

Center for American Progress



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# Fishermen's Views of a Changing Ocean

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By Michael Conathan

January 2015

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# Introduction and summary

When we think about climate change, we tend to think of it in terms of future impact. The commonly accepted target among scientists and climate activists is that society must keep global temperatures from rising more than 2 degrees Celsius by 2100. The U.S.-China Joint Announcement on Climate Change and Clean Energy Cooperation issued in November 2014 hinges on our reducing emissions 26 percent to 28 percent below 2005 levels by 2025, while China will level off its greenhouse gas emissions by 2030.<sup>1</sup> Projections of sea-level rise as a result of climate change vary widely but are typically discussed in terms of 50- to 100-year outcomes.

As a result, the narrative of what to do about these changes is driven not by current observations but by future projections—an inconvenient truth for climate hawks but an entirely convenient one for those with an interest in maintaining our current reliance on fossil fuels. The resulting political conversation is shaped by entities, primarily those—such as the coal and oil lobbies—with a vested financial interest in the status quo, which are allowed to establish a strong case for doing nothing based on a few uncertainties and doom-and-gloom economic projections. They claim that limiting carbon pollution will put miners out of business from West Virginia to Wyoming. They claim that electricity costs will skyrocket and that service will be spottier to boot.

But for commercial fishermen,\* climate change is not a future economic problem: It is a problem right now, and it is costing fisherman both income and jobs. While the fossil-fuel lobbies and their political allies craft predictions of certain economic doom if meaningful limitations on carbon pollution should someday find a firm foothold in public policy, those who make their living from the ocean are already bearing the cost of delaying such action.

\* It is the author's experience that, regardless of gender, individuals who catch fish for a living prefer to be called "fishermen" or "lobstermen" rather than "fishers" or other gender-neutral terms. As such, these terms will be used throughout this report to refer to both women and men.

The profession of fishing is often multigenerational, with knowledge typically passed down from parent to child to grandchild. The combination of constant exposure to all kinds of weather; the consistent logging of data in the form of catch totals and locations; and a seemingly imperceptible understanding of life over, on, and beneath the waves puts fishermen collectively in a unique position to assess the ecosystems that sustain their livelihoods and that, in turn, nourish the rest of us.

Spend time on the bridge of a boat from which people still hunt giant tuna with harpoons, and you'll observe a captain who can sense a ripple on the surface of the ocean almost before he sees it, practically intuiting the telltale sign of a bluefin. Watch a lobsterman turn off her GPS and navigate to her buoys by memory of wind, waves, and currents alone. Sit in a waterfront diner and listen to the fish stories. They're not all about the ones that got away; these days, they're all too frequently about the ones that disappeared and never came back. These stories can help illuminate the challenges we all face as a result of runaway carbon pollution and global climate change.

Ocean warming and acidification—arguably the two most dramatic effects of climate change on oceanographic conditions—are already wreaking havoc on those who make their living from the sea. Oyster aquaculture operations in the Pacific Northwest are struggling to maintain productivity in waters that operators have farmed for decades but that are now too acidic for oyster spat to form their shells.<sup>2</sup> Blue crabs, the iconic species of the Mid-Atlantic's Chesapeake Bay, are facing a dramatic decline in population, even as they are beginning to show up in greater abundance in northern waters such as the Gulf of Maine.<sup>3</sup>

More directly relevant to this report is the fact that in the Northeast, lobster populations have been devastated in recent years in the waters of Long Island Sound and off the southern coasts of Rhode Island and Massachusetts. According to the Connecticut Department of Energy and Environmental Protection, from 1998 to 2011, the amount of lobster caught annually in Long Island Sound fell from 3.7 million pounds to just 142,000 pounds, a decline of more than 95 percent.<sup>4</sup> While scientists have not yet been able to confirm the cause of this decline, it is becoming increasingly clear that warming water temperatures are a major factor. The Atlantic States Marine Fisheries Commission, which coordinates management of the lobster fishery, has found that lobsters are “moving to deeper, cooler waters, thereby concentrating their populations in much smaller areas” in southern New England.<sup>5</sup>

To determine fishermen's perspectives on these changes, the Center for American Progress contracted with Edge Research to conduct a survey of New England commercial fishermen in summer 2014.<sup>6</sup> Edge Research completed telephone surveys

of nearly 600 permit holders in the northeast multispecies fishery—better known as the groundfishery because it targets bottom-dwelling fish such as cod, haddock, and flounders—as well as the lobster fisheries in Maine and Massachusetts. The results clearly show that although fishermen generally tend to be politically conservative, they believe climate forces such as ocean warming and acidification are not only happening but also rank among the gravest environmental threats to their employment and the future of their industry and their communities. Here are a few key results from the fishermen surveyed:

- Although roughly two-thirds of them identify politically as either “conservative” or “moderate,” fishermen who say climate change is happening outnumber deniers by four-to-one.
- 65 percent of fishermen surveyed believe climate change could leave them “unable to profit” and ultimately “forced out” of their fishery.
- A plurality—roughly 40 percent—of them believe observed ocean changes are a “bad thing” for their business, while about 20 percent say it’s a mixed bag and just 10 percent think it’s a “good thing,” with the remaining 30 percent unsure.
- 40 percent of groundfishermen, 44 percent of Massachusetts lobstermen, and 63 percent of Maine lobstermen say they have noticed “warmer water temperatures.”
- More than 80 percent of those who have noticed a warming trend attribute it to climate change.
- In ranking the environmental challenges their industry faces, 36 percent of fishermen listed “ocean warming” as a major problem—roughly equivalent to the 37 percent who listed “declining fish stocks,” the 35 percent who listed “bycatch” of nontargeted species, and the 33 percent who listed “overfishing.” “Water quality” came in at 31 percent, and “ocean acidification” came in at 29 percent.
- In each fishery, at least 40 percent say they are catching new fish species in areas where those species have not traditionally been found.
- Fishermen who have been on the water for more than 20 years are somewhat more likely than their less experienced colleagues to perceive climate-related changes as a “serious problem.”

In short, despite a political predisposition that might indicate an unwillingness to acknowledge the science and reality of global climate change, fishermen know that something is happening on the water, and they know it's affecting both of their bottom lines—the one at the end of their bank statement and the one they lower to the ocean floor.

