OUR SHARED SEAS

Interview with Dr. Jane Lubchenco

The Our Shared Seas team is thrilled to welcome Dr. Jane Lubchenco today to discuss the ocean-climate nexus.

Dr. Lubchenco is a world-renowned environmental scientist who has deep experience in the worlds of science, academia, and government. From 2009 to 2013, she served as Administrator of NOAA and Under Secretary of Commerce for Oceans and Atmosphere. Nominated by President Obama in 2008 as part of his "Science Dream Team," she is a marine ecologist and environmental scientist by training, with expertise in oceans, climate change, and interactions between the environment and human well-being.

Thank you for joining us today, Jane. We're excited to dive in.

Dr. Lubchenco: Hey Emily, it's great to be here, thanks for the chance!

OSS: We were excited by the Science editorial that you recently co-authored with Steve Gaines, you suggest that it's time to shift the paradigm from "the ocean is too big to fix" to "the ocean is too big to ignore." You call on scientists to switch gears from simply documenting the challenge to contributing to the solution space. Which solutions give you the most hope that we can drive transformative change for the ocean?

Dr. Lubchenco: Thanks for the compliments on our *Science* editorial. It was really great to have a chance to talk about how we're seeing the arc of how people think about and act with respect to the ocean changing. I think that the fact that the ocean sustains us, feeds us, and connects us is a really important place to begin talking about the ocean. It really is our past; but it's also, I believe, our future. And that's why the focus on solutions and on thinking about the ocean in the way that it integrates so many other important things to us is appropriate.

Many people think about the ocean as doom and gloom. You know, we know that the ocean is higher, warmer, it's stormier, sicker, more acidic, and has less oxygen. That also means it's more disrupted and less predictable than it has been, and those are huge challenges. The exciting thing to me though is that people are beginning to pivot from just seeing all the problems to really focusing on, "okay, what can we do about it?," and—importantly—what are the co-benefits that might bring both good outcomes to multiple things that we care about. So, the solutions that give me hope are multiple. And what I see is that there is just a huge amount of positive things that are bubbling up around the world. They're not at the scale that we need, and they're not in many cases very well known. But to me they are super encouraging and provide a very clear path forward to identify these solutions, to adopt them, to escalate, to amplify, to scale them up in ways that are, I think, feasible and that would bring multiple benefits.

On the topic of fisheries management...

One of the solutions that I think is tremendously exciting is that there is a major shift underway now in fisheries management. There is a new focus on ending overfishing and recovering depleted fisheries. Now, this is not easy to do. But we've seen multiple instances around the world where it is possible and the result is far more fish in the ocean, and therefore, a more vibrant fishing industry, more food security, healthier ocean ecosystems. So, there is a triple bottom line win that is absolutely worth the difficulties in making this transition to sustainable fisheries. The Environmental Defense Fund calls this "fishing smarter, not harder" and I really like that label.

I'll give you a specific example. When I was at NOAA, one of the things that NOAA does is oversee management of federal fisheries in U.S. waters. NOAA was mandated by Congress to end overfishing and to do it within a certain timeframe. It was actually a very challenging, very painful thing to do. But the end result has really been transformative for U.S. fisheries. We have turned things around in a way that is totally remarkable and is an amazing story that I think is not well known.

Let me give you some numbers. In the year 2000 there were 92 stocks of federally managed fisheries that were overfished. Ninety-two. But, because of the changes that have been implemented, by 2018 there were 41. So, the number of overfished stocks has just been slashed and that's pretty impressive. Even more so, is the number of stocks that were significantly overfished so badly that the fishery was closed, and now the stock has been rebuilt to a healthy level where it can again be fished. In the year 2000, there were zero of those rebuilt stocks, but by 2018 there were 45 of them. And since 2008, these fisheries have resulted in a 21 percent increase in catch and a 24 percent increase in value as the stocks are rebuilt and as they can again be fished. So that's just one example of many around the world where we have demonstrated that sustainable fisheries is not just a good idea, it's actually feasible.

