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First, to address the questions posed in the invitation to attend this hearing.

1. What climate change impacts have I observed? I have been tracking the research gathered over the years by scientists who were not looking for evidence of climate change, but who found it, anyway, in receding ice, rising sea level, changing distribution patterns of certain fish and marine plants. In a small submarine, I have personally observed bubbles of methane escaping from the seafloor in 1800 feet of water in the Gulf of Mexico, and have wondered what increased warming might do to accelerate the release of more methane, that in turn would accelerate warming, and so on.

I have also personally witnessed an increase in ocean pollution and the sharp decline in the abundance and diversity of marine life in many parts of this country and elsewhere in the world, and have wondered how degraded systems could cope with changes in climate that healthy, intact systems could more readily endure.

2. Do increased concentrations of atmospheric carbon dioxide impact aquatic ecosystems. Changes of any kind will have some impact, but the specific concerns about CO₂ relate to chemistry, especially the trend toward acidification when more CO₂ enters the ocean than can be accommodated. Increased CO₂ is likely to favor some species over others, with consequences that could include disruption of fine-tuned systems that have developed over thousands of millennia, systems that presently favor humankind.

3. What are some of the initiatives we can take to conserve our oceans, and work towards their long term health? What we put into the sea and what we take out are perhaps the two greatest causes of degradation. Regulations have improved but not enough to stop the flow of excess fertilizers and noxious chemicals as well as an avalanche of plastic and other debris that clogs the ocean and kills creatures that live there. Identifying and protecting large areas of the ocean from destructive fishing should be a high priority. Establishing true marine reserves, where only non-destructive uses are permitted is critically important. Large areas are needed, but even relatively small places can make a difference, especially to protect breeding areas, feeding areas, nursery areas, and regions of high diversity, linked with substantial corridors.

General Comments

Sylvia A. Earle

Perhaps the greatest concern about climate change is that many people are not taking it seriously, and many others are not taking it seriously *enough*. To deal with a problem, it is necessary to first recognize that it exists. *The United States can help by making climate change issues priority issues, including actions that can help stabilize and reverse the troubling trends.*

Climate change is real, of course. Not only is change natural and inevitable, but owing to human actions over the ages, especially during the 20th and now the 21st centuries, the rate of change has accelerated significantly.

Most worrisome, perhaps, is the accelerated warming trend caused by excess greenhouse gases, notably carbon dioxide, that we have released into the atmosphere. *The United States can help by supporting policies that will reduce CO2 emissions sharply and swiftly.*

There should be a moratorium on cutting whatever old growth forests remain, wherever they are in the country, partly to maintain the irreplaceable diversity contained there. Maintaining the highest possible biodiversity is like writing an insurance policy against the negative consequences of climate change. The greater the diversity, the better the chances that some species will prosper and adapt to the new circumstances.

Protecting forests benefits watersheds and rivers that inexorably flow into the sea. Healthier landscapes yield healthier seascapes.

Moreover, intact forests store carbon; logged or burned forests release it to the atmosphere as CO₂ and methane. The same is true of ocean ecosystems. Kelp forests and coral reefs sequester carbon; dead or damaged systems release carbon. Fish and other forms of ocean life are carbon-based units that represent an enormous living store-house for carbon – as long as it remains in the sea. Wildlife taken from forests as bushmeat and the hundred million or so tons of wildlife taken annually from the sea diminish the resilience of their respective systems and put stored carbon into play.

Increased temperature brings with it a host of concerns. Plants and animals typically occupy a fairly narrow span of temperature that is suitable for their particular species. Some like it hot; some like it cold. Even small temperatures can have profound consequences for organisms that do not have our capacity to modify the environment to suit themselves. Some can migrate, but the ecosystems upon which individual species depend cannot migrate en masse. As migrating species move into new territories, they may displace and disrupt other species and undermine entire systems. *The United States can help by supporting policies to swiftly and sharply increase protection for natural systems, including forests and ocean ecosystems, and the diverse forms of life they support.*