In addition to the results of the polling work, this report also includes the following recommendations for improvements to fishery management and practices in response to a changing climate:

- The Obama administration should request and Congress should appropriate additional funding for ocean observation and baseline scientific research to give scientists, regulators, and industry members a clearer picture of how climate change is affecting fish populations. The National Oceanic and Atmospheric Administration, or NOAA, should also address the issue, prioritizing funding from sources such as the Saltonstall-Kennedy Grant Program and industry funding sources from profitable fisheries, as permitted under the Magnuson-Stevens Fishery Conservation and Management Act.
- Congress should include language in legislation reauthorizing the Magnuson-Stevens Act that directs regulators, including the regional fishery management councils, to work with scientists and industry members to develop a greater understanding of species that have begun to shift their population range beyond traditional areas, including by prioritizing ecosystem-based management methods.
- Regional and interstate fishery managers should establish an annual review of the latest scientific data, including fishery-dependent data such as the amount of fish landed and brought to market, to determine how climate change is affecting the species distribution within and among their areas of responsibility.
- To increase price stability, fishing industry groups—with assistance from the U.S. Department of Commerce—should coordinate efforts to ensure that seafood buyers are confident that as species shift locations, the industry will still be able to provide a consistent supply of product.

The remainder of this report details what is known about oceans and climate change, what is happening in the Gulf of Maine, and how fishermen perceive these challenges. It also provides additional details on the recommendations listed above.

# The science of oceans and climate change

*The science linking human activities to climate change is analogous to the science linking smoking to lung and cardiovascular diseases. Physicians, cardiovascular scientists, public health experts, and others all agree smoking causes cancer. And this consensus among the health community has convinced most Americans that the health risks from smoking are real. A similar consensus now exists among climate scientists, a consensus that maintains that climate change is happening and that human activity is the cause.*

– American Association for the Advancement of Science<sup>7</sup>

The inherent variability of day-to-day or even season-to-season weather has made the science of climate change vulnerable to skepticism. For people predisposed to question the existence of something called “global warming,” the occurrence of a winter like the polar-vortex-fueled freeze-out much of America experienced during the winter of 2013 to 2014 only reinforces their disbelief. The facts that the planet has warmed 1.4 degrees Fahrenheit over the past 100 years<sup>8</sup> and that 13 of the 14 hottest years on record have all occurred since 2000<sup>9</sup> do not resonate when stacked up against the still-shivering memory of several weeks of below-freezing temperatures and record snowfall across large swaths of the country. A century is a lifetime to a human but merely the blink of an eye to an ecosystem.

Yet these trends are real. Scientists have proof from empirical data from ice-core samples and other sources that date back millennia. In April 2014, the concentration of carbon in the atmosphere surpassed 400 parts per million after remaining at about 280 parts per million for thousands of years before the dawn of the industrial age and the subsequent increase in fossil-fuel use.<sup>10</sup> Asked about the effect of surpassing this inauspicious milestone, National Aeronautics and Space Administration climatologist and climate modeler Gavin Schmidt said, “We are a society that has inadvertently chosen the double-black diamond run without having learned to ski first. It will be a bumpy ride.”<sup>11</sup>

Oceans are acidifying at a rate faster than at any time in the past 300 million years.<sup>12</sup> Sea levels rose faster over the past two decades than they did during even the earlier part of the 20th century, posing dire threats to coastal communities.<sup>13</sup>

Over the next 50 years, levels are projected to rise at an even greater rate. While levels of rise will vary based on specific location, scientists are predicting increases of between two and five feet by 2100.<sup>14</sup> This means shoreside regions will be more frequently inundated during extreme weather events such as Superstorm Sandy, which swamped much of northern New Jersey and New York City in 2012, and some areas will be completely underwater.

These projections are based on scientific observations and honed data-gathering techniques. And the big fact hanging over each of them is worth emphasizing: 97 percent of scientists agree that all these changes to our climate are the result of human activity—just like the 97 percent of scientists agree that smoking causes lung cancer and emphysema.<sup>15</sup>

An increasing number of studies have also shown how our changing ocean is affecting marine species. In both hemispheres, fish are moving poleward and into deeper water to find the colder water temperatures their physiologies need to survive. According to John Manderson, a fishery biologist at the National Oceanic and Atmospheric Administration's Northeast Fisheries Science Center, “the effects of climate on the distribution of animals ... is happening ten times faster in the ocean than it is on land.”<sup>16</sup>

Another study in the journal *Science* confirmed that, in general, changes in most fish populations' locations correlated strongly with temperature changes. For lobster, that shift was even more pronounced. The researchers found that lobster populations are shifting north at the rate of 43 miles per decade.<sup>17</sup>

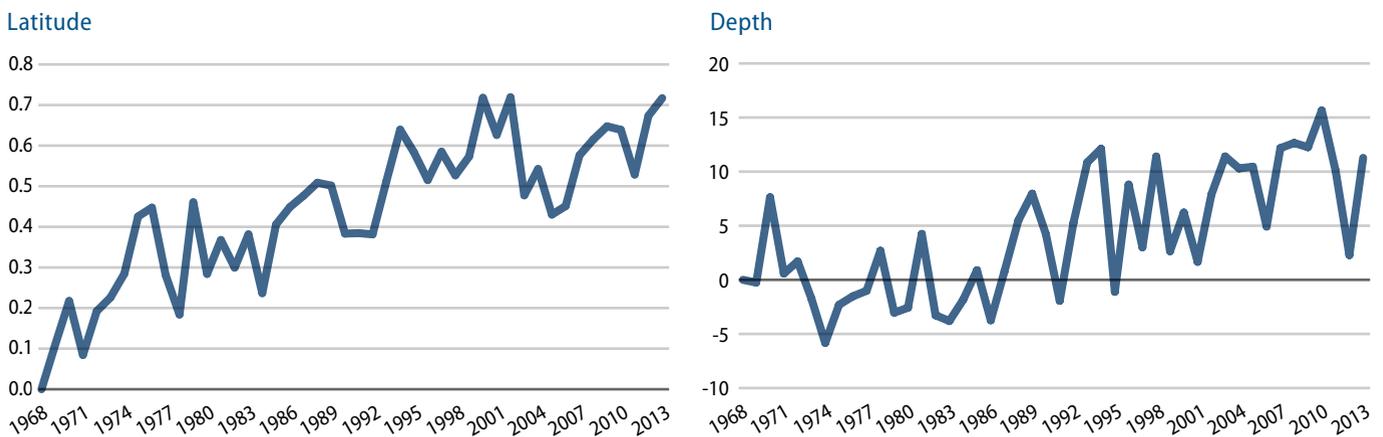
As a result, we are seeing some strange fish-related anecdotes, such as the case of a tropical skipjack tuna—generally at home around Mexico, Panama, and the Philippines—caught in the Gulf of Alaska in 2014.<sup>18</sup> Such stories grab headlines, but much in the way a cold snap does not disprove the scientific reality of a warming planet, one fish does not by itself paint a bigger picture.

