manner that no particular individual, corporation, or other entity acquires an excessive share of such privilege.

5. Conservation and management measures shall, where practicable, consider efficiency in the utilization of fishery resources; except that no such measure shall have economic allocation as its sole purpose.
6. Conservation and management measures shall take into account and allow for variations among, and contingencies in, fisheries, fishery resources, and catches.
7. Conservation and management measures shall, where practicable, minimize costs and avoid unnecessary duplication.
8. Conservation and management measures shall, consistent with the conservation requirements of this Act (including the prevention of overfishing and rebuilding of overfished stocks), take into account the importance of fishery resources to fishing communities by utilizing economic and social data that meet the requirement of paragraph (2) [i.e., National Standard 2], in order to (a) provide for the sustained participation of such communities, and (b) to the extent practicable, minimize adverse economic impacts on such communities.
9. Conservation and management measures shall, to the extent practicable, (a) minimize bycatch and (b) to the extent bycatch cannot be avoided, minimize the mortality of such bycatch.
10. Conservation and management measures shall, to the extent practicable, promote the safety of human life at sea.

The first four remain as they were written in the original Act of 1976. Standards five through seven were amended by the Sustainable Fisheries Act, or SFA, in 1996; the SFA also added the final three standards. Notably, it also amended Standard 5 by changing its goal from “promot[ing] efficiency in the utilization of fishery resources,” to “when practicable, consider[ing] efficiency...” This was a clear shift of focus toward sustainability. National Standard 8 was further amended in 2006 to clarify that the best scientific information available should also be used to account for fishing’s economic impact on engaged communities.¹⁴

Since its inception in 1976, the Fishery Conservation and Management Act has undergone two major revisions that have made its current form a model for sustainable fisheries worldwide. The original 1976 law initially provided the regional fishery management councils significant flexibility to regulate harvests in order to meet short-term economic needs and incentivized domestic companies to expand operations to fill the gaps left by expelling foreign fleets. By the late 1980s and early 1990s, however, it had become clear that despite eliminating foreign fishing pressure, many domestic fish populations were still in serious danger of collapse.¹⁵

After several years of regional hearings and contentious negotiations over how to balance fisheries' short-term operations with long-term sustainability, Congress enacted the Sustainable Fisheries Act of 1996, or SFA.¹⁶ The legislation was driven primarily by the efforts of elected officials from Alaska and Massachusetts—Sens. Ted Stevens (R-AK) and John Kerry (D-MA) and Reps. Don Young (R-AK) and Gerry Studds (D-MA). According to staffers who worked on passage of this legislation, their efforts led to a strong bipartisan and bicoastal alliance on the need to end overfishing and address habitat and bycatch considerations. In 1997, Sen. Earnest Hollings (D-SC) inserted a provision into an appropriations bill formally adding Sen. Stevens' name alongside Sen. Magnuson's in the title of the underlying law, which is now commonly referred to as the Magnuson-Stevens Act, or MSA.

The SFA refocused the MSA's goals, giving significantly more weight to conservation and ecosystem health. It required each fishery management plan to include specific criteria for determining whether a stock was overfished and added three new national standards to address vessel safety at sea; manage the harvest of species not specifically targeted by a fishery, also known as bycatch; and prioritize the role of coastal communities.¹⁷ The most important provision of this law was that, for the first time, it set the scientific estimate of maximum sustainable yield as the ceiling, not the floor, for the allowable catch, also known as the optimum yield. Under the original law, optimum yield was defined as the maximum sustainable yield "as modified by" economic considerations.¹⁸ The SFA changed the word "modified" to "reduced," in effect, making unsustainable fishing illegal.¹⁹ However, there were no measures included to ensure accountability to this new provision of law.

The SFA also acknowledged the need to reduce overcapacity in American fishing fleets and the potential long-term negative economic impact of having too many fishermen chasing not enough fish. New sections of the act allowed the Secretary of Commerce to provide disaster assistance if a commercial fishery collapses and established a regional transition program for fishermen, seafood processors, and charter fishing operations.²⁰

The spirit of bipartisanship which led Sen. Hollings to formally honor his Republican colleague by adding Sen. Stevens' name to the law's title was more than just a symbolic recognition of the myriad contributions to sustainable fishery management made by the senior senator from America's most fisheries-dependent state. It also proved indicative of the bipartisan approach to fishery management that has benefited the MSA throughout its history. This was most evident when the MSA came up for reauthorization once more in the early 2000s.

The 1996 amendments were intended to end overfishing, helping move all U.S. fisheries to sustainability, but flexibility in the legislation—including the lack of accountability measures if fishermen exceeded annual quotas—left regulators unable to force an end to overfishing. Therefore, some fish stocks continued to decline following its enactment.²¹ As legislators and their staffs turned to the task of renewing and updating the law, it became clear that significant changes would have to be made if the promise of rebuilt sustainable fish stocks was to become a reality. Sen. Stevens once again led the charge, having risen to become Chair of the Senate Committee on Commerce, Science, and Transportation, which oversees NOAA and has jurisdiction over the MSA. His strongest ally was his best friend and the senior Democrat on the Commerce Committee, Sen. Daniel Inouye (D-HI). The two men were both World War II veterans, had served together in the Senate for nearly 40 years, and formed an inseparable bond as early representatives of the nation's two newest states. In fact, instead of referring to Inouye as “Ranking Member,” as the minority party's committee leader is typically addressed, Stevens named him “Co-Chairman”—a favor Inouye would return when the Senate majority changed in 2007.²²

In 2006, following a long series of hearings, expert reports and conferences, and committee negotiations, Chairman Stevens, with the full support of Co-Chairman Inouye, shepherded the Magnuson-Stevens Fishery Conservation and Management Reauthorization Act, or MSRA, into law as one of the last bills to pass the House of Representatives on the final legislative day of the 106th Congress. The bill passed the Senate without a vote by unanimous consent and the House on a voice vote. The ayes had it. President George W. Bush signed the bill into law in January 2007.²³

The MSRA gave the law its strongest science-based mandate yet. It imposed strict deadlines and accountability measures for all fishery management plans to include annual catch limits for each managed species. It also gave fisheries scientists the final word on whether such limits were sustainable based on the “best scientific information available.”²⁴ It included a framework and criteria to manage fisheries using market-based tools called limited access privilege programs. These included individual quotas and community quotas and are more colloquially referred to as

catch shares. And in a nod to the original law's effort to curtail international fishing in what are now U.S. waters, the act also included powerful new tools to let regulators address illegal, unregulated, and unreported fishing activity overseas. Such nefarious activity is wasteful and undermines the effectiveness of fishery management; it also creates an uneven playing field with U.S. fishermen who abide by federal law. This problem was especially visible in the U.S. exclusive economic zone of the Western Pacific and Hawaii, making Sen. Inouye a natural leader on these issues. These and other provisions helped cement the United States' global leadership in sustainable fisheries management.

