MID-ATLANTIC BLUE OCEAN ECONOMY 2030

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Economics of Mid-Atlantic Fisheries in the Year 2030

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DISCUSSION PAPER

Dr. Dennis King of the University of Maryland's Center for Environmental Science has 40 years of teaching, research and consulting experience in the field of natural resource economics with strong emphasis on fisheries, aquaculture, seaports, shipping, and ocean-based industries and markets. He is the author of over 100 reports, papers and book chapters dealing with economic, business, and trade issues associated with environmental/economic linkages. He has served as project manager on over 100 interdisciplinary science/ policy research projects dealing with economic and bio-economic aspects of complex ocean-related issues. Dr. King serves as an expert witness in many court cases involving environmental impacts and economic losses related to ocean-related industries, and has been an advisor to many national and international natural resource and economic development agencies, small and large ocean-dependent businesses, seaport administrations, environmental organizations and insurance and financial institutions.

Economics of Mid-Atlantic Fisheries in the Year 2030

By Dennis M. King, Ph.D.
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1. Introduction

Between now and the year 2030, economic conditions in U.S. Mid-Atlantic fisheries will become increasingly volatile. There will be two major sources of disruption, and several less important sources that could combine, over time, to transform Mid-Atlantic fisheries. One source of major disruptions will be the impacts of climate change on ocean conditions that determine the abundance, distribution, and catchability of fish; the second is how fishery regulators respond to those changes in ocean conditions, and to evidence that certain fish stocks in the region are vulnerable to them and may even face immediate threats from them.

Less certain, but potentially very disruptive sources of change, will be: changes in the structure of fishery management in state waters (out 3 miles from shore), including the reallocation of catch quotas among Mid-Atlantic states to better match where fish are located; amendments to the Magnuson-Stevens Act that will give managers of fisheries in federal waters (from 3 miles to 200 miles out) more flexibility and require them to give more consideration to socio-economics; the planned shift from species-based to ecosystem-based fishery management; and the increasing influence of environmental NGOs on fishery and ocean management decisions.

By 2030 the rapid pace of technological change, especially the increasing accuracy and decreasing costs of real-time oceanographic data, shipboard data processing and telecommunications capacity, and acoustical and sonar equipment will also bring changes in Mid-Atlantic fisheries. These changes will result in consolidation of businesses in the commercial fishing sector that will favor larger integrated multi-vessel fishing businesses over individual vessel owner/operators. They will also favor landing, processing, and wholesaling more of the commercial harvest in the Mid-Atlantic region at larger northern fishing ports, such as New Bedford.

These same emerging technologies make it increasingly likely that human at-sea government observers, now required on only 8% of commercial fishing trips in the Mid-Atlantic region, will be replaced by electronic ship-board catch monitoring systems that will be required on a much higher percentage of fishing trips. This increased monitoring of fishing activity will reduce the significant problem of illegal and unreported catches and discards (the “observer effect”), and will improve catch statistics used in fishery models.

Unfortunately, these improved catch statistics will not overcome the fact that changing ocean conditions are rendering the results of conventional fishery models less reliable as a basis for establishing fishing regulations. Increasing scientific uncertainty will make fishing regulations more controversial in the years ahead, result in more political and legal challenges to fishing regulations aimed at conservation and stock rebuilding, and more enforcement and compliance problems. This unsettled situation will persist until fishery models can capture the effects of

changing ocean conditions on fish stocks and this may not happen before 2030. There is also a high likelihood that offshore renewable energy (wind farms) and offshore aquaculture (fish farms) will begin operating in the region before 2030. These new ocean industries could compete with fishing in various ways, and become additional sources of disruptions at sea and on-shore that will affect economic conditions in Mid-Atlantic fisheries.

Overview

The key fish species harvested in Mid-Atlantic commercial and recreational fisheries and their contributions to the 2015 harvest are shown in Figure 1. Note that there is very little overlap in the key species targeted by commercial and recreational fishermen. This has limited conflicts between commercial fishing and recreational fishing interests that are more common in some other regional fisheries. However, this situation can be expected to change in the years ahead as fish species move into and out of the region, become more or less abundant in near-shore or off-shore fishing areas, and become the focus of new ecosystem-based fishery management decisions.