The secret to many of the successes around the world has been focusing on secure access, changing the incentives for fishers so they are rewarded for fishing in a way that has the long-term benefit in mind, not just the short term. This approach of secure access, or "rights-based fisheries," is now being embraced in many, many countries around the world. A few years ago—that was the last count I saw—there were over 200 rights-based fisheries globally, and that was over 500 species and 40 countries. So, we've seen in the U.S. and in a number of other developed and developing countries, an impressive turnaround in fisheries. Again, it's not at the scale that we need, but we have learned what works and what doesn't work. One of the most important aspects of what works is not only this approach of having secure access and getting the incentives right for the fishermen, but having fishermen that are the champions of change, fishermen that are leading the progressive efforts.

Some of my colleagues, Chris Costello and Steve Gaines and others, published a paper not too long ago in the Proceedings of the National Academy of Sciences where they said, "Let's assume that we could fix all fisheries in the world. What would be the upside of doing that? What would the benefit be?". And they found, doing a very comprehensive analysis of fisheries globally, that you could increase global yield of fisheries by 40 percent, you could increase the abundance of food—of fish—in the ocean by five percent, you could increase revenues by 30 percent, and all of that would be by 2030 relative to business as usual. The bottom line there is, not only have we seen that it's possible, we're seeing fisheries come back and thrive, and fishing communities and fishing industries benefit from that. But there is a lot more potential if we could do it at a global scale. So, that's one of the solutions that gives me hope. Actually, I should mention that if we improve fisheries management like that,

it could actually offset many of the worst negative impacts of climate change. I'd spoken a little earlier about the co-benefits, and here is a very prime example where in fixing fisheries management, we can actually help address the impacts of climate change. And I think that's a repeated theme.

On the topic of combatting IUU Fishing…

Dr. Lubchenco: Okay, so another solution that I find very exciting is around this concept of illegal fishing, or, the jargon term is "IUU fishing" (Illegal, Unregulated, and Reported Fishing). It has been a huge, huge problem for decades. The best estimate that we have is that it represents about $23 billion dollars annually and as much as one in five wild capture fish are caught illegally so it's a big problem. It threatens the legitimate fisheries; it undermines governance; and it's a huge detriment to the health of ecosystems because the fishing practices with illegal fisheries are just scorched earth. They destroy the habitat so it's really bad news and it's been a problem because the ocean is so huge and it's hard to patrol every place that's out there.

Fortunately, we have seen a number of things come together that are converging to tackle, in some very significant ways, what many people thought was just an intractable problem. We're seeing new policies, new tools, new leadership, increased public awareness, all converging. The new policies have included things like a number of years ago Interpol created an international fisheries crime unit. We saw a number of countries around the world come together to create a new international agreement that has a mouthful of a name—the Port State Measures Agreement—and that agreement is really important. It says that any country that has signed the agreement joins other countries in saying that they will not allow vessels that have been found to fish illegally to come into their ports. It sort of acknowledges that the ocean is a really big space and it's hard to catch all of the bad guys out on the water, but in fact, those ships eventually have to come back to port. So, that's where the action is to reign in the illegal fishing activities. Now, over 58 countries and the EU have ratified the port state measures agreement and it is off and running and having a demonstrable impact.

We've also seen, to complement these new policies, that new tools and new technology have been brought to bear to facilitate this. Specifically, the use of remote sensing and satellites to enable pretty much anybody with a computer to follow in near-real time what's happening on the surface of the ocean. So, you can follow—through a very innovative platform called Global Fishing Watch—you can follow the paths, the tracks, the position, of fishing vessels globally. This new tool gives those who are doing enforcement of fishery rules or of marine protected areas, a huge leg up in seeing who's doing what, where, and when. This new tool takes advantage of the signals that ships use to signal to other ships that they're in the water, so they don't collide in fog or at night. It's not a perfect tool and there are some challenges because some of the fleet has figured out a way around that. But it has been hugely helpful and is really pointing the way to a cooperative approach to manage the commons—the open ocean—in ways where countries are trading information, are working together to collectively be better stewards of ocean resources, if you will.