Summary of changes to the Magnuson-Stevens Act

1976 Magnuson Fisheries Conservation and Management Act

- Established 200-mile EEZ
- Established eight regional fishery management councils
- Established initial seven National Standards to promote sustainable management

1996 Sustainable Fisheries Act

- Strengthened requirements to prevent overfishing and rebuild stocks, including ensuring catch limits could not be set above a level that constituted the maximum sustainable yield
- Set standards for fishery management plans to specify objective and measurable criteria for determining stock status
- Added three new National Standards to address fishing vessel safety, fishing communities, and the minimization of bycatch and introduced fish habitat as a key component of fisheries management

2006 Magnuson Stevens Fishery Conservation and Management Reauthorization Act

- Required every fishery to have annual catch limits that could not exceed scientists' recommendations and accountability measures in the event such limits are exceeded
- Established a framework for limited access privilege programs, better known today as catch shares
- Strengthened data management through peer review, the Councils' Scientific and Statistical Committees, and the Marine Recreational Information Program
- Enhanced international cooperation by addressing illegal, unregulated, and unreported fishing and bycatch²⁵

Key changes in the Magnuson-Stevens Reauthorization Act

Annual catch limits and accountability measures

While the MSRA brought many changes to fishery management, arguably the most ambitious and ultimately most effective was the mandate requiring NOAA and the councils to set annual catch limits—as well as accountability measures should those limits be exceeded—for each of the 528 federally regulated populations, or stocks, of fish species. Furthermore, the law specified that these limits could not be set higher than the level each council’s scientific and statistical committee determines is adequate to either allow an overfished stock to rebuild or to prevent overfishing from occurring.²⁶ In effect, this means that as of 2011, when the requirement took effect, overfishing was illegal in the United States.²⁷

So how is it that overfishing still occurs on 28 fish stocks in U.S. waters, according to NOAA’s 2015 Status of Stocks report?²⁸ The answer lies in the reality that fisheries science is rife with uncertainty. University of Southampton marine science professor John Shepherd’s oft-quoted analogy captures this well: “Managing fisheries is hard: it’s like managing a forest in which the trees are invisible and keep moving around.”²⁹

National Standard 2 has always required the use of “the best scientific information available” in the development of fishery management plans.³⁰ Until the MSRA’s passage, however, some councils developed a tendency to approve fishery management plans that stretched the boundaries of that science. Industry members, who hold a majority of seats on the councils, applied strong pressure to allow unsustainable levels of fishing to continue because they needed catch levels to remain high in order to remain profitable. So the councils would look at scientists’ recommendations, but in some cases still vote for plans that had a low probability of hitting the targets while being far more likely to allow overfishing to continue.

The MSRA closed this loophole. It required each council to submit to NOAA new fishery management plans for all overfished stocks no later than 2010. The new plans had to set annual catch limits at or below the level that the scientists who served on each council's science and statistical committee determined as being sufficient to end overfishing immediately—meaning the catch limits would allow the fishery to achieve its rebuilding target within the time frame allotted by law. In most cases, this time frame was 10 years. The MSRA further set a requirement for annual catch limits to be established for all fish stocks by 2011.

To ensure compliance, the fishery management plans also had to include accountability measures that specified what measures would be taken if a fishery exceeded its mandated annual catch limit—typically, measures to repay the overage by deducting it from the following year's limit.³¹

Since their entry into force five and six years ago, the measures provided by the MSRA have not entirely eliminated overfishing in the United States largely because scientific information is always changing. In order to inform the stock assessments on which catch limits are based, managers must rely on data that are often several years old by the time they have been adequately analyzed. The biology of the stock can change during the intervening years when the plan and its catch limits are in development; therefore, a catch limit that was sustainable when it was first set can become unsustainable after it is implemented.

Still, the system appears to be working. NOAA's most recent *Status of Stocks Report* put the number of stocks subject to overfishing at just 28. Of this relatively small number, many stocks have mitigating circumstances. For example, the overfishing list now includes seven stocks of New England groundfish, which is a group of species such as cod, haddock, and flounders that are caught and managed collectively and are thus exceedingly difficult to parse individually; 11 highly migratory species, such as tuna and swordfish, which are managed under international agreements, meaning the United States does not have sole jurisdiction over catch limits; and four stocks of Pacific salmon that have been affected by drought and other issues related to water management in the western rivers where they spawn.

Limited access privilege programs

While the MSRA's provisions on annual catch limits and accountability measures may have been the most effective at largely ending overfishing in America, perhaps the most discussed provision of the law was the addition of a section establishing the parameters for councils to create limited access privilege programs, more commonly referred to as catch shares. Catch share management is effectively a cap-and-trade system for fish. When one is established, regulators allocate specific percentages of the total allowable catch to individual fishermen, cooperatives, or communities in the form of quotas. These are typically based on how many fish each operator has caught in the past. The permit holder can then catch that number of fish or transfer or sell portions of the quota to other permit holders. Prior to the 2006 reauthorization, individual fishing quotas and community development quotas were allowed under the law, but the MSRA elaborated on the criteria fisheries managers should follow when implementing a catch share system.³²

The goal of such programs is to grant greater flexibility to fishermen regarding where, when, and how they fish. In some fisheries, these programs have been remarkably effective. The poster child for the effectiveness of a well-managed catch share system is Alaska's king crab fishery, made famous on the Discovery Channel series "The Deadliest Catch." This fishery established its morbid reputation because, prior to the 2006 fishing season, it was managed as a classic derby fishery. Regulators would open the crab season on a pre-established day, and at midnight all the permit holders would steam out of their harbors and fish nonstop until they caught all the crab they were allowed to catch for the year.³³ By the early 2000s, the season was down to as little as five days per year.³⁴ This was an incentive for fishermen to operate recklessly, steaming out to sea regardless of foul weather and overloading their boats with pots and crab, creating unsafe conditions. It did no favors for the market either, glutting processing facilities with product and depriving consumers of truly fresh king crab for all but a few days a year. With the institution of the catch share program, each permit holder was given his or her own quota to harvest whenever he or she wished to meet market demands during the season.³⁵

Catch shares are a controversial management tactic, however, in part because they can lead to excessive consolidation of fishing fleets if not properly designed. From a strictly profit-oriented perspective consolidation is not necessarily a bad thing. Just ask any of the massive conglomerates perpetually camped atop the Fortune 100. However, the effect of excessive consolidation on individual fishing operations—and, in many cases, small fishing communities—can be devastating. To help avoid

such outcomes, the MSRA's section on limited access privilege programs included requirements for councils to take great care in initial allocation decisions. These included a mandate to "consider the basic social and cultural framework of the fishery" and develop "policies to promote the sustained participation of small owner-operated fishing vessels and fishing communities ... and ... address concerns over excessive geographic or other consolidation."³⁶

NOAA encourages the use of catch share systems where appropriate and it supports implementing these fishery management plans whenever possible.³⁷ Sixteen federal catch share programs have been implemented since 1990, half of which were implemented after the 2006 reauthorization.³⁸ A 2013 economic assessment of U.S. catch shares touted the overall success of these programs, noting that annual catch limits were rarely exceeded and fishing season lengths increased for all programs. However, the assessment also stated that the economic effects of catch share systems have been mixed due in part to "factors external to the catch share program such as international trade, change in supply of substitute species, and the general economy."³⁹ Additional economic analysis is still needed to determine whether any overall trends exist for catch-share-managed fisheries.

