

Sylvia Earle

Deep Ocean Exploration and Research

The world's oceans today are in trouble, and the thing is, if the ocean is in trouble so are we. One of the biggest problems facing the oceans today is, of course, human beings and our impact on the sea. This is a change that has come about in just recent times. First of all, going back a few hundred years, our numbers were small, smaller than they are today. Our technology hadn't reached the point where we could access most of the ocean. But, in half a century, in my lifetime, we have been able to exert such an influence over the skies above, the land, and certainly the ocean. It's just unprecedented. We have hit this planet like something from afar, like the comet that hit the dinosaurs, and we are changing the basis of our life support system. The ocean is really the heart of that system.

What drives the way the planet works? Ninety-seven percent of earth's water is ocean. Of course, it goes up into the atmosphere, comes back as rain, sleet and snow. Thus, accounting for that small fraction of the remaining three percent, the fresh water that we access. Most of the fresh water is locked in polar ice, but the sea, with its massive water drives the way the planet works. The ocean drives not just weather and climate, generates most of the oxygen in the atmosphere, absorbs much of the carbon, but here's the thing: the ocean is a living system. It isn't just water. You take a spoonful of ocean water, and you have in front of you more than a thousand variations on the theme of microbes, including many millions of individual lives, in what looks like perfectly clear water. It isn't just water. It's a living soup. Extrapolate from there all of the waters in the world, from the little drops and spoonfuls, to the whole ocean basins that are filled with life.

This is what makes the planet function – life, not just water; not just rocks, not just the physical attributes of the planet, but the living systems shape the earth, and have been shaping it for billions of years. We, at such recent times, geologically speaking, are taking for granted the distillation of all preceding history that have shaped the ingredients that make this planet fortuitously hospitable for us, for life as we know it. Today we live on a planet that has an atmosphere of eighty percent nitrogen and about twenty percent oxygen. There's a small fraction of other gases in there, including just enough carbon dioxide to keep the photosynthetic engine that makes the planet work, operating. It's a small amount as compared to what there was a billion years ago or even 500 million years ago.

Going back to the earliest states of earth, it is thought that the atmosphere was largely carbon dioxide, much like the atmosphere of Mars today. It's only through the action of photosynthetic organisms that arrived somewhere along the line, many hundreds of millions of years ago, that have acted on the carbon dioxide, generated oxygen, transformed this planet that is just right for the likes of us. We don't have another few hundred million years to fine tune a system if we get it out of kilter, to get it back to where it was after many hundreds of millions of years, getting to where we now are. In our time we have been able to, without even trying, just doing what we do, we've been

Journey to Planet Earth

www.pbs.org/journeytoplanetearth

successful, if you could call it that, in nudging the natural systems that make the world operate the way it does, putting into the atmosphere more carbon dioxide than has been noted in the atmosphere for many thousands of years. Going back much farther, of course, there was much more carbon dioxide, but it's been whittled down by this great green engine – green engine and blue engine.

It all ties together – but it's the process of photosynthesis that has largely made earth hospitable. And through our actions, our actions that, unwittingly, have altered the basic processes that heretofore we have been able to take for granted. As a kid I never thought much about where air came from. I never worried much about water supplies. I lived on a small farm in New Jersey. We had a well. People would come from all over to draw water from that well because it was such good water, but I wouldn't drink from that well today because it takes ground water from the New Jersey area, which today, alas, is contaminated – not good for us, not good for the rest of life on earth. What we have done to the waters of the world – the fresh waters – and of course, the broader oceans beyond.

In half a century, we have lost on the order of ninety percent of the big fish in the ocean. I say lost, actually, we haven't lost them. We've consumed them. We've eaten them. We've captured them. We have the capacity now, through huge nets, trawls that leave a swath across the ocean floor, destroying the system in the process of extracting pounds of protein that have been going to market now for a few decades, to supply mostly high end luxury demand for exotic things to eat. When I was a child we didn't eat blue fin tuna. When I was a child, a few things were taken from the sea that appeared on our menu, but nothing like the diversity of the creatures that are now in far inland markets, that are globally distributed.