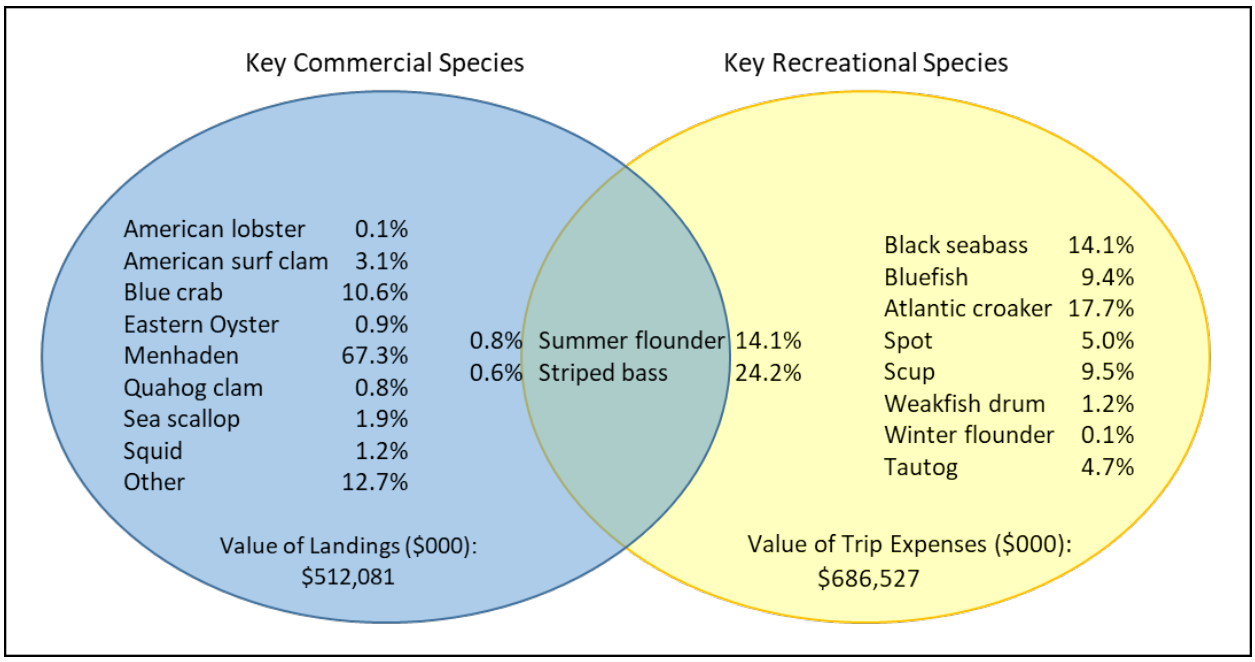

Figure 1. Key species in Mid-Atlantic commercial and recreational fisheries and their % contribution to the harvest. (Source: NOAA, Fishery Economics of the United States, 2015)

Figure 2 is from a preliminary climate change risk assessment that was prepared recently for the Mid-Atlantic Fishery Management Council. It shows that with the exception of one fish species (tilefish) all of the thirteen Mid-Atlantic species examined show high or very high measures of what the study refers to as "Species Distribution Risk Potential." That means the species is expected to become more difficult to locate for purposes of sampling and harvesting. That will pose challenges to fishermen who will need to spend more time searching for fish that may not even be available, and for fishery managers and fishery scientists who must decide whether

changes in fishery and non-fishery catch statistics reflect changes in fish abundance or availability or incorrect sampling location choices.

There is no doubt that anticipated changes in the distribution of fish, along with the much needed shift from species-based to ecosystem-based fishery management, will introduce more uncertainty into fishing and fishery science and management in the years ahead. This, in turn, will result in increasingly difficult conflicts involving fishery regulators, financially struggling fishermen, environmental NGOs, and others. All of this may force an overhaul in the institutions that have evolved to manage Mid-Atlantic fisheries with more overlap in management by state and federal fishery regulators in the Mid-Atlantic region and in regions to the north and south.