Illegal, unregulated, and unreported fishing

In constructing the MSRA, Sens. Stevens and Inouye fundamentally understood that creating sustainable fisheries in domestic waters was critical but that rebuilding global fish stocks would require international cooperation. Some of the boldest provisions of the MSRA strengthened the U.S. role in international efforts to enforce, monitor, and manage fisheries on the high seas and established provisions to reduce illegal, unregulated, and unreported, or IUU, fishing.⁴⁰ The act included a provision requiring the Secretary of Commerce to identify countries whose vessels are participating in IUU fishing on the high seas and work with international fishery management organizations to end illegal fishing practices.⁴¹

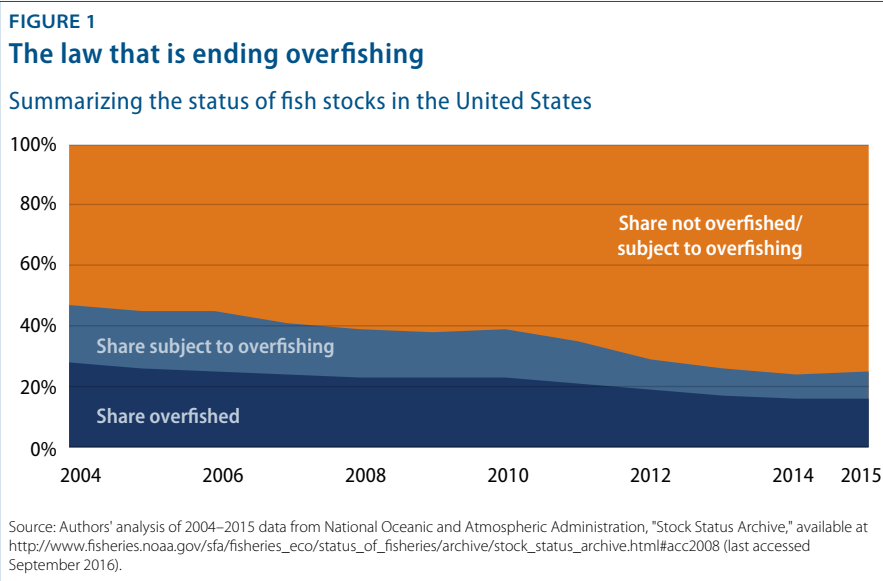
While NOAA and the Secretary of Commerce have not always enforced these provisions to the fullest extent, efforts to curb IUU fishing have increased during President Barack Obama's administration. In June 2014 President Obama established a Task Force on Combating Illegal, Unreported, and Unregulated Fishing and Seafood Fraud.⁴² As one of 15 recommendations outlined in the Task Force's Action Plan, NOAA is finalizing a seafood traceability program under the authority of the MSA that will require information such as where and when a fish was

caught to follow the product from harvest to the first point of sale in the United States.⁴³ This increase in traceability is intended to prevent IUU fish from entering U.S. markets and provide the data to act against illegal fishing practices. This rule is an important first step, but to be fully effective it must be expanded to include all fish species and extend past the first point of sale to the consumer.

Furthermore, with administration support, Congress ratified and passed the legislation necessary to implement an international agreement under the United Nations' Food and Agriculture Organization, known as the Port State Measures Agreement.⁴⁴ It helps deter illegal product from entering the U.S. marketplace by requiring member countries to collect identifying data from foreign vessels to ensure that they are traceable and that the vessels' fish has been caught under some form of regulation in its home country. Vessels that cannot provide these data are not permitted to enter a port and offload their catch.⁴⁵

Rebuilding America's fisheries

So how have these new provisions played out in real life? Fortunately, the MSA includes an easy metric, which was strengthened by the MSRA. The law now requires the Secretary of Commerce to submit an annual report to Congress regarding the status of U.S. fisheries. The first *Status of Stocks* was published in 1997 and listed 86 species as overfished, meaning their population levels were unsustainably low; it found 10 more species to be approaching an overfished state.⁴⁶ By 2006, when Congress passed the MSRA, that number of overfished fish stocks had dropped to 46.⁴⁷ And following entry into force of the MSRA reforms, the number has dropped even further—in the 2015 *Status of Stocks* report, there were just 38 overfished stocks, representing a mere 16 percent of all federally managed fisheries. It should be noted that some of these are very slow growing and are on rebuilding trajectories that stretch out for decades.⁴⁸ Perhaps more importantly, NOAA now estimates that 91 percent of stocks assessed are no longer subject to overfishing.⁴⁹



Included in the *Status of Stocks* report is a metric called the Fish Stock Sustainability Index, or FSSI, a ratio measuring the status of the nation’s fisheries as a whole. The FSSI uses information from 199 commercially important fish stocks that account for 85 percent of the total catch by volume in the United States.⁵⁰ Each fish stock is assigned a score from 0 to 4. Low scores signify an overfished stock, while high scores denote a healthy population. The FSSI is calculated by summing the scores of the individual stocks and dividing by the maximum amount of points available.⁵¹ As of 2015, the raw score is converted to a 1000-point scale to account for differences in the number of included fish stocks over time. As fish stocks improve, or become more sustainable, the FSSI score increases. Between 2006 and 2015, the FSSI increased from 557 to 758, demonstrating a dramatic increase in the sustainability of federally managed fish stocks.⁵²

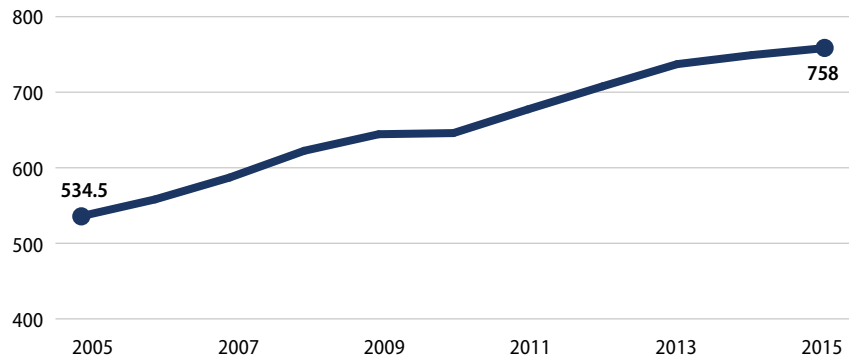
TABLE 1
Scoring methodology for each fish stock in the Fish Stock Sustainability Index

Criteria	Criteria points
1. Overfished status is known	0.5
2. Overfishing status is known	0.5
3. Overfishing is not occurring for stocks with known overfishing status	1
4. Stock biomass is more than the overfished level defined for a stock	1
5. Stock biomass is equal to or more than 80 percent of the biomass that produces maximum sustainable yield	1

Source: National Oceanic and Atmospheric Administration, “FSSI Scoring Methodology,” available at http://www.nmfs.noaa.gov/sfa/fisheries_eco/status_of_fisheries/fssi_scoring.html (last accessed September 2016).