We've seen new leaders step up to the plate in this space. The (then) Indonesian Minister of Maritime Affairs and Fisheries, Ibu Susi Pudjiastuti, has been a real leader in this space. She went out big and bold early on to signal that Indonesia was not going to tolerate illegal fishing in its waters. She went so far as to, when they would catch a ship that had been fishing illegally, they would blow it up. That of course caught everyone's attention, and has really made a very strong, bold statement that this is just not acceptable, and that illegal fishing is going to be taken very seriously.

Indonesia was the first country that has made its VMS (Vessel Monitoring System) data public. That VMS data are data that are signals from ships that countries usually have propriety access to but that are typically not made public. In making Indonesia's VMS data public, this was a very strong signal to the world that we, Indonesia, want to cooperate with other countries. Now we're seeing additional countries follow suit which only strengthens the fleet of tools in the toolbox for entities like Global Fishing Watch to keep a good eye on what's happening on the water.

We've seen the private sector—the fishing industry—pay attention to all of this and for example, there is a new organization called SeaBOS (Seafood Businesses for Ocean Stewardship). SeaBOS is an organization that are the CEO's of the ten largest seafood companies in the world and they have agreed to work together to be better stewards of the ocean. They want to be part of the solution, not part of the problem and traceability, transparency, illegal fishing, is one of the suite of topics that they have identified as on the top of their list to pay more attention and be more responsible in dealing with.

The connection between illegal fishing and other crimes associated with fisheries has come to light though the reporting of a number of reporters, notably Ian Urbina of *The New York Times*, and connecting slave labor with fisheries; connecting other kinds of illegal activities—human trafficking, drug trafficking, arms trafficking—many of those crimes go hand in hand. That has led to an increased public awareness which is strengthening the public awareness and appetite; and, creating a safe space for politicians to be more active in reining in illegal fishing. The final thing on the IUU front has been simply the greater global focus in international fora on IUU. When Secretary John Kerry began the series of conferences called the "Our Ocean Conference," IUU was an early focus of that meeting of foreign ministers, heads of states, and other ministers from countries around the world. Every year at the now annual Our Ocean Conference, there has been a very strong focus on IUU and really tackling IUU fishing. Just to wrap up the focus on IUU fishing, I think this is an area where it used to be thought of as a problem that was just impossible to do anything about. In a relatively short period of time, it has come to be seen as something that actually is tractionable and countries are doing something about it.

Make no mistake, it's still a problem and there's a long way to go, but the fact that we have these tools, that we have this awareness, that we have an appetite to do something about it, is really encouraging. Again, in addition to the fishery reforms, this is a solution that gives me hope. It is not at the scale that we need but it is moving absolutely in the right direction and is there to be taken up by others.

On the topic of MPAs...

I would highlight a third solution that gives me hope, which are Marine Protected Areas. These are areas of the ocean that are protected to one degree or another from extractive and destructive activities. It used to be the case that a decade ago that was about 0.3 percent of the ocean was in a marine protected area. Just a teensy, teensy tiny drop of the ocean was protected. Fast forward to now, we have about five percent of the ocean in implemented Marine Protected Areas and about three percent of that is in the strongest type of protection, what we call "fully protected" or "highly protected" MPAs (Marine Protected Areas). Those Marine Protected Areas are one of the strongest tools that we have to not only protect biodiversity but to enhance the resilience of ocean ecosystems. We also know that they can be very powerful tools in not only providing safe havens for wildlife, but also capturing and storing carbon, restoring ecological balance, protecting coastal areas from storm surge and coastal erosion, preserving genetic diversity, and in many cases, helping to recover depleted fisheries.

There are many, many benefits that have been well-documented of protected areas, but until relatively recently it was a powerful potential tool but just really was not being utilized.

