

**Testimony of Environmental Entrepreneurs (E2) on
The State of Our Oceans as it Relates to Global Climate Change**

**Committee on Global Warming and Climate Change
Barnstable, August 2, 2007**

I thank Senators Marc Pacheco and Robert O'Leary for the opportunity to describe to you the likely economic consequences of climate change/global warming on the state of our ocean, bays and marine fisheries from Salisbury to Westport, and around to Brayton Point in Mount Hope Bay.

My name is Rob Moir. I am president of the Ocean River Institute and a member of Environmental Entrepreneurs known as E2. I am speaking on behalf of the New England Chapter of E2, a national, volunteer community of ~800 business leaders -- 70 of them in Massachusetts. E2 believes in protecting the environment while building economic prosperity. The group is widely recognized as a resource for understanding the business perspective on environmental issues. As a group of entrepreneurs, investors and professionals, we have collectively started over 800 businesses which in turn have created over 400,000 jobs. About 20% of our members are in the investment community, where they have over \$20 Billion under management.

The U.S. is the third largest seafood consumer in the world with total consumer spending for fish and shellfish around \$60 billion per year. Coastal and marine commercial fishing generates upwards of \$30 billion per year.¹ The commercial seafood industry supported more than 76,500 jobs in the Northeast in 2004.²

In Massachusetts the annual commercial landings of fish and shellfish in 2005 was valued at over \$425 million. New Bedford, the number one fishing port in the United States in terms of ex-vessel revenue, brought in \$206 million in 2004, mainly from scallops.

The additional state revenue from seafood processing, commercial and recreational fishing services and related industries is many times that. Clearly loss of this source of jobs and

¹ Reports NOAA Fisheries Office of Science and Technology, 2007

² The Union for Concerned Scientists 2007 report

revenue would be a tremendous blow to the Commonwealth and the citizens of Massachusetts. But global warming is creating new threats to this economic engine.

I will limit my comments to the economic impacts to ocean life of four assaults that result from climate change: Acidification, water temperature increase, oxygen decrease, and a frightening lack of predictability in our marine ecosystems.

The ocean is intimately linked with the atmosphere. Last Saturday's fog rolling off Nantucket Sound onto Craigville Beach made the linkage between ocean and air palpable. Atmospheric carbon dioxide concentration has increased by 100 parts per million since 1850. This has driven approximately 525 billions tons of carbon dioxide into the world's oceans. About one third of humanity's carbon emissions released into the atmosphere is absorbed by the ocean³ with the result that the chemistry of seawater is changing⁴. Seawater pH is going down making seawater more acidic and creating what is commonly called "ocean acidification".

This interaction between CO₂ and seawater also reduces the availability of carbonate ions, which play an important role in shell formation for marine organisms such as corals, marine plankton, and shellfish. Researchers have already found that the calcification rates of the edible mussel and the Pacific oyster have declined in linear proportion with increasing CO₂ levels.⁵ I am particularly alarmed by this because, as my kids can testify, I love fried clams and steamers.

Turns out the toughest time for shellfish is as young larvae drifting about as part of the zooplankton. Then their calcareous carapaces, their outer skeletons, are transparent, but no less vital for their survival. This means that young lobsters and sea scallops, our state's most valuable shellfish, could be endangered by acidification of Massachusetts' ocean waters. Commercially valuable fish, including the Atlantic cod, are also vulnerable to acidification as eggs on ocean bottoms and as young fry sheltering in our estuaries. Fish eat plankton, some when young, some like mackerel and herring, most of the time. If the bottom tier of the marine food pyramid weakens entire fisheries can collapse.

³ (Sabine and Feely, 2007)

⁴ Already pH has gone from 8.21 to 8.1 (Feeley et al., 2004; Orr et al.; Caldeira and Wicket, 2005). 7.0 on the pH scale is neutral. If atmospheric carbon reaches the predicted level of 800 ppm near the end of the century, surface water pH would decrease by approximately 0.4 pH units (Orr et al., 2005).

⁵ (Gazeau et al., in press)

The other ocean assaults brought on by global warming are not as complicated as acidification but are no less harmful. Warming water temperatures that can hold less oxygen are not only bad for Massachusetts' cold water ocean life living north of Cape Cod but also for commercially valuable species of waters south of Cape Cod.

