A WARM SODA OCEAN

THIS YEAR WAS A DISCOURAGING ONE FOR THE OCEAN

The warm soda ocean

As a snowstorm tracks through I sit looking to my left through the window, watching our ducks dealing with the storm by hunkering down. They are puffed up and still not willing to retreat to their shelter. Pretty soon they will be hungry and quack every time they hear us opening a door or even casting a shadow in the early winter dark. To the right I see my beloved West Meadow Creek, whose marshes, shifting sands, and pathways simply make me feel right. The fiddler crabs are safely nestled within the sand for the winter, the mallards, brant and other geese are finding shelter, but I know that this spring will bring more oysters and mussels to a reviving system, so long pummeled by buildings, septic tanks and every other insult that builds up together to tear down a living system. But we can reverse that and we will.

Maybe not so for the ocean at large. This has not been a good year for the ocean. My marine biologist colleagues have become witnesses to destruction. It has become common for many to set aside their life-long quests for understanding of a pristine world that is becoming evermore mythical. Instead they have set upon scores of projects documenting impending doom, recent catastrophes such as the Gulf Oil Spill, and even attempts to restore what probably never can be restored.
When I was a kid, there was one thing that all of us on our block in the Bronx could agree upon: Not who was the greatest center fielder for the Yankees; not whether the Dodgers would ever return to Brooklyn; we all agreed that warm soda simply was terrible. In current parlance: It sucks. And now, 50 years later, the ocean is turning into warm soda.

Ocean warming has accelerated throughout the globe, as has been documented at a number of outposts in the Atlantic and the Pacific. A detailed study of Monterey Bay, California has recorded the shifting of southerly species toward the north, and the reduction of northerly species. The Antarctic Peninsula is warming at an alarming rate, causing major reductions in sea ice and the decline of Adelie penguins, which are dependent on krill, albeit favoring another species, the Gentoo Penguin. At the top of the world, more and more sea ice is melting rapidly during the Arctic summer, endangering the titanic Polar Bear and inviting a new era of exploration for oil and an increase in commerce in a pristine terrane. These stories are now myriad, and range from the discovery of remarkable physiological limitations of fish to ocean warming, to major effects on global production of open ocean phytoplankton. The warming is causing a stillness and stability in the water column, which inhibits wind turnover of ocean warming and replenishment of nutrients from deeper waters to the nutrient-starved surface waters of the open oceans.

Still, and perhaps despite, these discoveries, our world society still refuses to act proportionally to the danger. Will it take the flooding of coastal lands, from Brooklyn to Bangladesh? Will it take an extinction, or a thousand? Right now there is no global will to respond to a global problem by massively turning the ship of energy production toward less burning of coal and oil.

Some pundits actively complain that wind and solar energy are simply not going to do the job; they lack the economic base and event the energy base. Is there really enough sunlight and wind to deal with our problem? So far, the answer is a flat no, but so far no country is seriously attempting to move toward an economy that is dominated by an energy source without a carbon footprint. Needless to say, the United States is not taking the lead. Our current recession is a short-term excuse, but so many others claim simply that the cost of a new energy source will sink even a healthy economy. Even those who make the case against wind and solar are not convincing anyone to shift to other sources, such as nuclear fission. Least of all in the United States is there any popular expression of will to ...just deal with the problem.

If anything, many if not most in our country and in the U.K. do not sense any alarm and even have their doubts that human activities are causing global warming in the first place. Polls of United States and U.K. residents show a surprising skepticism that warming is caused by industrially derived greenhouse gases. If so, how will we even try to solve this greatest challenge to the world polity if we can't agree at home? On top of this, maybe perhaps because of this, a significant fraction of our national leaders are actively promoting the contrarian view that global warming is either not caused by industrial activities or at the worst will not cause enough environmental change to matter very much. After all, if sea level will just rise another 10 cm or so in the next century and perhaps a couple of degrees celsius, who will suffer beyond a few oceanic island nations and a few thousand hapless marine species?