FIGURE 2
U.S. fish stock sustainability index

Measuring the viability of federal fish populations



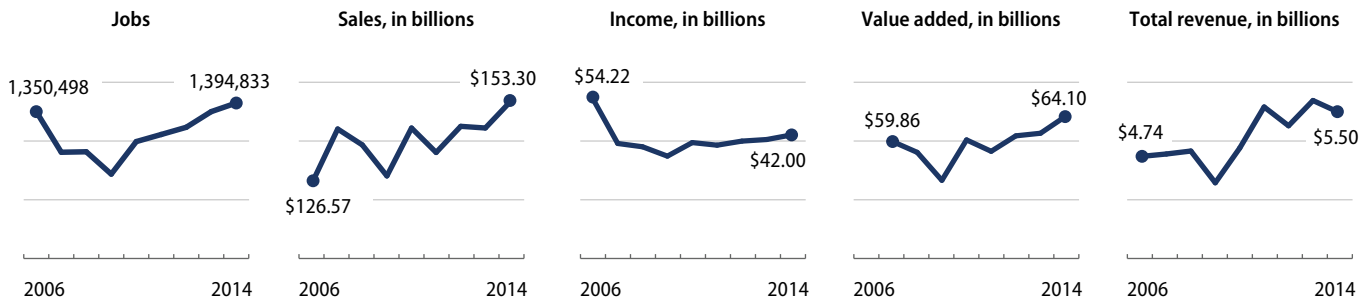
Sources: National Oceanic and Atmospheric Administration, "Species Information System Public Portal," available at <https://www.st.nmfs.noaa.gov/sisPortal/sisPortalMain.jsp> (last accessed September 2016); National Oceanic and Atmospheric Administration, "Stock Status Updates," available at http://www.nmfs.noaa.gov/sfa/fisheries_eco/status_of_fisheries/status_updates.html (last accessed September 2016).

Following passage of the MSRA, overall fishery production declined by roughly 17 percent, with total metric tons of fish landed in the United States decreasing from 4.3 million metric tons in 2006 to 3.6 metric tons at its nadir in 2009. Notably, this was before the mandate to set annual catch limits took effect in any fisheries, meaning the decline may have been due to natural fluctuations. Starting in 2010, however, landings trended upward once more, and in 2014, the last year for which NOAA's data are available, U.S. fishermen once again brought home 4.3 million metric tons of fish.

As the number of fish in the water has increased, the overall economic numbers in the commercial fishing industry have trended upward as well. In the year following the passage of the MSRA, the number of jobs provided by the seafood industry dipped from 1.35 million to 1.14 million. Since then, the number of jobs steadily increased, and by 2014, they had returned to 1.39 million.⁵³ Seafood industry sales increased by more than \$26 billion between 2006 and 2014, and the total value added, or the revenue minus the cost of production, increased steadily, from 59.8 billion to 64.1 billion in the same time period.⁵⁴ The total revenue generated from fisheries has also increased since 2006, from 4.7 billion to 5.5 billion in 2014.⁵⁵ It is important to note that the decrease in fisheries landings and revenue seen in 2009 may be due to the nationwide economic recession, which tightened sales and production in every industry.

FIGURE 3
Economic trends in the U.S. seafood industry

Adjusted for inflation, in 2014 dollars

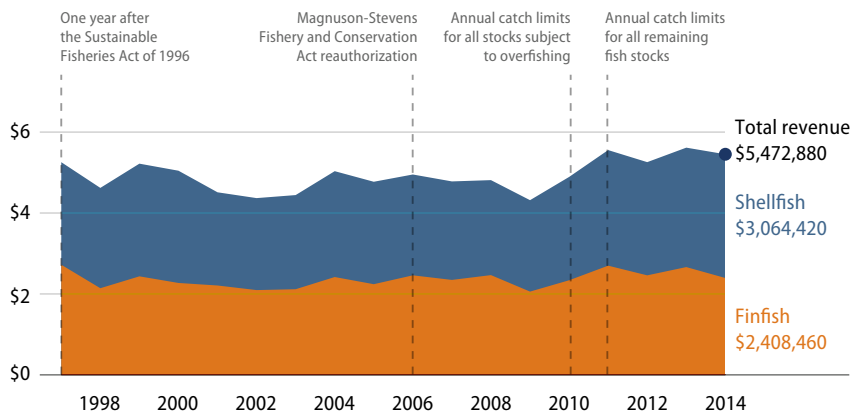


Notes: Total revenue generated equals the revenue generated from the commercial fishing sector. Total value added equals the value generated from the entire seafood industry.

Sources: National Oceanic and Atmospheric Administration, "Frequently Asked Question (FAQ) Sheet for the Value Added Table," available at https://www.st.nmfs.noaa.gov/st1/fus/FAQ_value_added.pdf (last accessed September 2016); National Oceanic and Atmospheric Administration and National Marine Fisheries Service, *Fisheries Economics of the United States 2014* (U.S. Department of Commerce, 2016), available at <https://www.st.nmfs.noaa.gov/Assets/economics/publications/FEUS/FEUS-2014/Report-and-chapters/FEUS-2014-FINAL-v5.pdf>; National Oceanic and Atmospheric Administration and National Marine Fisheries Service, *Fisheries Economics of the United States 2006* (U.S. Department of Commerce, 2008), available at http://www.st.nmfs.noaa.gov/st5/publication/econ/EconomicsReport_ALL.pdf; National Oceanic and Atmospheric Administration and National Marine Fisheries Service, *Fisheries Economics of the United States 2013* (U.S. Department of Commerce, 2015), available at <https://www.st.nmfs.noaa.gov/Assets/economics/publications/FEUS/FEUS-2013/documents/FEUS-2013-COMPLETE-v4.pdf>. Inflation adjustments made using the Consumer Price Index for all urban consumers from Federal Reserve Economic Database, "Consumer Price Index for All Urban Consumers: All Items," available at <https://fred.stlouisfed.org/series/CPIAUCSL#0> (last accessed September 2016).