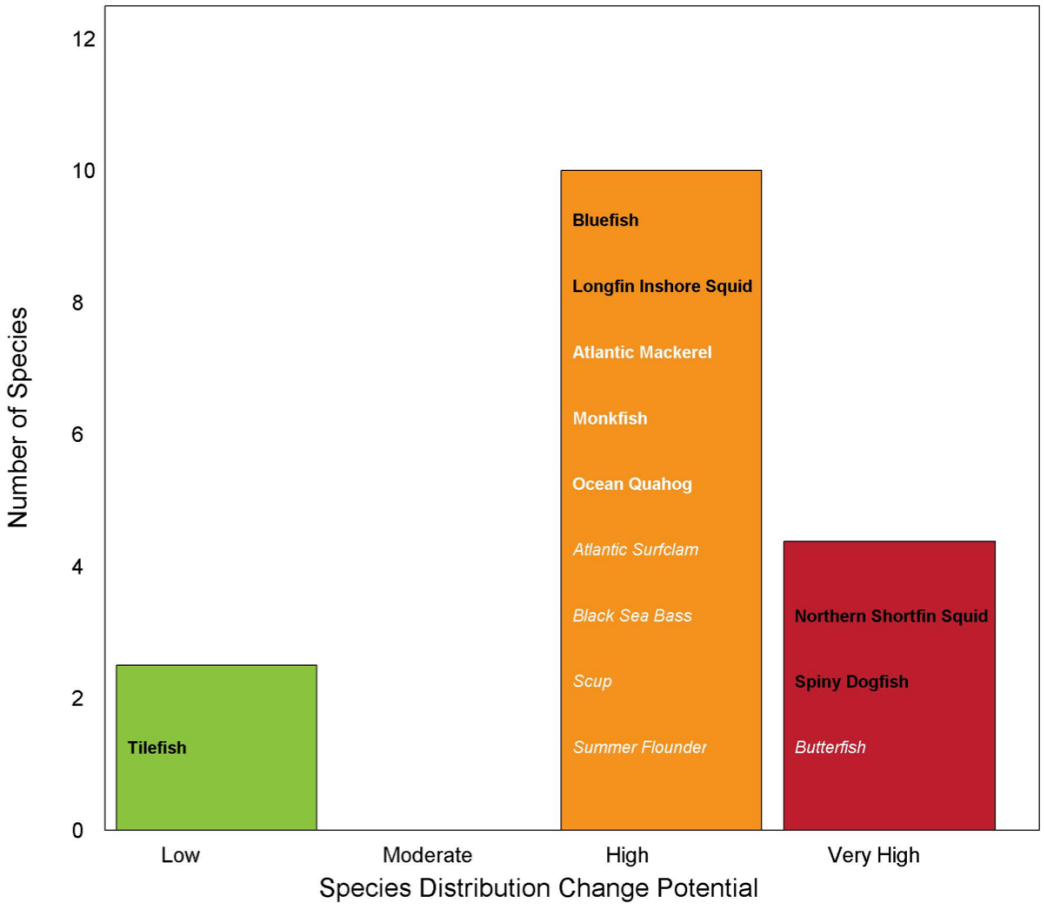

Figure 6. Results of Northeast Climate Vulnerability Analysis (Hare et al. 2016) for Mid-Atlantic species distribution shift risk (From Gaichas, S., G. DePiper, R. Seagraves, L. Colburn, A. Loftus, M. Sabo, and B. Muffley. 2017. DRAFT Mid-Atlantic EAFM Risk Assessment Documentation)

Climate-induced shifts in fish resources will have some positive impacts on Mid-Atlantic fisheries as warmer water in the region attracts some species, such as windowpane flounder and blueline tilefish, into the region from the south. Whether the economic payoff from fish species moving in

from the south will eventually offset the economic losses associated with fish species, such as black sea bass and summer flounder, moving out of the region to the north remains to be seen. However, the transition from one set of key MidAtlantic species to another is bound to be disruptive, complicate fishery management and favor some fishing fleet and fishing ports over others.

2. Economic Significance of Mid-Atlantic Fisheries

Direct Economic Impacts

The ex-vessel value of commercial fish landings at Mid-Atlantic ports during 2015 was $512.1 million and spending by recreational anglers on fishing trips was $686.5 million. During 2015 spending in the region by recreational anglers on durable goods that support their fishing activity (e.g., boats, vacation homes, and equipment) was estimated to be $2.8 billion.

Multiplier Impacts

Spending on fishing and incomes earned from fishing generate incomes in non-fishing sectors of the Mid-Atlantic economy that result in "rounds" of additional spending and indirect and induced economic impacts that are generally referred to as "multiplier" effects. These multiplier effects are usually measured in terms of increases in business sales, household incomes, jobs, and value added.

Table 1 provides estimates of economic impacts (multiplier effects) from Mid-Atlantic commercial fishing (Table 1a), recreational fishing (Table 1b) and both types of fishing combined (Table 1c) for 2015. As shown, commercial and recreational fishing in the region during 2015 generated $5.7 billion in business sales, $2.3 billion in household income, and just over 64,000 jobs.