The skepticism or predictions of muted change is pulling the rug from under much of the work and achievements of climate scientists. We have much to be grateful for the great work of Charles Keeling, who installed a carbon dioxide detector at Mauna Loa and demonstrated the steady increase in the atmosphere, pulsing between seasons as if the earth were inhaling and exhaling. The achievements of the IPCC is legendary and makes the case for human-caused global warming with clarity and honesty. Yes there is uncertainty in the future, but can we afford to ignore the danger?

And back to the warm soda. The carbon dioxide in the atmosphere also dissolves into the sea surface, and the increase of oceanic acidity has begun. When carbon dioxide dissolves into seawater the carbonic acid that is formed releases hydronium ions, which reduces pH. The effects are not even everywhere. So far in many
locations, such as Hawaii, the increase has been very modest, amounting to a tenth of a pH unit. But much higher increases of acidity have been observed in the Pacific northwest of the United States by Tim Wootton and his colleagues. Unlike warming, the effect of carbon dioxide from industrial sources is clearcut and cannot be explained by all of the alternatives invoked by climate change deniers and skeptics, ranging from pointing out small and inconsequential errors, noting uncertainty in models, and classifying climate change supporters as a bunch of Chicken Littles, screaming for action when we can really delay action for a few decades or more.

A coral researcher aptly named De’ath and colleagues demonstrated a reduction of the growth and density of the lime in coral skeletons. While some of this effect may be due to the additional impact of warming, it is very clear that the acidity of the ocean is steadily marching toward the concentrations of dissolved CO2 when the mineral composition of corals will most definitely be threatened.

Unfortunately, the mineral phase found in corals, aragonite, is far less stable than a common alternative form, calcite, and it is a matter of a few decades when we should see very unfavorable conditions for precipitation, which will threaten coral reefs around the world. Even organisms with a form of calcite, magnesium calcite, will also suffer very soon, so the effect will be widespread on calcifying marine organisms.

**The Gulf Oil Spill**

On April 20th you might say the inevitable happened. Human error, a refusal to believe in the dangers, a rare accident....whatever you want. It did happen. The worst oil release in recorded history revealed that neither oil industry nor governmental agencies had done much to prevent or respond effectively to a major accident. The blowout itself revealed that several defenses were ineffective or worse, so poorly maintained as to literally preordain a series of devastating consequences. As eleven men died tragically, others plunged into a fiery oil-coated sea, abandoning what should have been a sophisticated outpost of industrial activity and safety, to its oily fate.

The following weeks verged on the pathetic. At first both BP Oil and the US National Oceanographic and Atmospheric Authority played down the damage and seriously underestimated the amount of oil released daily from the wellhead. Sadly, NOAA also minimized the effects, even minimizing a plume of subtidal oily mixture discovered by researchers from the University of South Florida. All this gradually changed as a committee of scientists began to analyze videos and declared the leak to be the worst oil spill in history, even worse than that of the Exxon Valdez and a shallower wellhead blowout in Mexico at Ixtoc, which blew for 290 days in the late 1970s. For a crucial period of months, the Obama administration dithered about a large 500 million dollars U.S. fund offered by BP to study the impacts of the oil spill. Finally, in November 2010, a decision was made to allocate the funds, but much time was lost to study crucial initial releases of oil and their effects. Perhaps even worse, it is not clear that the funds would have been spent very well, since NOAA and other agencies did not have a ready plan to deal with such a spill. Even the defenses of the shoreline were inadequate. The same dispersant used in the Exxon Valdez

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spill of 1989, Corexit, was used massively in the Gulf. The same types of floats were used. Really nothing had changed at all. A few strange sidelights emerged. A very peculiar vessel, A WHALE, arrived that was supposed to process oil spilled and rising to the surface. It was about 300 m long and 10 stories high. It only worked offshore and its effectiveness was deemed inconclusive. Even actor Kevin Costner got into the act with a supposedly innovative oil separator. Aside from lawsuits nothing much developed. Overall, the oil spill revealed just how little research or deployment had occurred given the high stakes of a deepwater oil blowouts.