It's useful to think about the fact that if you look at the whole ocean, 42 percent of the surface area of the ocean is within the Exclusive Economic Zones (EEZ) of each of the coastal nations around the world and 58 percent of it is the High Seas which is not under any country's jurisdiction. Most of the protected areas that we have to date are within countries' EEZs. There has been a very dramatic increase by a few standout nations in the percent of their exclusive economic zones that are protected. The U.S. for example in 2008, U.S. had five percent of its EEZ that was at least highly protected. By 2016, it was 23 percent. In a very short eight years, it was an increase of over 400 percent of area that was at least highly protected.

Palau, a really small, wonderful country in the middle of the Pacific, has set aside the target of protecting 83 percent of its EEZ, so that's a big bold target. They're in the process of implementing steps to do that. They haven't achieved that yet, but they say they will. Chile has protected 42 percent; the Seychelles have protected 30 percent; the United Kingdom 25 percent (most of that in overseas territories); Mexico 23 percent. So, quite a few countries have realized the potential and the benefits of highly to fully protected areas and are moving boldly ahead in creating those protected areas. Others are yet to catch up. This again is another very powerful tool that is scalable and is yet to be used.

Countries of the world have agreed through the Aichi Targets (the Convention on Biological Diversity) and through the Sustainable Development Goals to protect 10 percent of the global ocean by 2020—that's just around the corner. As that deadline approaches, there are very robust conversations now about if we really want to achieve the benefits of these protected areas. Especially in light of climate change and ocean acidification, we probably want to be protecting at least 30 percent in highly and fully protected areas. There are new discussions about new targets that are out there.

Those are three tools, three solutions, that give me hope. They are all happening. We've learned a lot about what works and what doesn't work. They're not at the scale that we need, but underpinning those is an increased interest in the ocean more generally, an increase in public awareness. Plastics have been huge in drawing attention to the ocean and problems in the ocean, they're sort of the gateway drug to the ocean for a lot of the public. That increase in awareness, that increase in political leadership, and then, more recently, connecting the dots between ocean and climate, have all been strong contributors that I think are teeing up some huge opportunities to realize how important the ocean is, to return it to a healthy condition, so it can continue to provide the full suite of benefits that we want and need.

OSS: Wonderful, well, thank you so much for such concrete and evidence-based examples. As we approach global biodiversity targets to protect 10 percent of marine and coastal areas by 2020, what are your recommendations on how protection levels and definitional clarity should play into the post-2020 biodiversity agenda?

Dr. Lubchenco: I think it's useful to consider that for most of human history, most of the ocean was a de-facto Marine Protected Area. Most of the ocean was too far away from land, too inaccessible, too deep, for people to routinely exploit. It's only been in the last few decades where technology has allowed us to not only routinely go there, but extract things from it. Today, we virtually fish, drill, and mine everywhere, so it's not surprising that we are now having these conversations about "What have we lost and what do we need to restore in terms of

protections, because we need a healthy, productive, resilient ocean." Fully protected marine areas are the best tool to help achieve that. I firmly believe that there is no problem using the ocean—we need to use it, but not use it up. It means having good fisheries management, sustainable fisheries. It means having good other sustainable uses, but it also means protecting not only special places in the ocean but protecting the health of ocean ecosystems everywhere through use of the tool of Marine Protected Areas.

MPAs are a really powerful tool, and as I mentioned before, they are seriously underutilized. We now have good science that documents what outcomes you get and so we don't need to argue about that anymore. It's crystal clear that there are good outcomes that benefit people in the short term and in the long term. But it's also important to recognize that there are thousands of types of Marine Protected Areas. Everything from "you can't take anything out and you can't even go there," all the way to the other end of the spectrum which is "only a single species is protected but everything else can happen in that protected area." One of the complications that has arisen as countries have set targets and have gone about creating protected areas is huge confusion about how much do we have and how much do we need and what the heck is it going to do for us? To help alleviate the confusion around the types of MPAs, the outcomes, and how much we have, a group of people has worked diligently to create something that's called the MPA Guide.