Table 1a. Economic impacts of Mid-Atlantic commercial fisheries

Landed Revenues ($000)	New York	New Jersey	Delaware	Maryland	Virginia	Mid-Atlantic
Sales	$181,429	$26,170	$33,505	$435,685	$946,687	$1,623,476
Income	$63,039	$8,697	$7,096	$160,640	$362,035	$601,507
Value Added	$88,176	$12,488	$11,380	$218,656	$489,812	$820,512
Jobs (number)	3,514	292	263	7,465	15,439	26,973

Table 1b. Economic impacts of Mid-Atlantic recreational fisheries

Economic Impacts ($000)	New York	New Jersey	Delaware	Maryland	Virginia	Mid-Atlantic
Sales	$873,940	$1,838,756	$100,498	$723,669	$520,947	$4,057,810
Income	$376,697	$785,623	$40,261	$300,832	$212,751	$1,716,164
Value Added	$586,816	$1,225,361	$65,387	$470,291	$336,869	$2,684,724
Jobs (number)	7,844	16,096	968	6,999	5,263	37,170

Table 1c. Economic impacts of all Mid-Atlantic fisheries

Economic Impacts ($000)	New York	New Jersey	Delaware	Maryland	Virginia	Mid-Atlantic
Sales	$1,055,369	$1,864,926	$134,003	$1,159,354	$1,467,634	$5,681,286
Income	$439,736	$794,320	$47,357	$461,472	$574,786	$2,317,671
Value Added	$674,992	$1,237,849	$76,767	$688,947	$826,681	$3,505,236
Jobs (number)	11,358	16,388	1,231	14,464	20,702	64,143

Economic Impacts – The Commercial Fishery

The U.S. seafood market in 2015 was valued at $96 billion. It surprises many Americans to learn that 90% of this market is supplied by seafood imports, and that 50% of these imports are from aquaculture (fish farms), not foreign capture fisheries. About 30% of seafood imports are thought to be from illegal, unreported and unmanaged (IUU) fishing and about 33% has been shown to be mislabeled as to species or origin.

In 2015 the ex-vessel value of U.S. commercial fish landings at Mid-Atlantic ports ($512.1 million). This accounted for 9.9% of the value of total U.S. commercial landings ($5,184.0 million, and 26.5% of the value of landings at all U.S. Atlantic coast ports ($1,932.0 million).

One important caveat is in order when considering the commercial fishing impact estimates presented in Table 1. Like nearly all economic impact estimates, they are based on the assumption that there is a relatively stable relationship between spending on fishing activity (inputs) and the value of fish landings (outputs). As the next section will indicate, however, the value of commercial landings in the Mid-Atlantic region has been increasing because of rising ex-vessel fish prices, while actual landings of commercially valuable fish have been declining. In the case of highly valued sea scallops, for example, harvested value increased by 24.4% over the past ten years while the pounds landed declined by 34.9%. This probably means that incomes of commercial fishermen have gone up, but it also means that indirect and induced economic impacts from fishing activity and related supply chain linkages may not be as high as shown in Table 1a.

Economic Impacts -Recreational Fisheries

The economic impacts of recreational fishing shown in Table 1b are generated by spending on recreational fishing. However, it is important to distinguish these spending-generated economic impacts from recreational fishing from the economic benefits associated with recreational fishing. There is no reason to expect that recreational anglers derive more benefits from fishing when they spend more on fishing. In fact, the opposite is generally true. Typically the net benefits from recreational fishing are inversely related to how much anglers must spend on recreational fishing and, therefore, are inversely related to the economic impacts of that spending.

This may seem like a relatively unimportant distinction, but it can become important when people are using competing measures of impacts and benefits to compare the economic value of various recreational fisheries, or the economic rationale for allocating fishing rights among various types of recreational anglers. For example, a day "fishing from shore" requires relatively little spending and generates relatively small economic impacts when compared with a day of fishing from a

private or for-hire boat. That does not mean that the benefits that anglers derive from a day of fishing from shore is any less than a day fishing any other way. In fact, differences in incomes and other demographic characteristics may make it both more equitable and more economically beneficial to support policies that protect shore-based fishing over those that favor for-hire fishing. Note on Table 2 that fishing from shore accounted for 40% of the 12.4 million angler days in the Mid-Atlantic region during 2015, while fishing from private boats and for-hire boats accounted for 50% and 10% respectively.

3. Emerging trends affecting Mid-Atlantic Fisheries

Commercial Fisheries

Figure 2 shows that between 2002 and 2015 the annual commercial harvest in the region was relatively constant at between 600 million and 800 million pounds. However, this relatively stable overall commercial harvest is dominated by a huge and relatively steady annual industrial harvest of 400 to 500 million pounds of low-value menhaden that in 2015 accounted for over 67% of commercial landings in the region, but only 7.9% by value.