Trends, however, are more troubling. Blue crabs are becoming abundant in waters far north of their usual skittering grounds in the Mid-Atlantic.<sup>19</sup> Maine's state fishery regulators are, for the first time in its history, developing regulations to manage a commercial fishery for black sea bass, another Mid-Atlantic species that has moved into northern waters.<sup>20</sup>

Scientists at Rutgers University have partnered with NOAA to establish an online data portal known as OceanAdapt, which “tracks shifts in the distribution of U.S. marine species with changing ocean conditions.”<sup>21</sup> The database compiles NOAA’s species distribution data and displays them on graphs by individual species or as a general average for all species in a given region. For example, selecting all species in the northeast region produces a line graph that shows that, on average, in 2012 the population centers of all marine fish species in the waters of the Northeast United States were 0.72 degrees of latitude north of their average point in 1968, as well as 11.3 meters deeper. (see Figure 1)<sup>22</sup>

**FIGURE 1**  
**Shift in distribution of fish species in waters of the Northeast U.S.**

The geographic center of fish populations off the Northeast coast of the U.S. has shifted progressively northward and into deeper water since data were first collected in 1968.



Source: Rutgers School of Environmental and Biological Sciences, “OceanAdapt,” available at [http://oceanadapt.rutgers.edu/regional\\_data/](http://oceanadapt.rutgers.edu/regional_data/) (last accessed January 2015). Select “Northeast US” for region and “All” for species.

Not all of these changes are necessarily bad for fishermen. In 2012, nearly 80 percent of the value of fish brought to market in Maine consisted of one single species: the lobster.<sup>23</sup> In this case, therefore, diversification to something like black sea bass may actually benefit some struggling coastal communities by creating new fishing opportunities.

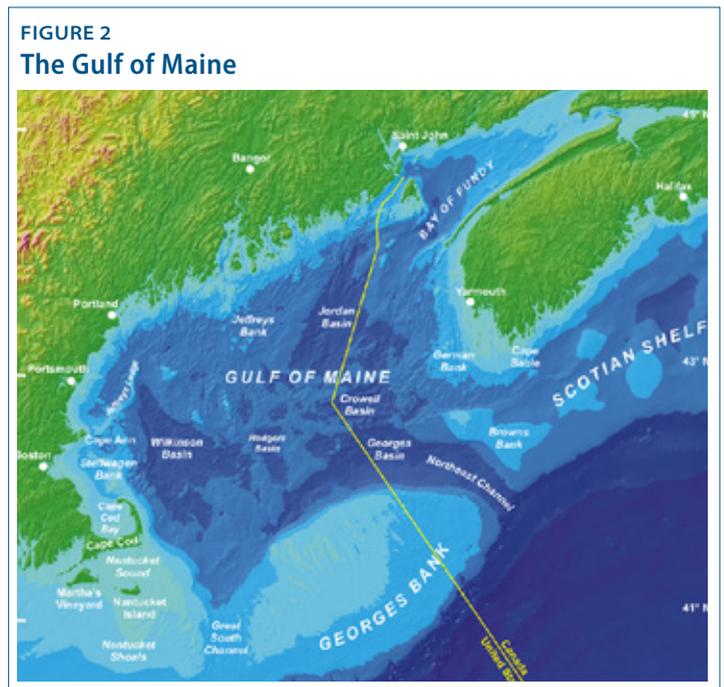
However, these same warming trends have meant the loss of the northern shrimp fishery after regulators were forced to cancel both the 2013–2014 and 2014–2015 seasons because warming waters devastated the shrimp population.<sup>24</sup> While some revenue from shrimp could be replaced by sea bass, it's unlikely to be a dollar-for-dollar swap. The changes will affect various subregions and individuals differently. Furthermore, to participate in a new fishery, fishermen must assume the expense of buying new gear or perhaps even new boats, face a steep learning curve in fish finding and harvesting techniques, and secure access to new and increasingly fungible markets. All these factors mean that relying on species substitution to recoup profitability is risky business.

# Changes in the Gulf of Maine

The Gulf of Maine has experienced remarkable warming events in recent years, particularly in 2012, which included what scientists have referred to as an “ocean heat wave.”<sup>25</sup> A study recently published by Andrew Pershing, chief scientific officer at the Gulf of Maine Research Institute—an independent research body in Portland, Maine—found that the Gulf of Maine is warming at a rate faster than 99 percent of the rest of the world’s oceans—roughly eight times faster than the average global rate.<sup>26</sup>

The reasons for the accelerated warming remain unclear to scientists, but possibilities include weather and atmospheric changes, as well as changes to the speed and trajectory of the Gulf Stream current.<sup>27</sup> Regardless of the reasons, temperatures in the Gulf—the body of water defined by Cape Cod and Georges Bank to the south; Newfoundland, Canada, to the east; and the New England and Canadian mainland to the north and west—have been warming by approximately half a degree Fahrenheit per year since 1982, when the region split with the ongoing worldwide trend of roughly 0.05 degrees of warming per year.<sup>28</sup> This makes the Gulf of Maine a harbinger for changes that are coming to the rest of the world as a result of runaway carbon and other greenhouse gases.

To assess how New England fishermen perceive the threat of climate change, CAP engaged Edge Research to conduct a poll of fishermen in two specific fisheries: the New England multispecies fishery, better known as the groundfishery because the target species all live close to the ocean floor, and the lobster fisheries in Maine and Massachusetts. The results of this polling,



which will be discussed in the next section, show some similarities but also some critical differences among these groups. To explain these differences, it's useful to have a background understanding of the key issues and relevant aspects of each fishery.