American lobsters have been found by scientists to suffer from unprecedented summer warming of bottom waters. One of the diseases, called "excretory calcinosis", is a gill tissue blood disorder resulting directly from warm water temperatures⁶. Other lobster diseases also appear to result from the stress of high temperature. In Long Island Sound the result of climate related stresses has been a 75% reduction in total landings and 85% reduction in the overall abundance of population⁷. These lobster diseases now appear to be moving northward into Massachusetts waters.

Another example of climate-induced effects on fisheries involves the northward expansion of a disease know as "dermo" that afflicts the oyster. This parasite yearly kills 50% of oysters in the Gulf of Mexico. Dermo has expanded its range northward in the 1990s to the Gulf of Maine and is now found in Cape Cod waters with no signs of abating⁸.

The cold waters of Massachusetts Bay where Atlantic bluefin tuna are caught has caused the species to be better known around the world as "Boston bluefin tuna." The cold water home for the "diamond of the ocean" fish cause tuna to acquire layers of fat, which gives their meat the rich, silky flavor so prized in Tokyo that chefs will pay \$100 per pound for Boston bluefin. Over the last three decades, while the total catch remained more or less constant at around 2 million pounds annually, the Atlantic fisherman's take for a bluefin tuna rose by 10,000 percent; this represents a creation of value with little parallel in history⁹.

The final global warming assault on our ocean wildlife is the least difficult to quantify. Climate change makes modeling and predicting the workings of ocean ecosystems much more difficult. Temperature, dissolved oxygen, acidity are all easily measured parameters. However, the impact of increased mixing of ocean waters due to different weather patterns, storms of variable intensities and directions are less predictable. Simple changes to cloud

⁶ (Dove et al. 2004)

⁷ (Conover, 2007)

⁸ (Ford and Smolowitz 2007)

⁹ (Issenberg, 2007)

cover can have an effect on the workings of ocean ecosystems such as the vertical migration of squid and deep water fish. Stresses brought on by global warming can make it easier for invasive species to take hold of new habitats. Global warming stresses will only accelerate the sliming and algal growth in Mass ocean waters.

The Union for Concerned Scientists report that Sea-surface temperatures along the Northeast's coast has already risen 1 degree F over the course of the twentieth century. Under a higher-emissions scenario, sea surface temperatures are projected to rise another 6 to 8 degrees F, and under a lower-emissions scenario 4-5 degrees F by late this century. These increases vary for different portions (circulations and depths) of Mass ocean waters. Bottom waters may increase 7 to 4 degrees F south of Cape Cod, 4-2 degrees F in the Gulf of Maine. Because Cape Cod Bay is the southern extreme for northern cold water species and Buzzards Bay the northern extreme for warmer water species much of Massachusetts marine life is already in a rather precarious predicament.

As a consumer of clams, I am particularly concerned with red-tide outbreaks. Though no one factor is responsible for red-tide outbreaks, the bad news is that unprecedented, or at least heretofore unobserved, combinations of factors can cause red tides that have closed shellfish beds from Maine to Rhode Island.

The nearly half billion dollars of commercial landings of fish and shellfish is only the beginning of the ocean's benefit to the Massachusetts economy. When I tuck into a plate of fried clams at Wimpy's or steamers at the Flying Bridge or the Captain Kidd, or a generous lobster sandwich at Four Seas, I am seeing economic value multiplied and compounded. Ocean life and seafood was and continues to be the backbone to Massachusetts' economy.

The global warming assaults already challenging our ocean waters make it far more important to take a cautious and well reasoned approach to ensure sustainable coastal development. The Massachusetts Ocean Act meets the challenge with comprehensive management informed by municipal and scientific voices and features transparent decision making that includes input from both professionals and citizens. I urge you to pass this bill as quickly as possible.

On the broader front of reducing global warming pollution, we believe a variety of measures are called for. One of the most important is the Global Warming Solutions Act of 2007

sponsored by Senator Pacheco which creates a market-based system to limit greenhouse gas emissions.

I thank Senator Pacheco for the work of the Committee on Global Warming and Climate Change for Massachusetts. Here is the economic engine that will continue to drive Massachusetts' prosperity while sustaining a quality of life and food we all cherish.

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