Figure 2 shows a significant downward trend in Mid-Atlantic commercial landings of economically important marine species other than menhaden. During 2002 to 2015 overall landings of these important commercial species declined by 53.0 % and landings of four key species--- sea scallop, squid, summer flounder and striped bass---dropped by 34.9%, 24.3%, 24.4%, and 20.0%, respectively. Annual landings of two other historically significant commercial species in the region, lobster and surf clams, declined during this period by 64% and 57% respectively.

Despite these significant declines in landings of commercially important species during the period from 2002 to 2015 the ex-vessel value of these landings during the period increased by 36.9%. This was a result of increases in fish prices, especially a doubling of the price for highly valued sea scallops which in 2015 accounted for only 1.9 % of commercial landings by volume, but nearly 29.4 % by value. This is important because it means that increasing fish prices have temporarily delayed some of the adverse economic impacts of a decline in annual landings of important commercial species in the region. The causes of these trends differ from species to species and may reflect declining fish stock abundance, availability, or catchability, or declining fish quotas aimed at rebuilding fish stock abundance. Whatever the cause, these trends are not sustainable and unless they can be reversed or offset over the next few years will have adverse economic impacts that will become apparent by 2030.

One important outcome that can be expect to result before 2030 as a result of the anticipated shift from species-based to ecosystem-based fishery management in the Mid-Atlantic region will be a significant reduction in the allowable commercial harvest of menhaden. Menhaden is an important forage species for many valuable fish species in the region, as well as for whales and sea birds. For many years it has been widely believed that the value of the "ecosystem services" menhaden provide when they left as forage for other species is probably higher than its harvested value ($.08 per pound in 2015). Within a few years this will be proven using modern ecological/economic models and will form the basis for managing the menhaden fishery.

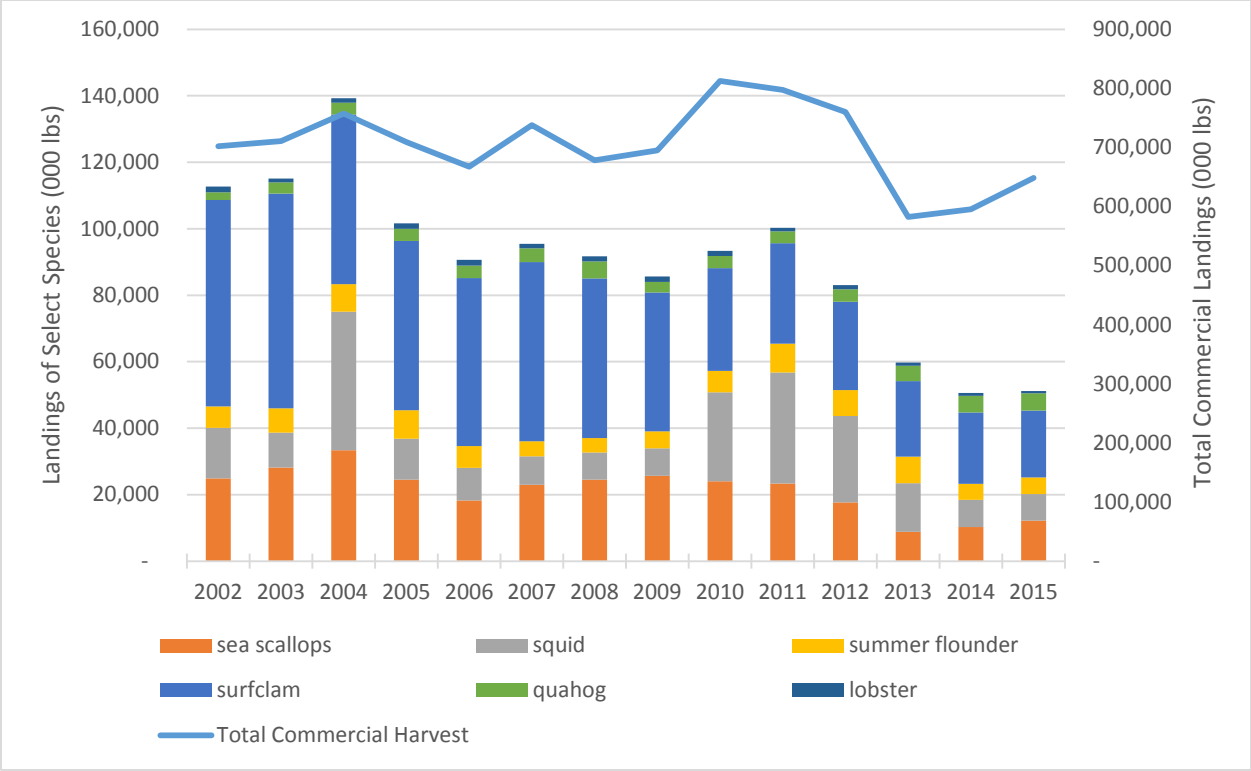

Figure 2. Total commercial harvest (including menhaden) and the harvest of important commercial species in the Mid-Atlantic region during 2003-2015 (000 lbs.) Source: NOAA, Fishery Economics of the United States, various years