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## The New England multispecies fishery

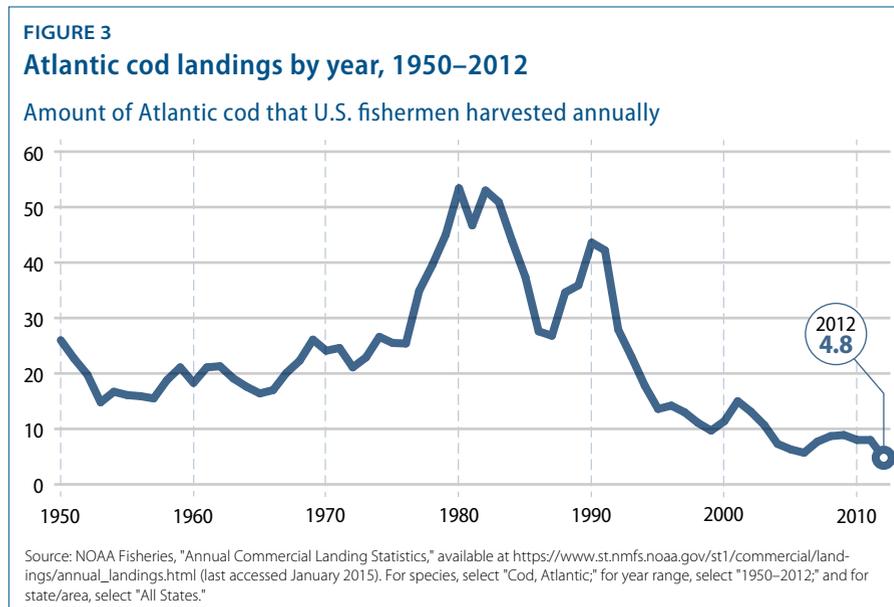
New England's most historic fishery would face ample challenges even if the ocean were not in an unprecedented state of flux. Many of the region's historically ample stocks of cod, haddock, and other fish suffered from significant overfishing for decades before new management measures were put in place in 2011.<sup>29</sup> Today, some fish populations—including haddock, redfish, and pollock—have made great strides toward recovery, while others, such as Gulf of Maine cod, have yet to bounce back.

Prior to the 2013 season, fishery regulators were forced to slash catch limits for the most iconic of New England's fish species—Gulf of Maine cod—by roughly 80 percent after a scientific assessment released in 2012 by the National Oceanic and Atmospheric Administration's Northeast Fisheries Science Center found populations were not recovering quickly enough.<sup>30</sup> Then last summer, despite such drastic reductions, an updated assessment found that instead of rebounding as a result of the reduced catch, the cod population had gone from bad to, in local parlance, “wicked bad.” Estimates now show that the Gulf of Maine cod stock is at just 3 percent of sustainable levels.<sup>31</sup> As a result, at a meeting in November 2014, regulators approved another 80 percent cut to the total allowable catch for the fishing year that begins May 1, 2015.<sup>32</sup>

In assessing the reasons for the continued failure of cod stocks to rebound even in the face of such dramatic cuts to fishing effort, fishermen have begun to point fingers at ocean warming and other environmental changes as the culprit.<sup>33</sup> While the jury is still out on this point, it's important to differentiate between the root cause of the stock decline and the forces preventing the fish from rebuilding to sustainable levels.

As the warming trend in the Gulf of Maine kicked into high gear in the 1980s and 1990s, cod was being dramatically overfished. In fact, that time period coincides with the highest historical landings ever recorded for cod in New England. From 1950 through 1976—the year Congress enacted the Magnuson-Stevens Fishery Conservation and Management Act, which forced foreign fishing fleets out of U.S. waters to 200 nautical miles from shore<sup>34</sup>—annual American Atlantic cod landings vacillated between about 14,000 and 26,000 metric tons. Following the

ouster of foreign fleets, domestic landings quickly shot up and stayed at elevated levels for about the next 20 years, topping out at 53,000 metric tons in 1980 and 1982. But by the early 1990s, the bottom began to fall out of the fishery, and cod landings have not topped 10,000 metric tons since 2003, due to a combination of dwindling fish stocks and stricter catch limitations. In 2013, the last complete year in the sequence, total landings were just 2,200 metric tons.

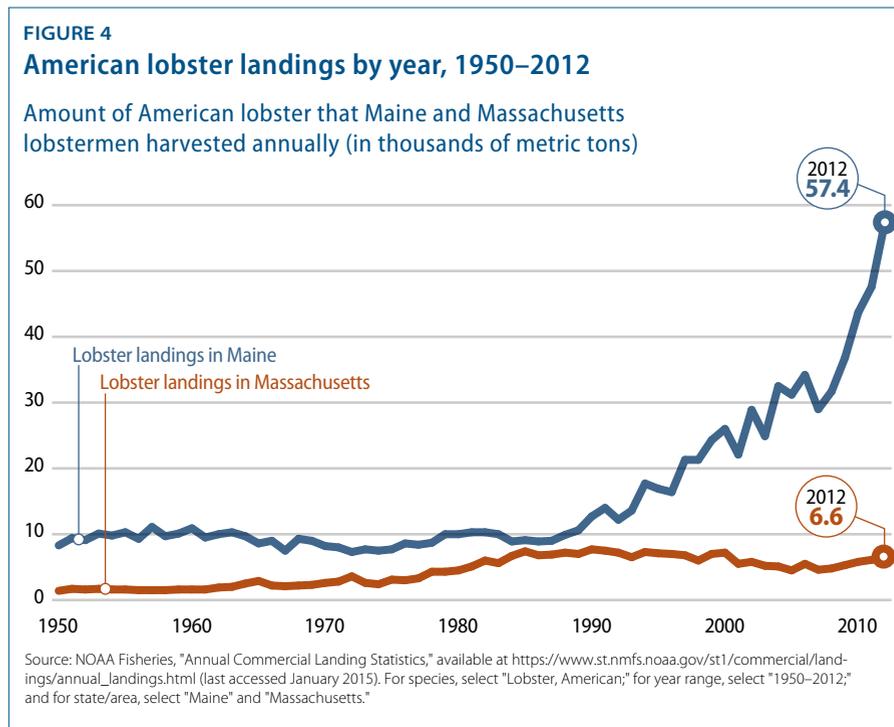


Even if all fishing were to end now—an arguably unjust outcome because fishermen catch other healthy fish stocks, such as haddock, redfish, and pollock, with the same trawls that net Gulf of Maine cod—the road back for cod would be arduous. For starters, the fish may not be as well suited to warming waters as some newcomers such as black sea bass. Even if the stock can manage in changing environmental conditions, its place in the ecosystem has now been taken by exploding populations of other species such as dogfish—voracious small sharks that consume anything they can get their teeth into, including juvenile cod.<sup>35</sup> This further hampers the cod population’s ability to rebuild. For a glimpse of what the future might look like, New England fishermen need look no further than north of the Canadian border, where regulators shut down the Newfoundland cod fishery in 1992. Some scientists predict that the commercial cod fishery will never fully recover.<sup>36</sup>

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## The lobster fishery

As the groundfishery has plunged deeper into general disarray over the past several decades, lobster has proven to be a key bright spot for the region's fishermen—at least north of Cape Cod. Lobster landings have steadily increased from the 1950s through the present, with both 2012 and 2013 setting records with more than 57,000 metric tons caught. (see Figure 4 below) The vast majority of this increase occurred in Maine, where more than 85 percent of lobster was landed in those years.<sup>37</sup>



Unlike groundfish, which are managed by the New England Fishery Management Council in conjunction with NOAA's National Marine Fisheries Service, the lobster fishery is primarily managed by individual state natural resource agencies under the oversight of an interstate body called the Atlantic States Marine Fisheries Commission, or ASMFC. This distinction is due to the fact that fishermen harvest a preponderance of lobsters from state-controlled waters, which extend three miles from shore. As a result, the states have greater freedom to regulate their fishermen, so Massachusetts and Maine have different rules for their lobster fisheries.