FIGURE 4
Revenue from fisheries landings in the United States

Adjusted for inflation, in 2014 dollars

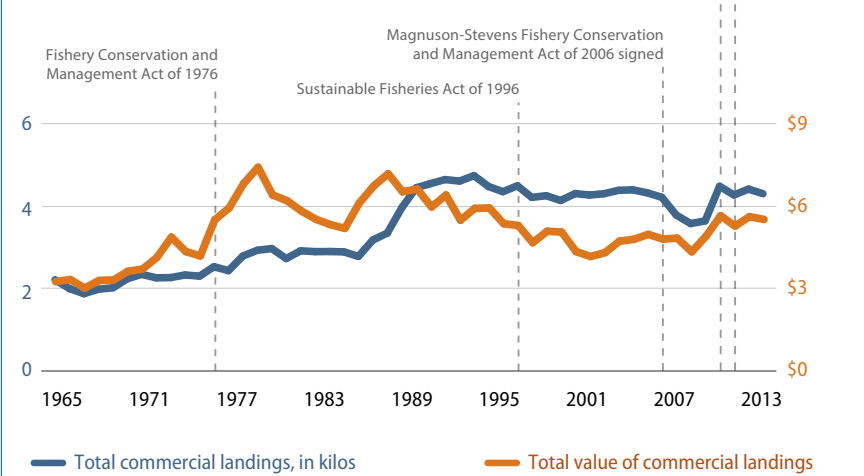


Sources: National Oceanic and Atmospheric Administration and National Marine Fisheries Service, *Fisheries Economics of the United States 2014* (U.S. Department of Commerce, 2016), available at <https://www.st.nmfs.noaa.gov/Assets/economics/publications/FEUS/FEUS-2014/Report-and-chapters/FEUS-2014-FINAL-v5.pdf>; National Oceanic and Atmospheric Administration and National Marine Fisheries Service, *Fisheries Economics of the United States 2006* (U.S. Department of Commerce, 2008), available at http://www.st.nmfs.noaa.gov/st5/publication/econ/EconomicsReport_ALL.pdf.

FIGURE 5

Value of commercial domestic seafood

Adjusted for inflation, in billions of 2014 dollars



Sources: National Oceanic and Atmospheric Administration, "Annual Commercial Landing Statistics," available at <http://www.st.nmfs.noaa.gov/commercial-fisheries/commercial-landings/annual-landings/index> (last accessed September 2016). Inflation adjustments made using the Consumer Price Index for all urban consumers from Federal Reserve Economic Database, "Consumer Price Index for All Urban Consumers: All Items," available at <https://fred.stlouisfed.org/series/CPIAUCSL#0> (last accessed August 2016).

Still, a look at two iconic fisheries in New England shows that these economic benefits are not universal. After collapsing in the early 1990s, the Atlantic sea scallop fishery was rebuilt in the early 2000s, and landings remained above 55 million pounds annually until 2013. Despite a decrease in landings, the average price fishermen received for their catch of scallops was the highest in the nation in 2014 at \$12.55 per pound.⁵⁶

Meanwhile, landings have remained low in the northeast multispecies fishery—better known as the groundfishery—that targets cod, haddock, and flounders, among other species. Despite increasingly steep cuts to annual catch limits for stocks such as cod and winter flounder, these populations have failed to bounce back from historic overfishing in the 1990s and early 2000s. Their recovery has also likely been complicated by rising ocean temperatures in the Gulf of Maine, which scientists have found is warming faster than 99 percent of the world’s oceans.⁵⁷ This region represents the southern end of cod’s range, and this effect of global climate change and carbon pollution is clearly taking its toll on one of New England’s most iconic species. In this fishery, revenues decreased 23 percent between 2010 and 2013.⁵⁸ Differences in fishery management plans, data availability, and market dynamics each play a role in the economic returns a given fishery generates.

Even within successful fisheries, a rising tide does not necessarily lift all boats. Fisheries without controls carefully crafted to ensure distribution of effort can allow some operators—typically larger ones with the financial capacity to ride out tough times—to thrive, while smaller fishermen operating closer to razor-thin profit margins are forced out during lean years and are often bought up by their larger competitors. This consolidation can lead to unintended consequences not just for individual fishermen but also for entire coastal communities, which can be left without an industry that in some cases has supported them for centuries when consolidated operations mean the boats remaining in the fleet move to fewer ports.⁵⁹ The councils have the authority in many cases to set regulations that address these consolidation concerns, but they do not always have the political clout or willingness to exercise their ability to do so. To again use the example of the New England groundfishery, when a new catch share system was implemented in 2010, the council did not include consolidation limits. In the subsequent six years, it has promised repeatedly to address issues of consolidation and community participation via an amendment to that plan, but negotiations have been contentious, and at the time of this report’s publication, there is no sense that a resolution is forthcoming.⁶⁰

The United States has taken strides to advance the sustainability of its fish stocks, including through data collection and accountability measures, but many countries lack the ability to monitor and enforce fishery management. As consumer demand for seafood continues to increase, the United States has relied on imported product, and in both 2014 and 2015, the country represented the second largest importer of seafood worldwide.⁶¹

According to NOAA, roughly 90 percent of the seafood consumed in the United States is imported, although an unknown amount of that fish is actually American caught fish exported for processing and reimported for consumption. As a result, those international management provisions that Sens. Stevens and Inouye included in the MSRA are critical to ensuring the sustainability and safety of the American seafood supply. Earlier this year, the Center for American Progress published “The Future of Seafood Security: The Fight Against Illegal Fishing and Seafood Fraud,” a report which details efforts the Obama administration has undertaken to address the problem of illegal fishing and seafood fraud and contains recommendations for future actions.⁶²

Setting the bar for fisheries management worldwide

Internationally, the Magnuson-Stevens Act has set the standard for responsible fisheries management. This has been most notable in the influence the MSA has had on European fisheries management policies.⁶³ For nearly 40 years, the European Union struggled under a haphazard accumulation of fisheries management policies called the Common Fisheries Policy. Like earlier iterations of U.S. fishery management, this system was plagued by ineffectiveness. It oversaw a 200-mile exclusive economic zone; total allowable catches and quotas that incentivized the discard of bycatch; an ineffective reduction in fleet size in an attempt to decrease overcapacity; and overall failed efforts to increase sustainability both ecologically and economically.⁶⁴ In 2009, EU officials admitted that despite attempts at sustainable fisheries management, 88 percent of fisheries were still being overfished. And almost one-third of fisheries were outside safe biological limits—meaning that the stocks were struggling to reproduce normally due to the dramatic depletion of the parent population. This made it apparent that reform was necessary.⁶⁵