What is certain is that economic conditions in Mid-Atlantic fisheries will be influenced to an enormous extent by fishery management decisions that will need be made on the basis of fishery models that are just now being modified to take account of climate-related changes in ocean conditions. As things stand, these models must rely mostly on historical relationships between stock abundance and recruitment and sampling methods that usually do not account for shifting ranges or distributions of fish stocks, fish eggs, and larvae. Fishery scientists are improving their models, but this will take years, and result in years of controversy that will be fueled by increasing uncertainty associated with the shift from species-based to ecosystem-based fishery management.

It is reasonable to expect that between now and 2030 there will be a good deal of trial and error in fishery science and more uncertainty about the scientific justification for changes in fishing restrictions. At the same time amendments to the Magnusson-Stevens Act are expected to give federal fishery regulators more flexibility when establishing and enforcing fishing restrictions and setting timetables for achieving fish stock rebuilding targets, and require them to give more consideration to socio-economics. Eventually all this added flexibility and new mandates to consider socio-economics could result in positive economic outcomes in Mid-Atlantic fisheries. However, this is not likely to happen before 2030.

Trends in Recreational Fisheries

Figure 3 shows that between 2002 and 2015 there was a significant 39.6% decline in recreational fishing in the Mid-Atlantic region, measured as “angler trips”, and a 45.9% decline in the number

of fish caught by recreational anglers (including both harvested and released fish). The annual recreational catch of every species reported as being taken by recreational anglers in the region declined during the period, with the catch of popular striped bass dropping by 43.5%, and catches of summer and winter flounder dropping by 38.8% and 94.4 %, respectively.

These trends show a significant decline in all forms of recreational fishing in the region. However, there is evidence that this may reflect problems with the telephone survey method NOAA has been using rather than actual declines in recreational angling. Historically NOAAs survey methods relied on phone calls to land lines in area codes near the coast to contact anglers and potential anglers and estimate participation rates, spending, and catches. Two modern trends have resulted in these phone survey yielding unreliable results. First, increasing numbers of Americans, including anglers, have gone wireless each year since about 2000, reaching over 50% in 2017. Second, many people, including anglers, keep cell phone numbers with area codes that reflect where they first received cell phone service, not where they live. Comparisons between recreational fishing statistics developed from these phone surveys and developed in other ways (e.g., interviews or mail surveys) suggest that recreational angler trips and recreational catches in the Mid-Atlantic region in recent years are probably 2 to 4 times higher than those presented the recent NOAA reports that formed the basis of Figure 3.