Maine lobstermen have been leaders in sustainable fishing practices for generations. Maine lobstermen have been developing industry standards to ensure they protected their resource as far back as the 19th century. They established the practice of v-notching to safeguard the brood stock: When a lobsterman catches a female lobster that is “berried,” or that has eggs coating the underside of her tail, instead of keeping her to sell, he or she cuts a v-shaped notch in one of the lobster’s flippers and throws her back. If that same lobster ever comes up without eggs in another trap, the notch identifies her as a breeder, and she must be returned to the water. Today, it’s illegal to keep or sell a v-notched lobster in Maine, and in 2012, ASMFC made recommendations to streamline regulation of the practice in all states.<sup>38</sup> Maine lobstermen also adhere to a maximum size limit as well as a minimum size limit.<sup>39</sup> This is designed to protect the largest, most productive lobsters, whose fertility goes up exponentially with age.

There are practical differences between the lobster fisheries in Maine and Massachusetts as well. For example, in Maine, lobster boats must be owned and operated by the permit holder, ensuring that individuals cannot consolidate or concentrate ownership into large conglomerates. As a result, most Maine boats are smaller and fish day trips closer to shore. In Massachusetts, the fishery is more concentrated in larger boats that fish offshore and that can go to sea for as long as a week at a time.

Despite these differences, in both Maine and Massachusetts, lobstermen fear they can see their future by looking to the south. While Maine has always been the nation’s leader in harvesting its signature crustacean, lobster once also supported robust fisheries throughout New England, in Long Island Sound, and even as far south as New Jersey. Now the southern reaches of the fishery have all but vanished. After calling for a moratorium on lobster fishing in 2010, regulators announced that the southern New England lobster population had experienced a “recruitment failure,” meaning there were not enough young lobsters maturing to legally harvestable size. As a result, they recommended a five-year closure of the fishery.<sup>40</sup> While they ultimately decided to keep the fishery open, landings have plummeted. In 2013, *The Boston Globe* reported that the harvest from Buzzards Bay in southern Massachusetts had sunk from an average of 400,000 pounds to just 72,000 pounds.<sup>41</sup>

In 2013, Sen. Angus King (I-ME) took to the Senate floor to join Sen. Sheldon Whitehouse (D-RI) in talking about the effects of climate change on the lobster fishery. Sen. King compared climate deniers to Europeans who turned a blind eye to the rise of Nazi Germany. “There was data, but there were very few people who wanted to do anything about it because it would have caused disruption: economic disruption and personal disruption,” he said. When it comes to lobster, the data are showing a clear northward migration.<sup>42</sup>

In his speech, which followed 2012’s “ocean heat wave,”<sup>43</sup> Sen. King talked about how this trend played out for Maine’s lobstermen:

*In the 1980s, the lobster fishing was concentrated in southern Maine along our coast in what’s called Casco Bay down around Portland, and then it moved up into what’s called the Midcoast, Lincoln County, near where I live. And then it moved, the bulk of the lobster fishing moved up into Penobscot Bay. And now the bulk of the lobster fishing is up in what we call Hancock County, the village of Stonington, Maine, or at least that’s where it was last year. In other words, the lobsters are moving north because the temperatures are getting warmer—and that’s what’s happening.<sup>44</sup>*

Sen. King’s mention of Stonington as the new center of the lobster fishery is striking. Recall the study of lobster migration from the academic journal *Science*, which found that lobster populations are migrating northward at about 43 miles per decade.<sup>45</sup> If this trend continues, the center of the fishery will move all the way up to the Canadian border by 2040.

The warming event in 2012 also had a dramatic effect on lobstermen’s profits. Because the warmer temperatures caused lobster to shed their shells and move to shallower water several weeks ahead of schedule, the processors to whom Maine fishermen sell their product were not prepared to buy in bulk so early in the season. This meant that while the volume of lobsters was through the roof, the price fishermen were getting crashed. Maine fishmongers and supermarkets were selling lobster for less per pound than bologna.<sup>46</sup> Volume of lobsters, in this case, was not equivalent to an influx of cash.

Few in Maine’s lobster industry think current harvest levels are likely to remain the new normal, and projections about future populations are not pretty. Results of the most recent annual survey released by the University of Maine in summer 2014 suggest that juvenile lobster populations have fallen by more than half,

meaning the boom will draw to a close in the next three to five years.<sup>47</sup> This is the same survey that correctly predicted the current population explosion.

Meanwhile, as lobstermen in Maine's remote Downeast region have benefited from an increase in harvest, they have been without one of their key supplemental sources of income—shrimp—over the past two winters. Regulators closed the northern shrimp fishery for the 2013 season, and in October 2014, they announced that the 2014 season would also be scrapped.<sup>48</sup> According to fisheries scientists, the cause of the shutdown was decreased shrimp population due to warming temperatures in the Gulf of Maine.<sup>49</sup>

Two Fall River, Massachusetts, lobstermen took concerns about their collapsing industry public in 2013, when they used their lobster boat to blockade a freighter carrying 40,000 tons of coal to a power plant on the Massachusetts-Rhode Island border. According to *The New York Times*, their September 2014 trial was ultimately cancelled when the district attorney dropped the charges, saying he sympathized with the defendants' concerns about climate change.<sup>50</sup>

# Fishermen's perceptions

To conduct the survey, CAP acquired a list of permit holders in the groundfishery from the National Marine Fisheries Service and lists of lobster permit holders from the state fishery management agencies in Maine and Massachusetts. Edge Research then carried out the survey by randomly calling permit holders from each fishery, completing interviews with 146 groundfishermen, 163 Massachusetts lobstermen, and 262 Maine lobstermen, for a total of 571 respondents. This roughly equates to 10 percent of groundfish and Massachusetts lobster permit holders and 5 percent of Maine lobstermen. The results clearly show that fishermen believe climate change and ocean warming are major concerns that threaten the future of their industry.