The MPA Guide is a simple framework for helping people understand and use the same language, the same terms, so we're all talking about the same things and we can communicate better. The MPA Guide just refines existing language and captures a shared vision to describe MPAs and the conservation outcomes they provide. It builds on global work that has been done around MPAs for decades and it recognizes that when an MPA is created, there are a series of steps that a country, or other entity, goes through to create one. A president or a prime minister might announce that there is the intent to create a protected area. We call that the first stage, which is "committed"—somebody is announcing an intent to do something. That doesn't change anything on the water, but it signals that something will happen. The second stage of establishment is "designated," which is when a legally-constituted body like a congress or a legislature says this MPA, is now a legal entity. Again, nothing has changed in the water, but the MPA now exists in law; so, that second stage of "designated" is really important. The third stage, which is "implemented," is when there is a change on the water in management. There are new rules in place about what can and cannot be done and those are in place and enforced. That is the third stage. It is only at that "implemented" stage when protection of biodiversity actually happens. It doesn't happen when an MPA is committed or designated; it does begin to happen when it is implemented. The fourth stage of establishment is called "actively managed." That signals that not only is there implementation of a management plan, but there is ongoing monitoring, ongoing enforcement, ongoing evaluation, and adaptive management.

Simply clarifying these four stages of establishment has been hugely helpful in diffusing some of the arguments that were happening on how much we have that's protected now, because, as it turns out, people were counting different things. Some groups were counting how many MPAs had been designated and others were counting how many MPAs had been implemented. Now we can actually clear up the confusion by simply saying "x" number have been designated and "y" number have been implemented, so now people can be in much better agreement and in good communication. In addition to the stage of establishment, the MPA Guide recognizes that there are four general levels of protection of an MPA.

We mentioned that there were thousands of different kinds of MPAs. Well, we can break those thousands of different kinds into four general bins. One is a bin that is called "fully protected." That means there is no

extractive or destructive activity that is allowed—no fishing, no mining, no drilling, no dumping—it is fully protected from those activities. It is those MPAs for which we have really strong evidence that there can be many of the benefits that I described earlier from those fully protected areas. They provide safe havens for wildlife, capture and store carbon, restore ecological balance, protect coastal areas against storm surge, help recover depleted fisheries, etc. Those are from fully protected areas. The second level of protection is called "highly protected" and those refer to areas which just a very small amount of fishing is allowed—subsistence, recreational purposes, artisanal fishing—but only a very small amount. The outcomes from those highly protected MPAs are fairly similar to what you get from a fully protected area. Not quite the same, but really, really close. So, those two levels, highly and fully protected, are the ones that have the biggest outcomes in terms of the ecological benefits. The third category, the third level of protection, are called "lightly protected" and as you might imagine, those are areas that have more extractive activity that are allowed. The fourth category is "minimally protected" and that has even more extraction that is allowed. But all of them have to adhere to the overarching definition of MPAs that are, as described by the International Union for Conservation of Nature (IUCN), which specifies that an MPA, the primary objective of an MPA, needs to be the conservation of nature.

This MPA Guide helps to get rid of a lot of confusion so that people can communicate effectively about what we have and what we need. The MPA guide is being embraced by the official government keepers of the numbers, the World Conservation Monitoring Center, which is part of the UN Environment Program, the keeper of the data for the governments of the world. They are part of this group of folks that have been working on the MPA Guide to bring some clarity and transparency to all of the conversations on MPAs. The purpose here is not to tell countries, or anybody else, how much we need, but to say as we're having those conversations about what the new targets should be post-2020, we need to be clear what is that we're talking about. We need to be clear what kind of benefit one can get from different levels of protection. And it is crystal clear from lots and lots of studies that the benefits that people normally associate with MPAs come only from the fully and the highly protected MPAs. They don't get the same benefits from minimally or lightly protected areas. So, if you want all those great benefits, then you need to be thinking about fully or highly protected areas.