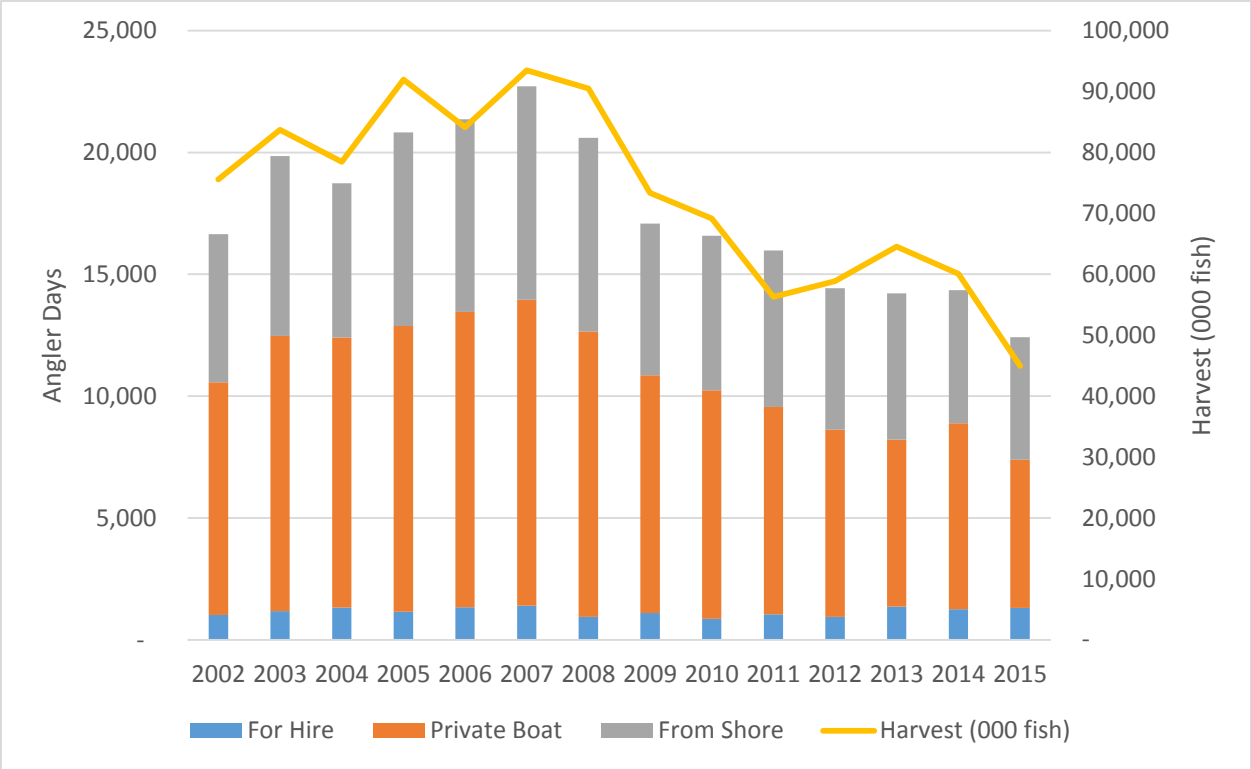

Figure 3. Mid-Atlantic angler days and recreational harvest, 2002-2015.

4. Key Milestones for improving benefits

- The shift from species-based to ecosystem-based fishery management

- The incorporation of changing ocean conditions into fishery science and fishery models
- Ability to impose fishing restrictions based on perceived risks, not conclusive science
- Adjustment in state fishery management to account for shifts in fisheries between states
- Modifications in the structure of federal fishery management to reflect new realities
- More joint government/fishing industry fish stock assessment research
- Improved communication of real time information about ocean conditions to fishermen.
- Political support to prevent scientific uncertainty from derailing necessary fishing restrictions
- Balanced responses to growing concerns of already financially stressed commercial fishermen, growing numbers of recreational anglers, and increasingly influential environmental NGOs who are concerned about ocean health, not just fisheries.

5. Challenges, Threats, and Impediments

- Impacts of climate change on ocean conditions that determine the abundance, distribution, and catchability of fish
- Economic impacts from fishery regulators responding to changes in ocean conditions.
- Need to equitably reallocation catch quotas among Mid-Atlantic states to better match fishing rights with where fish are relocating
- Need to comply with amendments to the Magnuson-Stevens Act that will give managers of fisheries in federal waters more flexibility, and require them to give more consideration to socio-economics
- Implementation of the planned shift from species-based to ecosystem-based fishery management.
- Effective response to new information and increasing concern about non-fishery benefits of fishery conservation and the increasing influence of environmental NGOs.
- Rapid technological change which is currently being developed more quickly to support fishing and aquaculture than to manage the challenges they pose to ocean health
- Dealing with the economic threats posed to small fishing operations from gentrification of waterfronts and emerging conditions that favor consolidation of fishing businesses in the commercial fishing sector which favor large integrated multi-vessel fishing businesses and industry consolidation
- Deciding if and how to respond to more fish caught in the Mid Atlantic being landed processed, and wholesaled at larger fishing ports north of the region
- Overcoming the fact that changing ocean conditions are rendering the results of conventional fishery models less reliable as a basis for establishing fishing regulations
- Minimizing at-sea and shore side space/use conflicts between fishing and emerging offshore industries, including renewable energy (wind farms) and offshore aquaculture (fish farms)
- Effectively responding to economic opportunities associated with warmer water in the region attracting some species into the MidAtlantic region from the south

- Maintaining trust in fishery management and achieving widespread compliance with fishing regulations in the face of growing uncertainty in fishery science and about the beneficial response of fish stocks to those fishing regulations
- Dealing with understandable resistance by fishermen to fishing restrictions that impose clear costs on them and, because of uncertain science, have vague and distant fishery conservation or fish stock rebuilding benefits

6. Conclusions and Recommendations

Between now and 2030, fishery impacts of climate driven changes in ocean conditions and a shift from species-based to ecosystem-based fishery management will result in increasing uncertainty about the scientific basis for managing Mid-Atlantic fisheries. That will lead to increasingly contentious fishery management decisions regarding when, where, and how to restrict fishing. Under the circumstances, it seems likely that federal and state fishery managers will have no choice but to develop, justify, and start using fishery management decision rules that rely more on changes in indicators of the risks facing fisheries rather than scientific estimates of fish stock abundance or what reductions in the allowable harvest will be required to achieve arbitrary fish stock rebuilding targets.