Our capacity now to find, to capture, and to market a wide range of wildlife taken from the sea is unparalleled in human history. Imagine sitting down at a dinner somewhere in Iowa and eating a fish that's been caught in Antarctic waters, and brought – still fresh – to your table. Or to be in a restaurant in Tokyo, and get a fish that was swimming two days ago in the North Atlantic. Or to be in London, and get something from the Gulf of Mexico, perhaps a snapper that has a high value as a Chef's Delight and it's blackened the way New Orleans chefs like to do. There are many things that have caused us to take beyond the capacity of the ocean to renew, that in our time. we have seen the collapse of the major fishing operations worldwide. A few appear to be somewhat healthy, but the trend is really alarming.

When you think about it, why are we still doing it? Going back to when I was a child half a century ago...here's where blue fin tuna, or swordfish, or marlin, sharks, big flounders, cod fish...their populations were already being hammered, depressed, but as compared to today they were here. We've lost ninety percent. We've got ten percent left to go, in some cases only 2 percent. The North Atlantic populations of blue fin tuna are really in precarious shape – maybe one percent remains. When I served as the chief scientist of NOAA in the early 90's, I was stunned when I learned that the blue fin tunas in the North Atlantic, according to the fishermen's own records, were down to ten percent. That was

in 1990, '91, and '92. That situation has not improved. Populations have continued to decline and yet we continue to extract them because the value of every single fish is so high. The numbers go down, the price goes up; it's still profitable to fish.

It doesn't make sense in the long term, because if you keep on with populations at the current depressed level – and continuing business as usual – it won't take fifty years to eliminate these key species. Not just key species as far as our menus are concerned...It has little to do with our economy because fisheries worldwide, including in the United States, are subsidized heavily, so it's not a matter of economics. It's a matter of perception. If we really understand, first of all, that these creatures are not like something you farm, although we talk about harvesting the sea, it's a misuse of the word if ever there was a misuse, we don't plant fish in the ocean...we are hunters and gatherers. We go out, like hunters, like our long-ago ancestors, and track them down; find them; extract them; not really paying the true cost of what it took to make a blue fin tuna, or a shark, or let's say an orange roughy, which was not on my menu, anybody's menu, fifty years ago.

It was only about thirty years ago that people began to realize that in deep water, around undersea mountains, these fish could be captured and marketed, not by the name that scientists referred to them as, slime heads. If they had been marketed as slime heads it's not likely that they would have become so popular. They were given this new fancy name, a Madison Avenue name - orange roughy – now popular in restaurants all over the world, but soon to disappear from the restaurants and supermarkets because they'll disappear, from the ocean. Why? It takes thirty years for them to mature. They may be 150 years old, some believe as much as 250 years old by the time they reach your plate. This is not a likely target for sustainable extraction, especially when you consider the methods used. These trawls that are like bulldozers smashing the deep-sea forests of corals that are home for the orange roughy. Take away the homes where these creatures live, and how does recovery take place? Even if you do back off, and allow those that remain a chance to recover, to restore? Wait another century, perhaps some will come back, but we are literally mining, clear cutting the deep sea, and having really extracted the great wealth of our coastal waters, the shallow waters around the world, we're now moving further and further off-shore and deeper and deeper.

Until recently, I didn't worry so much about what was happening to life in the deep sea, it seemed that this was a great wilderness, still relatively inaccessible, still largely untouched by human aggressiveness, but that has certainly changed in recent decades. While we still don't have working access, as scientists, to even half the oceans' depths and most parts of the sea...we've only seen 5 percent, less than 5 percent, of the oceans as a whole, below the surface – and even the surface waters are not that well-known. But, when you take the ocean as a whole, this biosphere--97 percent of earth's biosphere is ocean, where life on earth actually lives, we now can access it either directly, by taking ourselves there, or indirectly by using our gathering techniques – hooks and lines and all the rest – to gather from increasingly deep water.

One of the greatest problems facing the oceans today is what we're putting into it. Some of it is deliberate. Some of it is just the flow of groundwater that picks up whatever it is we put on our lawns or fields, our farms, our streets, and what falls out of the atmosphere, which, ultimately, enters the land and flows into the sea or falls into the sea directly. But largely, it's just the toxic load that flows into the ocean from upstream sources that has increased enormously in the past century, and especially the last half-century and the pace is certainly picking up. Fifty years ago there were certainly algal blooms known around the world; it's a natural sort of thing, it goes back perhaps through all time, certainly through our recorded human history. There are notes about what appear to be algal blooms and even toxic algal blooms.