Most of the studies that have been done by scientists about how much of the ocean needs to be protected have come up over and over again with at least 30 percent of the ocean in highly to fully protected MPAs. That target is being increasingly embraced by a number of groups that are talking about that both within countries' EEZs but also at a broader scale including the high seas. I would note that the percentages—people tend to get hung up on percentages—what's really important to me is that we be clear about what we want and be clear about what it is we're talking about. In the end it's not just a global number percentage that's needed. We need protection of each ecosystem with enough protection of it that it continues to be healthy, productive, and resilient so we have protected areas that are well managed, well financed, well supported, and that are adjacent to sustainably used areas. The assumption should be that everything needs to be done sustainably, but within that framework, it's not enough to just have sustainably-managed activities. We also need to be protecting certain places, and those protected areas are really one of our strongest tools to help us meet the challenges of climate change and ocean acidification that are already underway. Those protected areas really enhance the resilience of ocean ecosystems, and we need that resilience as we have increased challenges with climate change and ocean acidification.

OSS: There are several important events this year that may help policymakers recognize climate-ocean linkages, from the forthcoming IPCC "Special Report on the Ocean and Cryosphere in a Changing Climate" to the Conference of the Parties (COP25) which is being dubbed the "Blue COP." Do you think there is an increasing appetite among policymakers to integrate the ocean into climate solutions? Secondly, what are promising carbon mitigation opportunities to highlight?

Dr. Lubchenco: It has certainly been the case for a long time that the climate policy community just ignored the ocean; it just was not on anybody's radar screen. Fortunately, starting with the Global Climate Action Summit that was in September, almost a year ago now, in San Francisco, that door was open. It was open in a way that I think surprised a lot of people. There was a lot more there than I think people had begun to realize. That conversation has only strengthened, it's gaining momentum. I'm hopeful that the new climate summit that will be in September in New York will have a strong spotlight on the opportunity to do both mitigation and adaptation from the ocean. Certainly not only with the Blue COP in December but also Costa Rica with the Pre-COP in October are both saying strong things about including the ocean in this portfolio of tools that we have to both mitigate climate change, but also adapt to climate change. In my view, the ocean should absolutely be on climate policy maker's radar screen both on the mitigation side and on the adaptation side. A number of countries are keenly interested in beginning to incorporate the ocean in their NDCs (Nationally Developed Commitments) and that will really be where the rubber meets the road to have the ocean be incorporated into those. There is still a lot of work under way about what that looks like, how to do it, how to do it in a way that is consistent across countries. That is a rich discussion which I think is very exciting.

I think there is also an increased recognition that many of the opportunities for mitigation and adaptation also bring co-benefits. By decreasing carbon, you can increase the adaptation potential; you can increase food security; and you can increase biodiversity protection through, for example, Marine Protected Areas. Again, I think we're going to see a lot more attention to not just a single myopic focus on carbon mitigation, which is important, but a broadening of that plus other co-benefits, which I think is only to everyone's benefit. The High Level Panel for a Sustainable Ocean Economy, which is a group of 14 heads of state that have agreed to work collectively to focus on ways to protect, to produce, and to prosper ("Three Ps") in their taxonomy, have honed in on this huge opportunity of this ocean-climate nexus and are going to be releasing a report in September at the UN General Assembly with some new and I think very exciting climate analyses about opportunities for, in this case, mitigation with respect to a portfolio of ocean activities. The numbers that have been crunched for those have been greatly enhanced by the work of CEA Consulting. Those numbers are still undergoing review so it would be premature to talk about them in any specific way, but I think just drawing attention to the importance of those analyses is a very good point to make. The kinds of things that people are talking about for mitigation opportunities in the ocean space tend to revolve around ramping up renewable energy from the ocean, so, marine renewable energy, and that seems to be a huge opportunity that is still untapped.

A second area, though, is to recognize how important shipping is. There are huge opportunities to make shipping greener, and to reduce carbon emissions from the whole transportation enterprise. There are other kinds of subsectors that are being actively discussed and analyzed. One of those are nature-based solutions focused on blue carbon and other kinds of things but looking at opportunities for ocean and coastal ecosystems to absorb and store carbon. We have learned how incredibly important some specific coastal ecosystems are in terms of their abilities to store and sequester carbon. In particular, mangroves, and seagrass beds, salt marshes, are really, really more bang for the buck in terms of carbon stored per unit area than any other habitat on Earth, so they are incredibly important to look at. Those are the primary targets for many countries looking at NDCs

and having their marine protected areas in coastal areas help contribute to their Paris agreements through this sequestration.