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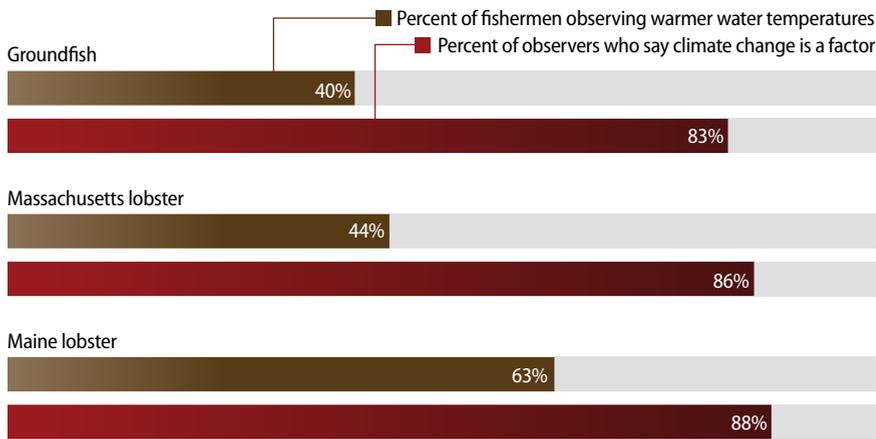
## What fishermen are experiencing

The scientific literature has proven that the ocean is warming, and these measurements are borne out by fishermen's observations. Depending on the fishery, between two-fifths and two-thirds of fishermen reported experiencing warmer water temperatures. This figure is significant because to a casual observer, the difference of a degree or two of warming from one year to the next would not necessarily be noticeable. If you went for a swim at a coastal Maine beach in July 2011 and again during the ocean heat wave in July 2012, the water would feel more or less the same. And yet a change not detectable to the average beachgoer can make a huge difference to a fish or lobster.

FIGURE 5

### Fishermen's perspectives on ocean warming and climate change

Percent of fishermen surveyed who have observed warming ocean temperatures, as well as percent of observers who attribute warming to climate change



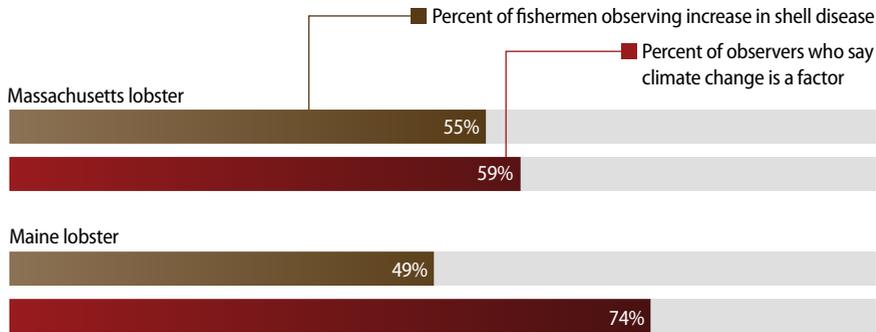
Source: NOAA Fisheries, "Annual Commercial Landing Statistics," available at [https://www.st.nmfs.noaa.gov/st1/commercial/landings/annual\\_landings.html](https://www.st.nmfs.noaa.gov/st1/commercial/landings/annual_landings.html) (last accessed January 2015). For species, select "Lobster, American;" for year range, select "1950–2012;" and for state/area, select "Maine" and "Massachusetts."

In addition to warming, lobstermen in Massachusetts and Maine reported an increase in shell disease—a phenomenon that proved to be a harbinger of the collapse of the southern New England lobster fishery. Massachusetts lobstermen were more likely to note this change than their northern neighbors, but Mainers were more apt to attribute the increase to climate factors. In addition, more than half of Maine lobstermen reported seeing early molting among their catch—a likely fallout from the 2012 Gulf of Maine warming event that led to an early molt and subsequent market disruptions.

FIGURE 6

### Lobstermen's perspectives on shell disease and climate change

Percent of lobstermen surveyed who have observed an increase in shell disease, as well as percent of observers who attribute it to climate change



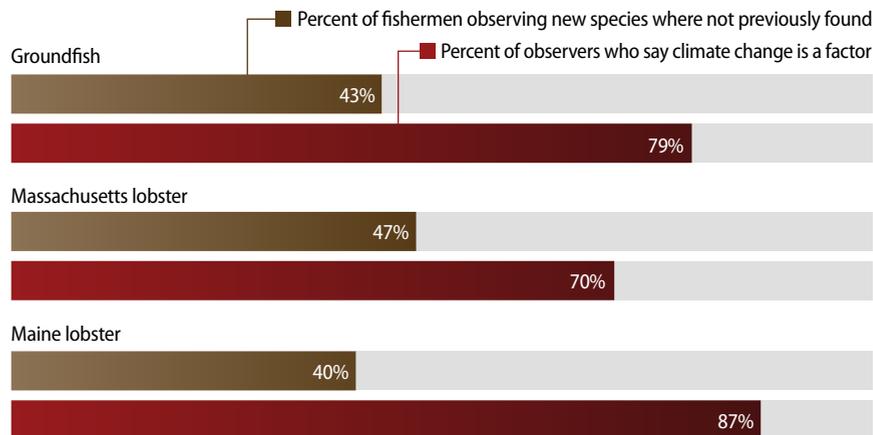
Source: Edge Research, "Commercial Fishermen Research" (2014), available upon request to author.

More than 40 percent of participants in all three fisheries—groundfish, Maine lobster, and Massachusetts lobster—also reported finding species where they had not previously seen them, with large majorities of participants attributing these new encounters to climate change.

FIGURE 7

### Fishermen's perspectives on finding new species

Percent of fishermen surveyed who have observed fish species where they had not been found previously, as well as the percent of observers who attribute this phenomenon to climate change



Source: Edge Research, "Commercial Fishermen Research" (2014), available upon request to author.

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## How fishermen view changes

Fishermen have the reputation of being politically conservative, even in deep-blue Massachusetts, and our data proved this, with 67 percent of groundfishermen and 70 percent of lobstermen in both states self-identifying as either “conservative” or “moderate” and roughly an equal split between each label. Only 11 percent of groundfishermen and Maine lobstermen and just 5 percent of Massachusetts lobstermen described themselves as “liberal.”

Despite fishermen’s strongly conservative ideological bent, their perception of whether climate change is happening was close to that of the general public, measured by a 2012 survey conducted by Yale University.<sup>51</sup> Across all fisheries, permit holders who say they are “sure” climate change is happening outnumber those who are “sure” it is not happening by more than four-to-one.