But, what has happened just in the last thirty years is an increase in what we're allowing to flow into the sea, nitrates, phosphates, and who knows exactly what triggers these events. It depends on suite of organisms that are out there. Certainly nitrates and phosphates are key ingredients in fertilizers that we apply to the land in large amounts, and what we put on our lawns, fields, farms, and golf courses. We are allowing this to ultimately go into the world's oceans. This stimulates, apparently, the growth of a handful of species that are very fast growing – you could call them weeds on a micro scale, if you will. They dominate an area to the exclusion of virtually everything else...gobble up the oxygen that is there so that whatever else was there ultimately, is going to die. This is one of the key ingredients for most of the life that we think about in the oceans. Certainly the fish and the sponges and other things require oxygen. There are other microbes that are quite happy in an anoxic situation.

Thus even though it looks as though everything dies in a so-called dead zone, as in places such as at the mouth of the Mississippi River, seasonally, at the end of summer, when the water temperature gets to be at a level, it favors the growth of a certain number of organisms. They are favored also by the nutrients that are available, and they just explode in terms of their population, but even they ultimately fade away, leaving what appears to be an empty ocean. It's not truly empty. Microbes prosper wherever there's water, microbes of diverse kinds, but not the kind of microbial suite of organisms that characterize a healthy ocean.

Going back only a decade, there was something like fifty dead zones that were acknowledged around the world...notorious areas, such as the mouth of the Mississippi River, that seasonally develops this huge area. Some characterize it by saying it's as large as the state of New Jersey, well it's actually larger than that during most years, occupying a big chunk of ocean with this deadly low oxygen area. The Chesapeake Bay, seasonally, can be characterized as – can you believe it – a dead zone. This most productive place in the back yard of the capital of the United States. But all around the world's coastal areas, mainly at the mouths of rivers...now, just in recent times, that number has escalated to more than 150 dead zones. In the summer of 2005, I had an opportunity to witness the death of Tampa Bay, a place that I've known and loved since I was a child. It was only temporarily dead, if you will, but included for the first time in this unpopular list of dead zones. Certainly there was plenty of life still there. But, the initial appearance that, as you

Journey to Planet Earth

www.pbs.org/journeytoplanetearth

approach this area was-- first of all you could smell it, and then you could see the fish belly-up, dead and dying.

The water that, as a child, I knew by the name of one of the nearby communities, Clearwater. It was named that for a good reason – clear water on Tampa Bay. It hasn't been clear in a very long time. In the summer of 2005 it was disgusting. You could barely see your foot if you were standing in two inches of water. It was that rich with this sediment, with the collective bodies of these microorganisms that had prospered and then they themselves had died. It was quite a contrast to being offshore – directly offshore – about 150 miles into the Gulf of Mexico, where the water is as clear, almost as clear, as the air. The depths that we were working in the little submersible called Deep Worker, on the bottom almost 100 meters beneath the surface, we were able to see the sun, right at the surface, just as a clear sphere, and creatures that were surrounding us, a diverse, and rich reef situation, even in waters that deep. But, coming inshore from that beautiful place, into the coastal waters of Florida, the transition was a real eye opener. To see the influence of what we've done upstream to cause these once pristine waters, these productive waters to, to really die and to see the transition into the offshore areas beyond.

The biggest problem facing the world's ocean today is lack of awareness on the part of human beings. If we really understood how important the ocean really is to all of us with every breath we take, with every drop of water we drink, we would be inspired to do everything in our power to take care of it because we realize that our life depends on it. But we haven't quite got that yet. When we do get it, we may change our ways and alter the way that we treat the ocean, and not just the ocean as a body of water, but the life in the ocean that shapes the character of the sea, and thus the planet as a whole.

The second aspect of that is not just that we know that the ocean matters, but that we have the capacity to alter the way it works. Going back to the 1960s, even more recently than that, there are people who think that the ocean is so big, so vast, so resilient, that there isn't much that human beings can do to alter the way it works. We used to think that about the atmosphere too. We used to think that about wildlife on the land, that our job was to conquer the wilderness. Well with the ocean, there's still the notion on the part...on the minds of many, that it doesn't matter what we put into the sea, or what we take out, that the ocean will be able to recover, just give it time.