\As the ocean warms, there is concern that frozen methane now abundant and widespread in the deep sea may be released, enhancing the greenhouse effect, and speeding up the warming trend, and thus increasing the release of more methane – a classic feedback loop. Moreover, increasing warmth will cause the release of methane from the now-frozen permafrost in the Arctic's tundra, with similar feed-back consequences. *The United States can help by acknowledging the importance of methane in global warming and recognize the need to view climate change with an enhanced sense of urgency.*

The results of global warming include the melting of polar and alpine ice leading to sea level rise, another natural process that is accelerating, with impact most obvious in densely populated coastal areas worldwide. Today's children and the majority of adults will experience the consequences. *The United States can take the lead in helping prepare people for how to deal with this in a timely manner.*

Sadly, while the ocean provides the foundation for all of the planet's systems – driving climate and weather, stabilizing temperature, taking up and holding carbon dioxide from the atmosphere, generating oxygen, shaping global chemistry, providing home for most of life on Earth – the ocean is being largely ignored by most of those who have been working on climate change issues. *One of the most important and positive things that the United States can do to prepare for the consequences of climate change is to recognize the role of the ocean, and take all possible measures to protect that vast but vulnerable system that governs the way the world works.*

Recognizing that the ocean's wildlife – the fish, the whales, the kelp, the crabs, the krill, the sharks, the urchins and starfish, the coral reefs and deep sea forests of coral – are all components of our life support system, it is truly alarming that in just a few decades, these vital natural treasures are in serious trouble.

Viewed from afar, Earth comes into focus as the one and only World Bank, the natural asset base that humankind relies upon for all that matters to us.

Our overfishing and use of trawls, draggers, longlines and other destructive gear have cost us dearly. Ninety per cent of the big fish are gone – sharks, swordfish, tunas, cod, marlin, groupers, snappers, and many more. Hundreds of thousands of marine mammals and seabirds as well as numerous sea turtles are killed as bycatch every year. Critical habitats, from mangrove forests to sea grass meadows to coral reefs and deep sea mountains have been devastated -- with perverse subsidies helping to underwrite the destruction.

The good news is that some coral reefs are still in reasonably good shape. There is still a chance for blue-fin tunas and blue whales, for cod and corals and deep sea crabs. But only if we understand that alive they are critically important to the health of the ocean, and therefore to our health. If the ocean is at risk – and it is – then so are we. If the ocean is in trouble, so are we. By taking care of the ocean, we are taking care of ourselves.

An opportunity was missed in 2007 when the United States joined with most other countries to establish a moratorium on bottom trawling in the High Seas, a recommendation to the United Nations that was narrowly defeated. How does this relate to climate change issues? It seems simple enough. During a time when the world is undergoing changes unprecedented in the history of humankind, the last thing that we should be doing is to go about disrupting stable, diverse, natural systems that may be critical in holding the planet steady as temperature swings, currents change, and living systems try to adapt to new circumstances.

Trawling the ocean floor is comparable to bulldozing forests for songbirds, Despite the Enormous destruction, most of the deep sea has been beyond our reach until now. There is only one chance to keep the deep sea ecosystems from severe trauma. Once trawled, the distillation of millions of years of fine-tuning is lost. *The United States could take actions necessary to stabilize ocean ecosystems: curb overfishing and destructive fishing practices, and stop using the ocean as a place to dump wastes.*

The blue heart of the planet is choked with plastic and other debris. Even more troubling is the other big problem with carbon dioxide. The ocean takes up a lot, but so much as been generated so fast that there is an excess of CO₂ in the ocean, CO₂ that converts to carbonic acid. The ocean has been trending toward acidification in recent years. That is bad for coral reefs, sea snails, clams, the planktonic young of many creatures, as well as the small green organisms with carbonate shells that dissolve in acidic water. No longer can they take carbon out of the atmosphere, generate oxygen, or produce food for other creatures.

There are many reasons for the United States to be optimistic, to consider the powerful influence this country can have on the rest of the world by setting the right example, as well as providing help in blunting the sharp edge of climate change impact. Many feel helpless and therefore hopeless.

There is time, but no time to waste.

The next ten years may be the most important in the next ten thousand years because of what we do – or fail to do – concerning climate change. As never again, we have a chance, and you who represent this country have a unique opportunity to promote actions That will protect all that we hold near and dear – our health, our wealth, our security, our very lives, and the lives of all who follow.