**FIGURE 8**

### Fishermen's perspectives on climate change

Fishermen's perceptions of whether or not climate change is happening are slightly lower than the overall attitude of the American population, but believers still outnumber skeptics by roughly four-to-one

All fishermen combined



Groundfishery



Massachusetts lobster fishery



Maine lobster fishery



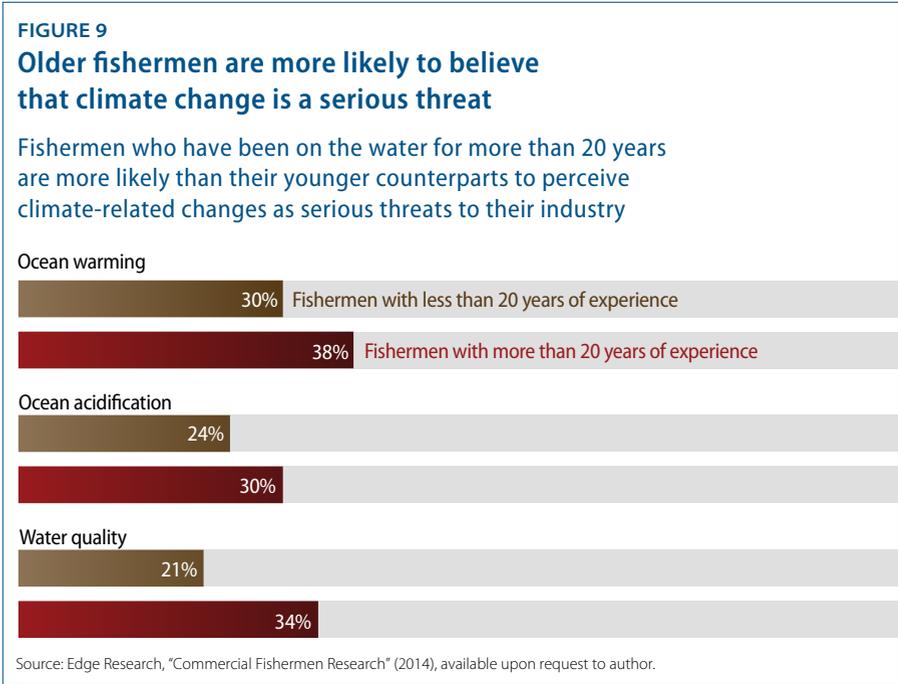
U.S. public (2012)



Source: For fishermen’s opinions, see Edge Research, “Commercial Fishermen Research” (2014), available upon request to author; for the opinion of the U.S. public, see Anthony Leiserowitz and others, “Climate Change in the American Mind: Americans’ Global Warming Beliefs and Attitudes in September 2012” (New Haven, CT: Yale Project on Climate Change Communication, 2012), available at <http://environment.yale.edu/climate-communication/article/Climate-Beliefs-September-2012/>.

Again, Maine lobstermen lead their counterparts, showing a nearly seven-to-one ratio of climate believers to skeptics.

Our polling also showed a clear gap among respondents based on the length of time they have been participating in the fishery. While, according to pollsters at Gallup, younger people in the general public tend to be more likely to perceive climate change as a threat,<sup>52</sup> the opposite holds true among fishermen. Our poll showed that fishermen who have been active for more than 20 years were moderately more likely to perceive ocean warming, rising sea levels, and ocean acidification as a “serious threat” than their younger colleagues.



Perhaps the best way to explain this finding is the theory of “shifting baselines,” developed in the mid-1990s by fisheries biologist Daniel Pauly.<sup>53</sup> As Pauly writes:

*Essentially this syndrome has arisen because each generation of fisheries scientists accepts as a baseline the stock and species composition that occurred at the beginning of their careers, and uses this to evaluate changes. When the next generation starts its career, the stocks have further declined, but it is the stocks at that time that serve as a new baseline. The result obviously is a gradual shift of the baseline, a gradual accommodation of the creeping disappearance of resource species, and inappropriate reference points for evaluating economic losses resulting from overfishing, or for identifying targets for rehabilitation measures.<sup>54</sup>*

Overall, while fishermen as a group may be less likely than the general public to accept climate science or to ascribe changes they experience to human activity, their observations make it plain that things are changing in the Gulf of Maine. And the longer they have been out on the water, the more clearly they are seeing it.

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## Effect on business and the fishing industry

Overall, we found that Maine lobstermen are most concerned about climate change and its potential effects on their industry, primarily as a result of ocean warming and acidification. This was not a surprise given the recent record-setting temperatures in the Gulf of Maine and the shocking 2012 lobster season that led to early shedding, record landings, and a crash in prices—all of which are still fresh in their memories. But across all fisheries, our data show that fishermen view climate change as a major threat to their livelihoods, on par with declining fish stocks, overfishing, and water-quality issues.

# Policy recommendations

While our polling focused solely on three critical fisheries in the northeast, the problem of changing oceans is not confined to one region. It occurs to varying degrees around the nation and throughout the world. To reflect the uncertainties and difficulties posed by changing marine ecosystems, we conclude this report with the following recommendations for future action.

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## Appropriate additional funding for ocean observation and baseline scientific research

The administration should request and Congress should appropriate additional funding for ocean observation and baseline scientific research to give scientists, regulators, and industry members a clearer picture of how climate change is affecting fish populations. The National Oceanic and Atmospheric Administration should also use funding from sources such as the Saltonstall-Kennedy Grant Program and industry funding sources from profitable fisheries, as permitted under the Magnuson-Stevens Fishery Conservation and Management Act.

There is no denying that federal funding is tough to come by. Congress remains committed to reducing outlays, and with the majority in the Senate shifting to Republican hands in 2015, that approach is unlikely to change. Historically, however, fishery management has been a bipartisan priority, and there is a clear case to be made that when it comes to fishing jobs, additional scientific data can reduce uncertainty and allow us to manage our fisheries most efficiently, for the greatest economic benefit both in the present and into the future.

Industry members should also seek additional ways to support data collection. For example, fishermen in the Atlantic scallop fishery have agreed to contribute a small portion of the revenue they receive for their catches to what is known as a “research set-aside”—a fund for additional research to support the ongoing health of the resource and to ensure that management continues to be successful.<sup>55</sup>

While this model may not be replicable in fisheries facing tougher economic circumstances, such as the groundfishery, other successful fisheries should look to establish such a program.