In order to begin revamping its law, the EU began to look to the United States—to the extent that some scholars have called the MSA, and in particular the MSRA’s reforms, a “template” for EU policymakers.⁶⁶ In 2014 the EU passed the Common Fisheries Policy Reform, an act which was heavily based on the MSRA, particularly the provisions establishing empirically informed catch limits and supporting catch share systems.⁶⁷ Since these changes were enacted, the EU has consistently assessed fish stocks and enforced catch limits, resulting in a reduction from 88 percent to 58 percent of fish stocks that are not in “Good Environmental Standing.”⁶⁸ This success is especially notable in areas around Iceland, the United Kingdom, and Scandinavia, which contain the highest proportions of fish stocks rated as being used sustainably, whereas areas in the Mediterranean and Black Seas have not been successful.⁶⁹

Historically, EU fishing policies have been critiqued for allowing too much industry intervention, over-centralization of management policies, and reliance on fishing subsidies. As a leading producer of farmed fish and processed fish products, commercial fishing is an important industry to many parts of the EU.⁷⁰ Because of the prominence of the industry, however, the EU has attempted to balance ecosystem needs with the needs of the fishing industry—often resulting in policies that are overly focused on preserving current jobs and the industry’s economic gains. With recent legislation, however, the EU has successfully limited the influence of purely commercial interests, thus allowing it to make management decisions to end overfishing.⁷¹

The second critique of EU fishing policies is that they are overcentralized. Many are urging a transition to regionally managed fisheries such as the Regional Fisheries Management Councils that the United States adopted as a means to effectively reform fisheries management. A regional approach would provide flexibility to help fishermen respond to changing environments and would also help authorities understand key issues at the local level.⁷²

Future challenges

As a result of the MSRA, overfishing has decreased dramatically in the United States, but challenges in fisheries management remain. Addressing them will take cooperation among regulators, industry members, scientists, consumers, sustainability advocates, and other seafood stakeholders.

It will also require cooperation among legislators—something that has certainly been in short supply in recent years. As seen in the 2015 passage of legislation implementing the Port State Measures Agreement, however, the partisan sand that has slowed the gears of Congress does not necessarily prevent progress on fishery management issues. Co-Chairmen Stevens and Inouye broke the logjam blocking the MSRA, but as momentum for future action builds, Congress is without their leadership and experience and is also missing other former members who played key roles in the run-up to the 2006 effort, including Sens. Olympia Snowe (R-ME), John Kerry (D-MA), Trent Lott (R-MI), Frank Lautenberg (D-NJ), Ernest Hollings (D-SC), and many others. There has also been a high level of turnover among key staff. There are no staff members remaining in either the Senate Commerce Committee or the House Committee on Natural Resources who worked extensively on the MSRA.

Here are some of the key areas where additional work is needed to ensure a prosperous future for America's fishing industry.

Enhancing fisheries science and stock assessments

Science-based stock assessments are the heart of the MSRA's signature accomplishment—establishing annual catch limits and accountability measures for every federally managed fish species. Of course, these stock assessments are extremely complicated. Recall Shepherd's metaphor about managing fish being

“like managing a forest in which the trees are invisible and keep moving around.”⁷³ And the difficulty does not stop there. Fish also eat each other.

This complexity also means that accuracy in stock assessments, to the degree it’s possible at all, is expensive. And yet to the fishing industry, inaccuracy is also expensive because higher degrees of uncertainty in the data mean scientists have to account for it in their recommendations for the level at which managers can set catch limits—the more uncertainty in the science, the lower the catch limit can be set to ensure rebuilding targets are met.

Scientists rely on multiple sources of data to build their stock assessments. NOAA funds research surveys by independent scientists in many fisheries, though high value or overfished fisheries receive the bulk of these trips, meaning other smaller fisheries can often go a decade or more without a fishery independent research trip. Fishery independent data comes from research trips carried out by scientists, and in most cases, funded by the government. Fishery-dependent data, meanwhile, is reported by fishermen based on their trips. Both are crucial in the development of a robust stock assessment, but fishery independent data is the only way to sample throughout the entire geographic range of the fish and thus provide a more objective survey of the population. Fishermen, after all, fish where they expect to see high concentrations of their target species. Therefore, assessments based solely on their data can provide an unduly rosy picture of population health.

Fishery-dependent data is also vital and because it comes from the fishermen themselves, can give industry members a sense of ownership of the science being used to establish their restrictions. This in turn can make them more likely to trust the results of stock assessments based on their own experience. However, these requirements can be onerous and at times inaccurate or collected on too large a scale to be helpful.⁷⁴ Most fishermen do not get into the business because they like doing paperwork and filing reports. Furthermore, some of these reports are collected by human observers who are required to accompany fishermen on a portion of regular trips in some fisheries. Since their only job is data collection and they have no incentive to underreport amounts of discarded bycatch or interactions with protected or nontargeted species, such as marine mammals and sea turtles, their information tends to be more accurate. These observers’ presence on fishing vessels is generally not appreciated by captains and crew, who must host a government agent in their already cramped quarters on trips that can last as long as a week or longer.⁷⁵

Even when a particular species has sufficient data to generate a credible assessment, there is always some degree of uncertainty in modeling and predicting future reproductive potential. Incorporating interactions between stocks poses an additional challenge. Fish populations are dynamic and connected, each playing a role in the ecosystem and serving as both prey and predator. Multi-species stock assessments must take into account interactions between and within targeted species, non-targeted species, and the environment that surrounds them at an ecosystem level.

Changing climate, changing fisheries

As if all these challenges were not enough, climate change is already increasing the amount of variability and uncertainty in stock assessments. Warming ocean temperatures have led to shifts in distribution for some fish species, causing stocks to migrate north or to deeper waters in order to find colder water. Ocean warming and acidification may also affect the spawning habits of certain species and may reduce critical habitat for juvenile fish. In the Gulf of Maine, for example, lobster populations are moving north. On the West Coast, sablefish and Pacific hake are moving farther south.⁷⁶

Climate migration alters stock abundance, species composition, and overall productivity within specific regions. It can cause invasive species to move into regions where they can out-compete native species for resources, as is the case for lionfish, which are slowly moving northward up the U.S. Atlantic coast.⁷⁷ Even if a new species is not a destructive invader—as the lionfish is—as abundance increases, fisheries managers are forced to adjust.