Well we have learned, unfortunately, the hard way, that this is not necessarily the case, In fact it is definitely not the case. In areas where cod have been protected in parts of the North Atlantic Ocean, now for some years, looking at the state and decline of cod in recent times, they have not recovered. There are some success stories that suggest maybe this is one of the actions that we can take to help the ocean rebound from some of the problems we're causing. One success story is the striped bass, also in the North Atlantic Ocean, where for five years, we did what would seem the smart thing to do if you want a species to recover once it has been depressed, and that is just stop killing them! Yes, you have to protect breeding areas, but first thing you do is give them a break. We gave striped bass a break for five years, a moratorium on taking them. That was not a

guarantee that they would recover, but in fact, they had a couple of good years for the young and got established and since then we have changed our ways, cut back on the number that are allowed to be extracted. It's not a full-scale success story but it's certainly a promising sign of hope that we can take actions that will have positive, desirable results.

Most people on the planet don't get to see the ocean the way I get to see the ocean, from the inside out, getting to meet creatures on their own terms, face to face. People, therefore, have to rely on other means, whether it's books or films or whatever it is, to gain insight into the sea. I love the fact that the news about the nature of the ocean is shared in this way, but I really don't love the way that it's sometimes misrepresented. And one of the key creatures in the ocean, group of creatures, that is much maligned, are those big, beautiful, powerful animals known as sharks. When I started as a diver I was cautioned about sharks..."watch out, be careful of the man-eaters". I thought, I don't have to worry. I don't qualify. But man-eating sharks are certainly high on the minds of most people when they first think about the ocean. Even if they never see the ocean, they worry about the sharks.

Part of that came as a consequence of that very powerful book and film, Jaws. And Peter Benchley subsequently...I mean I talked with him many times, seemed to want to get down on his knees and apologize to sharks because he understands they're not bad guys. You used to worry about man-eating sharks. Now we have to worry about man eating sharks. We consume hundreds of millions of sharks literally every year. Not I, but people generally, take them not just for sport but for shark fins, for the cartilage that supports their big bodies. A lot of reasons why people now go after sharks, but one of the reasons is because of the feeling that we're doing something good for the ocean if we eliminate these big bad creatures, a threat to human kind. Nothing could be further from the truth and Peter Benchley had spent years now trying to establish a counter point to the myth that, that sharks are really out to get us. Made a good story, but that's all it was. It was a good story. Now, people probably wouldn't care the way they do about dolphins were it not for that television series that I certainly loved watching myself as a kid...and it featured Flipper! Or Mike Nelson and his underwater exploits that sometimes involved marine mammals, and films that portray dolphins as our allies, and certainly having sympathy for creatures such as these intelligent sea residents is a very positive good thing. Now it needs to be put in perspective in terms of this greater system.

If I could, I would love to take anybody and everyone down into the sea to see what I have come to know and love. The best way to go beyond where divers go is in a little submarine. Now you can send your vicarious presence down with a camera and remotely operated system, but there is nothing like being there yourself. Ask any astronaut, do you want a camera as a substitute for yourself in the sky or do you want to go and use all of your senses? Certainly having cameras in the sky is valuable, it's not a displacement, but imagine being in a little shell: Deep Worker; Deep Rotor; Alvin; Johnson Ceiling; the whole suite of submersibles that now exist and take you down into the sea. As you descend in a healthy ocean, where the water is clear, where light penetrates to 300 meters,

400 meters, 500 meters, sometimes even to as much as 800 meters beneath the surface. There's the faintest glow of sunlight above, and the water changes from this ethereal blue to kind of a purplish violet, and then it gets to deepest purple-blue, and finally, any hint of blue or purple disappears and it's just black, but it's not completely dark because all around there is a galaxy of light, life that illuminates the area, like being in the middle of a Fourth of July celebration--fireworks, these little sparkle, flash and glow--little jellies and minute crustacean and squids that fire-off a jet, bioluminescent ink.

All the way down from the surface even to the deepest sea, according to the two people in history who have been to the deepest part, seven miles down, light that is created by life itself follows you. It's there. It's there in all of the depths of the ocean, and it's just such a joy to be able to see that. Turn on the lights and you can see these little creatures all about you. People ask me sometimes when I come back from a trip where I've been down by myself, solo in a little submarine to 1000 meters beneath the surface, or maybe only 1000 feet, they say, "aren't you scared? Don't you get lonely down there?" I say, "Scared? No, I love it down there". There are things to worry about, I'm more afraid of traffic than I am underwater. And lonely? There's this galaxy of life all around. It's not just the lights, it's the living creatures behind them that make every trip a trip of sheer joy. And that's what I would love to be able to share with every person on the planet--to get to understand the ocean is alive. The ocean drives the way the world works. We need to take care of the ocean as if our lives depend on it, because our lives do depend on taking care of the ocean.