Finally, enactment of and funding for a national trust fund, such as the National Endowment for the Oceans, to support healthy oceans and coasts would also be a means of promoting stronger scientific footing to understand the changes currently afoot in our oceans.<sup>56</sup>

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## Reauthorize the Magnuson-Stevens Fishery Conservation and Management Act

Congress should include language in legislation reauthorizing the Magnuson-Stevens Fishery Conservation and Management Act to direct regulators, including the regional fishery management councils, to work with scientists and industry members to develop a greater understanding of species that have begun to shift their population ranges beyond traditional areas, including by prioritizing ecosystem-based management methods.

Authorization of the Magnuson-Stevens Act expired in 2013, and in the 113th Congress, members of both the Senate and the House of Representatives introduced bills to update the statute. As the new Congress develops its proposals in the early days of 2015, the bills' authors should include language directing managers and scientists to consider how the fisheries of today will evolve. In meeting the current legislative mandate to provide best available science to fishery managers, scientists should seek to include predictions of future warming in their stock-assessment models. Regulators should then consider these factors when setting rebuilding timelines and targets for depleted fish stocks, as well as annual catch limits. Similar language should also be added to the Interjurisdictional Fisheries Act of 1986 that established the legal framework for management of fisheries carried out primarily in state waters.

The most recent reauthorization of the Magnuson-Stevens Act required NOAA to produce a report on the implementation of ecosystem-based fishery management. The term refers to efforts to manage a given fishery in a manner that recognizes the species' role in a broader ecosystem context—in other words, that the survival of any one fish population is inextricably linked to other populations and, ultimately, to the health of the broader environment. The report, completed in 2008, found that fishery managers currently “consider and apply some of the principles”

of ecosystem-based management and suggested that each regional fishery management council, a quasi-government body comprised of fishermen and other fishery stakeholders that develops and recommends management plans to NOAA, should develop and implement a fisheries ecosystem plan to facilitate ecosystem considerations in future management decisions.<sup>57</sup> Four of the eight fishery management councils—those in the North Pacific, Western Pacific, Pacific, and South Atlantic—have completed their fishery ecosystem plans.<sup>58</sup> Completing, implementing, and periodically updating these plans should be a priority action for each fishery management council.

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### Establish an annual review of the latest scientific data

Regional and interstate fishery managers should establish an annual review of the latest scientific data, including fishery-dependent data such as the amount of fish landed and brought to market, to determine how climate change is affecting species distribution within and among their areas of responsibility.

The leaders of the regional fishery management councils should reserve time at each of their annual Council Coordination Committee Meetings to review scientific data on changes to species' traditional geographic ranges and to consider management options to ensure that fishermen's access to the fishery reflects any such shifts. Likewise, the interstate fisheries commissions that manage state-waters fisheries along the Atlantic, Pacific, and Gulf coasts should seek similar means of annually reviewing science and landings data to determine how the species for which they are responsible are adapting and responding to their changing environment. By making this practice a standard, regular occurrence, managers will develop a definitive measure of the impact of these changes so they can be more effective in discussing management options, particularly in cases where fish populations are shifting across traditional management boundaries.

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### Coordinate efforts to ensure a consistent supply of product

To increase price stability, fishing industry groups, with assistance from the U.S. Department of Commerce, should coordinate efforts to ensure that end users are confident that as species shift location, the industry will still be able to provide a consistent supply of seafood.

At the end of the day, fishermen are businessmen; they care most about maximizing the value they get for the goods they produce. On this topic, one of the difficulties climate change represents for the fish business is consistent availability of product. Dealers and processors are accustomed to buying certain fish from certain regions, or even from certain individuals. But as ecosystems change and species shift their locations, markets will inevitably have to adapt too. And just like fishermen are ultimately interested in the dollars they receive for their catch, dealers and processors are ultimately interested in the catch they receive for their dollars. Markets for fish that operate on a global scale do not care whether a black sea bass is caught in North Carolina or in Maine; they just want filets on plates and in display cases.

To keep its buyers happy, the fishing industry should seek to coordinate efforts to reassure its buyers that it will support management policies that recognize shifts in fish populations and ensure as much consistency as possible in the supply chain. This will help prices remain as stable as possible, even as fisheries shift within and even across jurisdictions.

## Conclusion

The survey we conducted in summer 2014 shows that climate change is not just a future problem. It's affecting industries and costing jobs right now in coastal communities from the Gulf of Maine to Long Island Sound and beyond. Some of the fish species that have sustained the New England region since before the arrival of European settlers, putting food on tables and money in pockets, are now struggling to survive in waters they have inhabited for millennia.

Marine ecosystems in today's carbon-overloaded environment are already beginning to look very different than they used to. This new reality is presenting major challenges for fishery managers and fishermen as they try to adapt to ecosystem-scale shifts. For policymakers at all levels, these environmental and economic changes should reverberate and serve as a wake-up call to address the issue of runaway carbon pollution and to take the actions needed to mitigate the harmful effects of a changing climate.

The cliché so frequently employed to describe the loss of a fishery such as the southern New England lobster fishery or the northern shrimp fishery is that it's the "canary in the coal mine." In this case, the old expression is particularly apt. For as climate deniers bemoan the loss of jobs and economic devastation that they foresee in the decline of the coal industry, they rarely stop to consider the economic ramifications of business as usual when it comes to carbon pollution.

The ledger has two columns: While coal-country jobs may decline as society moves toward a lower-carbon future, other jobs will be saved by reducing carbon pollution. Fishermen are already taking the hit for society's insistence on continuing to burn fossil fuels.

Reducing emissions of greenhouse gases is as much an economic imperative as it is a social or environmental one. While lobster, shrimp, cod, black sea bass, and other fish species have the liberty of simply shifting their locations to find a suitable climate, New England's fishermen do not, and neither do the rest of us who call this planet home.

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## About the author

**Michael Conathan** is the Director of Ocean Policy at the Center for American Progress. His work focuses on driving progressive solutions to the multitude of problems facing the world's oceans. Prior to joining CAP, Conathan spent five years staffing the Senate Committee on Commerce, Science, and Transportation's Subcommittee on Oceans, Atmosphere, Fisheries, and Coast Guard—initially serving a one-year appointment as a Dean John A. Knauss marine policy fellow before joining the committee full time as a professional staff member in 2007. In that capacity, Conathan worked primarily for Subcommittee Ranking Member Sen. Olympia Snowe (R-ME), as well as the ranking members of the full committee, Sens. Ted Stevens (R-AK) and Kay Bailey Hutchison (R-TX). He oversaw enactment of multiple key pieces of ocean legislation, including the Magnuson-Stevens Fishery Conservation and Management Reauthorization Act, the Integrated Coastal and Ocean Observation System Act, the Federal Ocean Acidification Research and Monitoring Act, and the Shark Conservation Act.

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