Black sea bass has always been present in the mid-Atlantic waters of the United States and regularly ranged as far north as Cape Cod. Over the past few years, fishermen in Rhode Island and Massachusetts have been seeing an increase in the amount of black sea bass ending up in their nets as the species has begun to appear in never-before-seen numbers even into the colder waters of the Gulf of Maine. The ecosystem implications of this population shift are unknown and concerning to state regulators, particularly those in Maine who know that one of the fish's favorite foods is juvenile lobsters.⁷⁸ In 2014, for the first time in history, Maine had to establish a management plan for black sea bass in state waters.⁷⁹

Down in Rhode Island, the more pressing problem is that, because the state's commercial fishermen do not have a history of catching as much of this commercially valuable fish as they now find in their nets, fishermen there lack adequate quota to allow them to land and sell the fish they are catching. They also lack a seat on the mid-Atlantic council that would give them a voice in the quota allocation. Current council members representing states that have traditionally caught most of the bass are reluctant to cede any of their share to their northern neighbors.⁸⁰

In 2015, recognizing the likelihood of more such climate change-related issues, NOAA released a "Fisheries Climate Science Strategy" report to help coordinate efforts to increase knowledge and use of climate-related information in fishery management. The strategy was based on seven core objectives, including adaptive decision-making; identifying future states of marine and coastal ecosystems; tracking trends in climate; and building a science infrastructure to fulfill NOAA's mandates given a changing climate.⁸¹ In the short term, NOAA plans to conduct regional analyses of climate vulnerability for living marine resources and produce status reports to help prepare for climate changes.⁸² As these distribution patterns continue to shift, however, more action will be required to follow up on the findings of this research.

Foraging for answers

One of the most difficult aspects of fishery management and stock assessment development is how to balance interactions among species. It is hard enough to determine how much fish humans can catch while leaving the population large enough to continue reproducing itself. One must also consider the broader ecosystem implications of taking vast quantities of fish out of the water. After all, as every high school student learns in basic biology, what do big fish eat? Little fish. So when the little fish become fishermen's targets the big fish have a harder time maintaining or rebuilding their populations.

Species such as herring, menhaden, and anchovies are commonly referred to as forage fish. They typically subsist on plankton or marine plants, and serve as food for larger fish such as tuna and swordfish as well as for seabirds, some whales, and other marine mammals. Left to their own devices in the marine ecosystem, they represent the main pathway for energy to flow from the bottom level of the food web to the higher trophic levels. They are also the targets of human predators who pursue them for food; to grind into fishmeal that becomes aquaculture feed or fertilizer; to use them as bait in other fisheries; or to harvest them for their omega-3 rich oils.

In recent years, management of forage fish has become an increasingly contentious issue. Tuna fishermen have found themselves allied with environmentalists and marine mammal advocates fighting to leave more forage fish in the water to serve their ecosystem function in the food web.⁸³ On the other side of the equation, herring fishermen have joined forces with lobstermen who rely on herring and menhaden to bait their traps, lobbying to keep catch limits up.⁸⁴

The Lenfest Ocean Program, a science- and communications-focused nongovernmental organization, has teamed up with Stony Brook University's Institute for Ocean Conservation Science and become a global leader in studying the role of forage fish in ecosystems and coastal economies. It published a landmark report in 2012 that found that worldwide forage fish are twice as valuable in the water as in the net. The report, "Little Fish, Big Impact," estimated that the so-called supportive value of forage fish left in the water as food for commercially viable species is \$11.3 billion annually in 2006 dollars. These same forage fish, meanwhile, would have a comparative direct catch value of only \$5.6 billion.⁸⁵ The report found supportive value to be greater than direct value in 30 of the 56 ecosystem models studied.

"Ecosystem" is the key word here, because ultimately that is the scale at which ideal fisheries management must occur. Humans are just one part of the global ecosystem, and managing fisheries as if human effort to catch that one species is all that matters not only leaves other species wanting but will also directly undermine human needs and even fishermen's needs, including availability of higher-trophic-level—and higher-value—fish.

In the MSRA, legislators and their staffs discussed ecosystem-based management as a tool, and the act included a section requiring NOAA to report to Congress on "the state of the science for incorporating ecosystem considerations in regional fishery management."⁸⁶ As efforts like those of the Lenfest Ocean Program continue to point out the vital role forage fish and other ecosystem considerations play in maintaining healthy fish stocks and the broader environment on all trophic levels, the time has come to begin integrating these principles into fishery management plans.

Eyes on the water

All of the previously discussed improvements to the law share one common trait: the need for more and better data and faster data management and processing. In an era when our phones can tell us how many steps we take in a day, provide

minute-by-minute traffic reports, and lead us by the nose to even the remotest destination, it seems absurd that we still rely on extra, and often unwelcome, human beings to travel aboard a percentage of tiny fishing vessels more than 100 miles from shore to count fish by hand. It seems there must be a better system than relying on vessel trip report documents handwritten by weary captains on pitching and rolling ships in the middle of the ocean to verify where and when they harvested their catch.

In fact, technological solutions already exist that can provide better data at lower costs, put fewer people at risk, and cover even the most distant, deserted stretches of ocean.

Electronic monitoring is one such solution, through which cameras are installed on fishing vessels to record fishing activity. In 2013, a group led by the Environmental Defense Fund produced a “Fisheries Monitoring Roadmap,” a handbook of best practices for implementing the tactic in U.S. fisheries.⁸⁷ With human on-board observers remaining such a contentious and expensive solution, the roadmap illuminated a path to a system that would lead to better coverage of fishing activity, better working conditions for observers, and ultimately, better data delivered to managers and scientists that would help guard against bad fishery actors and lead to more accurate stock assessments.

Naturally, when the topic of video monitoring comes up, some fishermen complain about Big Brother looking over their shoulders as they do their jobs.⁸⁸ But these fishermen should understand that no industry operates independent of inspectors. Fisheries are unique, however, in that it is exceedingly difficult for regulators to just pop by for a surprise inspection when they are moving around vast swaths of ocean sometimes hundreds of miles from shore. When cameras are proposed as an alternative to carrying an extra body on a vessel, many captains change their tune. When cost becomes a factor, the balance skews even further in favor of video monitoring. The Roadmap found that the cost of electronic monitoring in the Pacific whiting fishery was between \$270 and \$350 per day depending on whether the equipment was purchased or leased. By comparison, taking a human observer on a fishing vessel in the New England groundfishery cost an average of \$847 per day.⁸⁹ While the roadmap cautions that “care should be exercised in comparing the relative costs among fisheries,” the comparison remains stark and meaningful.⁹⁰

Advanced monitoring tactics have also become vital in the fight against illegal, unreported, and unregulated fisheries in international waters. Two different systems have emerged in recent years that rely on data gathered from vessel monitoring systems, or VMS, which most nations require their fishing vessels to carry. VMS are effectively satellite tracking systems that emit unique pings on a regular basis. They contain basic information about a vessel, including its name, registration number, and nationality. When amalgamated, these pings show a clear track of a vessel's voyage. By analyzing the location and rate of travel, these tracks clearly show where vessels have been, as well as when they were in transit or conducting fishing activity.⁹¹

Oceana has partnered with Google and Skytruth to develop a system called Global Fishing Watch, which is currently in a beta version.⁹² This system places vessels' VMS data into tracks superimposed over Google Earth maps of the ocean surface. These data have been most effective for showing when vessels engage in fishing activity inside the boundaries of marine-protected areas or in waters controlled by countries in which they do not have permission to fish.⁹³ The data can also be used to show when vessels make unusual transits that indicate other illegal activity such as transshipments at sea. The Pew Charitable Trusts has also launched a similar initiative, Project Eyes on the Sea, in partnership with Satellite Applications Catapult.⁹⁴ Tools such as these will prove invaluable for enforcement against illegal fishing activity worldwide.