And what are the stakes? Fisheries closures, oiling of marshes perhaps for decades, long-term losses of crucial species owing to recruitment failures in this and successive years. The only good news is that the well was finally sealed in the summer of 2010 and the rest of the oil is beginning to be decomposed by natural bacteria, aided by ocean turbulence, wind and tide. We won’t know for a long time just how bad the effects may be. Many fisheries have been completely reopened and only a minority are still affected, at least in terms of closures.

The effects will be studied but we are now just waiting for another accident. That is the nature of rare events. There is no reason to doubt that the deep-sea exploration industry will now intensify efforts to reduce accidents. Indeed these accidents can be judged from history to be few and far between. But each one is devastating. Will we be ready for the next one? Past experience sadly says no. We can only hope that the recent Gulf Spill will not linger for decades, as an extremely minor fuel spill has in the marshes of Cape Cod, where crabs still suffer from oil that permeates the marsh sediments. We hope that the people who fish the Gulf will not suffer the way local fisheries and people of Prince William Sound have suffered. We hope for our marine life. How many tragic accidents can they endure before the ocean permanently declines with no hope of recovery?

Corals are under threat of ocean acidification. Photo by J. Levinton

Fisheries: A Bad Year for Bluefin Tuna but Some Hope for Sharks and United States Fishery Policy

Fish populations and fisheries are in severe decline around the world. Both open ocean fisheries and inshore fisheries have shared the same fate. On the high seas, many fisheries suffer because many countries have to agree to regulate fishing by treaty, or through quotas that emerge from international agencies, such as the United Nations Food and Agriculture Organization. The International Whaling Commission has been in existence since shortly after World War II. Both organizations have had a spotty history, since it is so difficult to get member nations to agree to limits on fishing and enforcement is a murky business on the international level.

This year there has been focus on the Atlantic Bluefin tuna, a magnificent beast, often weighing in at hundreds of pounds and, perhaps unfortunately, giving connoisseurs a great sushi experience. The western Atlantic population has declined over 90 percent since 1970, but the main focus recently has been on the Mediterranean, which is a major spawning ground. The profit, tens of thousands of U.S. dollars per large fish, is irresistible and political pressures from fishing nations have prevented effective management, even of the spawning grounds in the Mediterranean. Thus, despite dangerously low population levels, the Atlantic bluefin failed to make the list for endangered species.

Some glimmers of hope have appeared. Countries such as Australia have pioneered in creating exchangeable licenses for fishing, which limits the total fishing to current firms, but allows any fisherman to sell his license to another. The advantage is a leveling off of fishing pressure, but the obvious disadvantage is the centralization of ownership of licenses as smaller firms give up and sell their shares to larger corporations. This idea has finally arrived in the United States. NOAA proposed a series of rules for ground fishing on the west coast of North America. Trawlers drag the bottom and haul up many fish that are tossed because they are not the target
known as bycatch, and can cause extensive damage to non-target fisheries. The new rules not only install exchangeable licences, but also create bycatch quotas. The rules are very complex, but include observers and may help to reduce fishing pressure on an already severely overfished regime.

Another encouraging development is the passing, by the U.S. Congress of a shark protection act, which is meant to discourage collection of shark fins, while tossing overboard the rest of the shark carcass. The law simplifies the rules, but installs an exemption for the smooth dogfish, to please the constituency of Sen. Richard Burr (R. - N.C.). The exemption is a pity, but the price we pay for getting enough votes in the U.S. Senate, where even a single senator has the right to talk and talk and talk a bill to death.

I should say in closing this discouraging report that we owe so much to the late Ransom Myers, who helped document the collapse of shark species around the world. He and his excellent shark researcher colleagues used fishery data in order to document the great danger that large-bodied sharks now face.

Prepared by Jeffrey Levinton, webmaster of MBWEB, the Marine Biology Web Page.