For these reasons it seems that some new decision-support tools are needed to support fishery management in the mid-Atlantic region, at least until trust can be regained in fishery models. One set of general tools that may be useful was developed to support decision-making under conditions of uncertainty and is applied routinely in other areas is referred to generally as "Integrated Risk Management". A simple three-step version of "Integrated Risk Management" is as follows:

Step 1 Control manageable risks (e.g., various types of fishing mortality, habitat damage)
Step 2 Monitor a set of agreed-upon leading indicators of unmanageable risks (ocean warming impacts on forage abundance, natural mortality, and recruitment failure)
Step 3 Establish rules for responding by controlling more manageable risks (Step 1) when the preponderance of evidence from leading indicators of unmanageable risks (Step 2) indicate that outcomes likely to result from overall risks are becoming unacceptable.

Addendum: Marine Aquaculture in the MidAtlantic Region

Marine aquaculture (offshore fish farming) is the fastest growing sector in the global food industry and, although the U.S. lags behind many other countries, this sector of the U.S. seafood industry has been growing recently at an annual rate of about 8 %. As a result of some new technologies, growing seafood markets, rapidly declining opportunities to expand seafood supplies from wild fisheries, increasing federal and state support, and increasingly accommodating state and federal regulations, the marine aquaculture industry in the U.S. is expected to grow at an exponential rate in the years ahead. This will pose significant new ocean-based economic opportunities, but also new and potentially complicated regulatory challenges.

Shellfish aquaculture in bays and estuaries in the Mid-Atlantic region is already a large and growing industry. However, at this time there are no marine aquaculture operations in state or federal offshore waters in the region. This situation will change over the next few years with one offshore aquaculture venture planned off the coast of New York state, and clear indications that another is likely to develop off the coast of North Carolina. Other ventures may be in the planning and permitting stages elsewhere in the region.

The venture planned in New York by Manna Fish Farms (www.mannafishfarms.com) is reported to involve installing 8 to 20 submerged pens capable of holding 250,000 pounds of fish each in federal waters 8 miles off Long Island in 150 feet of water. The company has not announced what species of fish it plans to grow.

For three reasons there is widespread speculation that a second offshore aquaculture venture will develop soon off the coast of North Carolina. First, in 2015 the Canadian-based aquaculture conglomerate Cooke Aquaculture Company (www.cookeseafood.com), which owns and operates large salmon aquaculture operations in Canada, Maine, and elsewhere around the world and has 3,000 global employees, purchased Wanchese Fish Company, a large integrated Virginia and North Carolina based fishing and seafood business. Second, in 2017 Cooke Aquaculture Company purchased Omega Protein (https://omegaprotein.com) which operates a large menhaden harvesting and processing operations in Virginia. Press releases related to these two acquisitions refer to the Cooke Company's desire to diversify into areas of seafood production other than aquaculture. However, it is generally believed that the acquisitions reflect the company's desire to integrate, by purchasing Omega Protein as a source of feed for expanded aquaculture operations, and expand, by purchasing Wanchese Company to get a foothold in the Mid-Atlantic and have access to ships and crews that may be available to service offshore aquaculture facilities. Third, the state of North Carolina has been strongly supporting the development of marine aquaculture and the North Carolina legislature, with some reported guidance "from Maine-based aquaculture interests" largely believed to be Cooke Aquaculture, is in the process of passing a Marine Aquaculture Development Act which will "allow people to lease from 100 to 1,500 acres … in the Atlantic Ocean where they could build underwater pens to raise various species of fish...."

NOAA's Office of Aquaculture (www.fisheries.noaa.gov/topic/aquaculture) is strongly supporting industry efforts to develop U.S.-based marine aquaculture as a way to both reduce pressure to supply U.S. markets from domestic fisheries and reduce U.S. imports of foreign seafood. That office will be a reliable source of information about new marine aquaculture ventures that will be developing in the Mid-Atlantic region. Some of these may be designed to be integrated with offshore wind energy facilities in the region. There is growing interest and some new investments being made in northern Europe to integrate offshore wind energy facilities with offshore aquaculture operations.