There are other kinds of things people are looking at. For example, there was a report last year from the EAT-Lancet Commission talking about the importance of shifting diets globally and having more of a focus on seafood both from wild capture and from aquaculture. There are huge potential carbon benefits of doing that just because fishing or farming seafood is much less carbon intensive than most types of operations on the land that are growing protein. One analysis that I think is going to be really interesting to watch will be the bang for the buck in shifting diets. Not that that is an easy thing to do, but that it's worth understanding what the benefits might be. And then, of course, there is also some discussion about ocean-based carbon capture and storage with a lot of work to be done to fully understand what the benefits and potential challenges might be. This is a really exciting new area, it's come about relatively recently, and I'm really excited that there is a lot of interest in this now. We're going to be seeing, I think, more and more just in the next six months starting with the Climate Summit in New York and then with the Pre-COP in October and then the Blue COP in December. I think we're going to be seeing more and more analyses in this space of incorporating the ocean into our thinking on climate mitigation. Beyond mitigation, there are huge important additional benefits in the adaptation space. There has been less attention to that, but I think we will be seeing more and more in the years to come. It couldn't be coming at a more important time given how important it is to address climate, but this increased focus on the ocean as central to our future really incorporates and brings together all of the different threads that are climate, food security, human well-being, economic opportunity, and healthy opportunities to live and work and play. It's exciting as an ecologist to see all of these different threads finally coming together because they've been too disparate for far too long.

OSS: Let's wrap up thinking about effective science communications. You have called on scientists to not only discover knowledge but to share that knowledge more fully with society through engagement with the public, decisionmakers, media, and private sector. You've played a founding role in three successful organizations focused on science communications. Can you share an insight or two about what you've learned through this work and how it might apply to professionals engaged in environmental communications today?

Dr. Lubchenco: What I'm seeing is that young people today, young scientists and young scientists in training, really understand how important it is to connect science to society. The old concept of scientists in the ivory tower in academia making discoveries and eventually having that knowledge be published and eventually making it into policy and management just doesn't work anymore. Things are happening so fast. The younger generation is impatient and rightly so. They want to get on with the solutions, so I think we're seeing a real revolution in the academic world, certainly, that is not just a focus on communication, but on more engagement with society. Communication is talking about something and trading ideas in two ways, but engagement is really working together to understand a problem and craft a solution and implement it. We're seeing more of a focus on co-creation of knowledge and engagement of scientists with society. I personally believe that one of the best anecdotes to the post-truth world that we are seeing is for more citizens to be part of this knowledge creation with scientists, not just the recipients of scientific knowledge, but participating in citizen science and actively understanding what the process is and contributing to it. Therefore, having a lot more trust in science and more understanding of the scientific process.

So, I think there's some really exciting opportunities now for scientists, whether they're in academia or elsewhere, to be tackling real-world problems, focused on solutions, but engaging with users in a way that is

pretty radical for what scientists—or, what most scientists—have done historically. It couldn't come at a better time: we need that now more than ever before, and the ocean space has proven to be a really ripe cauldron for this engagement of scientists solving global and local ocean problems. We really do have huge opportunities but also huge problems, so we need an "all hands on deck" approach. Science can help inform understanding; it doesn't tell people what to do, but if they understand how things work, how they're changing, what the likely consequences of different options are, and can help co-create solutions to address those problems, then I think we will be in a much better position to be implementing solutions much faster than we currently are at present. We need all of that. If we're to achieve the vision of Our Shared Seas, we really need all hands on deck. We need evidence-based approaches, we need scientific-based approaches, and that means engagement of not only scientists, but everyone who benefits from the ocean, which of course, is everyone, and everyone who contributes to changes in the ocean which is of course, again, is everyone. There are huge opportunities and thankfully a lot of great things to build upon and to make happen.

OSS: Thank you so much for your time today, Jane. We're deeply grateful for your insights and leadership in the field as a scientist, conservationist, and communicator.