The U.S. Department of State has engaged in this effort as well, developing a Safe Ocean Network—formerly known as the Sea Scout Initiative—which aims to “strengthen monitoring, control and surveillance (MCS) efforts through the integration of existing and emerging technologies, expanded use of internet-based tools, enhanced coordination and information sharing, and capacity building.”⁹⁵ Secretary of State John Kerry, who was also a leader in fishery management and lead co-sponsor of the SFA during his tenure in the U.S. Senate, has made addressing IUU fishing and seafood traceability one of the pillars of his department's series of “Our Ocean” conferences.⁹⁶

Finally, the Global Ocean Commission is also an important player in the ongoing fight against illegal fishing. It is an independent, international body of former regulators and legislators focused on improving management of the world's oceans, particularly areas beyond any national jurisdiction—better known as the high seas. It has focused one of its highest priority recommendations on pushing

the United Nations' International Maritime Organization to apply its standard requirements for vessel registration and tracking to all fishing vessels operating on the high seas, including the use of VMS.⁹⁷ Combining this single action with increased use of oversight tools such as those developed by Oceana, Google, and Pew would make tremendous strides toward ending illegal, unregulated, and unreported fishing activity.

Policy recommendations

To achieve improvements in all of these categories, the authors recommend that regulators and policymakers take the following actions:

Account for changes resulting from climate change

Regulators should work to account for changes in fishery dynamics that fishermen around the country are already experiencing as a result of climate change, including ocean acidification and warming. To the extent that legislative amendments are necessary to permit such action, Congress should act to grant regulators such authority. Climate change will affect each regional fishery management council differently, and any new legislation must be strong yet flexible in managing shifting fish stocks and changes to species composition, particularly in adjacent regions. Congress can do this by facilitating discussion between regional management councils, as species may shift their distribution outside their traditional range and into the waters of neighboring states.

Prioritize ecosystem-based management

Fisheries managers and regional councils should prioritize ecosystem-based management as a tool to facilitate a holistic fisheries management. Ecosystem-based management differs from traditional fisheries management by considering the entire ecosystem, including humans, when designing conservation measures instead of focusing on a single fish species.⁹⁸ This integrated approach takes into account the complexity of the interactions between species in a given environment and acknowledges that a decline in a certain fish population may adversely impact other fish stocks that rely on specific food chain linkages.⁹⁹ Prioritizing ecosystem-based management will highlight key interactions between species in order to effectively manage an entire ocean area.

Increase accountability and data collection

NOAA should aggressively pursue the development and deployment of electronic monitoring systems for fishing vessels, particularly in lieu of continuing to rely on the use of costly and contentious on-board fishery observers. It should work with NGOs and other governmental agencies to promote the use of technology, such as Global Fishing Watch, designed by Oceana, Google, and Skytruth, and Eyes on the Sea, developed by the Pew Charitable Trust, and collaborate with the Department of State in development and implementation of the Safe Ocean Network.

Appropriate additional funding and prioritize existing funding streams

Congress should appropriate additional funding for ocean observation and baseline research to facilitate data collection and stock assessment science. In addition, the next reauthorization of the MSA should include provisions for an outside review of fishery management plans and the corresponding status of fish populations. An outside review will allow fishery managers to prioritize future efforts and highlight the progress the MSA has already made in domestic fisheries management.

To address the long-term need for additional data and improved fisheries stock assessments, including in light of changing ocean ecosystems, Congress and the administration should prioritize new funding for stock assessments and affiliated research. In addition, whenever possible, the fishing industry, in conjunction with the councils and NOAA, should dedicate a small percentage of revenue to fund future stock assessment science through research set-aside programs.¹⁰⁰ Research set-aside programs, established by the New England and Mid-Atlantic Fishery Management Councils, currently provide competitive grants to scientists and organizations researching Atlantic herring, sea scallop, and monkfish.¹⁰¹ Each regional council should develop its own research set-aside program to advance data availability and technology in fisheries.

Finalize regulations to curtail IUU fishing abroad

Using the MSA's strong international provisions, the Obama administration should finalize regulations aimed at curtailing illegal, unreported, and unregulated fishing abroad. The next administration should continue to enhance and develop these regulations, including by expanding the national seafood traceability program to cover all species imported to the United States and extending the traceability requirements to follow the product from the initial harvest to the final consumer rather than the first point of sale. NOAA should work with other agencies, including the State Department, USAID, and Customs and Border Protection to ensure efficient data transfer and coordination.

Promote expansion of vessel monitoring and registration standards

U.S. leaders and government officials should press the International Maritime Organization to expand application of its vessel monitoring and registration standards to include all fishing vessels operating on the high seas. Currently, the U.S. Coast Guard requires commercial vessels larger than 65 feet to use an Automatic Identification System, or AIS, that provides real-time GPS information on the speed, course, and position of the vessel.¹⁰² Vessel monitoring systems, or VMS, currently monitors 4,000 vessels in the United States. This information helps ensure that commercial vessels abide by the law and provides a first step for identifying and stopping illegal fishing.

Conclusion

For 135 years, government scientists have studied American fisheries. For more than 40 years, fisheries have been regulated using a law that 10 years ago became the most effective fishery management regimen anywhere on the planet. Today, as regulators look toward the next decade and even the next century of American fisheries, they are faced with increasing challenges: population growth; climate change; maintaining coastal economies; and the perpetual dilemma of counting fish that are invisible, constantly moving, and hungry for each other. Fortunately, those in fishery management are now in possession of knowledge and technology that will allow them to make an already powerful tool even more effective.

By working together to acknowledge these challenges and experiment with potential solutions, fishermen; scientists; regulators; environmental groups; and all those with an interest in fish, the marine environment, and the well-being of coastal communities can drive fishery management to even greater understanding of the mysteries of the deep. Instead of continuing the trend of “food fishes ... rapidly diminishing in number, to the public injury,” first identified by Congress in 1871, the United States has already begun to reverse this downward slide in its waters. And in doing so, the country has provided a model for other nations to follow. If the United States continues to lead by example, the world will still be eating wild-caught fish 135 years from today.

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