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U.S. House of Representatives, Committee on Natural Resources

Virtual Legislative Hearing on H.R. 8632, the Ocean-Based Climate Solutions Act,

and related Natural Resources Committee-referred bills

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Chair Grijalva, Ranking Member Bishop, and distinguished members of the Committee, it is an honor to submit this written testimony concerning the Ocean-Based Climate Solutions Act.

I am a marine scientist with expertise in ocean-climate interactions, and their connections to human wellbeing. My contributions to these topics have been recognized by multiple scientific organizations including the National Academy of Sciences – who elected me a Member twenty-four years ago, and presented me with its highest award, the Public Welfare Medal, three years ago – and by the National Science Foundation who bestowed on me its most prestigious honor, the Vannevar Bush Award. I received my bachelor's degree from Colorado College, my master's degree from the University of Washington and my PhD. from Harvard University. I have been an academic scientist for most of my career, serving on the faculties of Harvard, Stanford, and Oregon State Universities.

I have also had the opportunity to serve my country in a different way through positions in the federal government. From 2009-2013, I was honored to serve as the Under Secretary of Commerce for Oceans and Atmosphere and the Administrator of NOAA. It was a pleasure to work with many of you and many of your colleagues during those four years on issues ranging from fisheries and coastal habitats to climate change, from weather forecasts and weather satellites to oil spills. Then from 2014 to 2016, I served as the first U.S. State Department Science Envoy for the Ocean doing science diplomacy in developing countries around fisheries, healthy oceans, climate change, ocean acidification, and sustainable development.

Since moving back to Oregon, I have worked to produce the knowledge and solutions needed to meet serious challenges like climate change. I have been delighted to find that people at all levels of organizations have a genuine hunger for durable, practical, scalable solutions – from the leaders at the tops of governments and organizations to those whom they serve.

I am therefore pleased to see the introduction of the Ocean-Based Climate Solutions Act. This bill focuses on the underappreciated connections between the ocean and climate change and it highlights solutions. Moreover, the bipartisan nature of many of the related referred bills gives me hope that this committee can provide much-needed bipartisan leadership to address one of the most urgent problems of our time, climate change.

Solutions to climate change are urgently needed

As amply documented in the *National Climate Assessments* and the *Intergovernmental Panel on Climate Change* (IPCC) reports, climate change is already affecting people's health and safety, opportunities and quality of life, and economic growth. In addition, climate change exacerbates existing inequities and functions as a threat multiplier for peace and security, increasing the likelihood of political instability and terrorism around the world. Global action to reduce greenhouse gas (GHG) emissions as rapidly as possible is urgently needed and can substantially reduce climate-related risks. The ocean has much to offer toward solutions.

In my testimony, I wish to (1) emphasize the urgency of moving decisively; (2) highlight the need to embrace the full suite of science-based ocean solutions in this bill, and (3) underscore the added bonus of multiple co-benefits that many of the solutions bring, ranging from economic to health to biodiversity benefits. This is not a time for timid action, nor for piecemeal solutions. Time is short and failing to act aggressively will have dire consequences. It is time for a full-court press using every play in our playbook.

The Role of the Ocean in the Climate System and Climate Impacts on the Ocean

Until recently, most discussions of the ocean and climate change focused either on the (1) central role the ocean plays in regulating the climate system or (2) on the impacts of climate change to the ocean. Scientists have documented that the ocean absorbs over 90% of the excess heat trapped by GHG emissions and it absorbs nearly a third of the carbon dioxide that we emit. The ocean has literally 'taken the heat' for us, modulating some of the impacts of excess greenhouse gases.

The 2019 IPCC *Special Report on the Ocean and the Cryosphere in a Changing Climate* and the 2018 *National Climate Assessment* document in depressing detail the myriad ways that climate change has impacted the ocean and the consequences of those impacts to people's lives, health, safety, livelihoods, and economic opportunities. (a) Sea level rise is an obvious example, and it disproportionately affects some coasts – such as our mid- and south- Atlantic coastlines – more than others. The ocean is also (b) warmer and (c) more acidic; it is experiencing (d) unprecedented ocean heatwaves and (e) loss of oxygen. And the ocean is (f) more variable and (g) less predictable.

Each of these impacts has consequences, but a deeper dive into one of these changes, a warmer ocean, can illustrate the far-reaching implications for people. According to NOAA, the average global sea surface temperature has increased by approximately 2.3°F (1.3°C) over the past 100 years. This might seem like a small amount, but it is having disastrous consequences for many coastal communities and economies, and for people far inland as well. For example, we are seeing the consequences of warmer water in the changing nature of tropical storms

including hurricanes. There is unequivocal evidence that climate change is affecting hurricanes. Let me be clear: there is no evidence that climate change affects the number of tropical storms and hurricanes each year. However climate change does affect the intensity, speed, and water content of tropical storms including hurricanes. The results are more powerful Category 4 and 5 storms, storms that move more slowly (for example Hurricane Harvey in 2017 that caused catastrophic flooding and many deaths in Texas and Louisiana), and storms that hold more water (contributing to flooding). Just last week, a new analysis was published (Li and Chakraborty 2020) suggesting that the greater moisture in hurricanes also acts like an extra battery pack to keep them stronger and last longer once they have made landfall. Hurricanes in North America are decaying at slower rates over land than they used to. These three climate-related impacts enhance the power and destructive impact of hurricanes, as well as the intensity of storm surge, coastal and inland flooding, and the destructive impact of more powerful winds. Sea level rise makes some of these impacts even worse. In short, we can connect the dots directly between climate change, warmer ocean waters and air temperatures, and threats to coastal and inland inhabitants. Warmer Atlantic, Caribbean, and Gulf of Mexico waters are supercharging hurricanes, fueling rapid intensification, and enhancing the power and longevity of the destruction.

Another impact of warmer water is seen in the heatwaves now being documented globally. One particularly well studied heat wave was the so-called 'Blob' of warm water off the West Coast in 2013-2015, stretching some 2,000 miles from Alaska to California, with water temperatures close to 7° Fahrenheit above average! The Blob triggered the largest harmful algal bloom ever recorded on the West Coast, shutting down crabbing and clamming for months, and resulted in multiple declared fishery disasters and triggered the death of thousands of marine mammals and seabirds.

Clearly, many climate change impacts are multifaceted and serious. And the impacts to people are profound, underscoring the urgency of tackling climate change aggressively and effectively.

Ocean Solutions to the Rescue – the Ocean Panel's Analysis of Mitigation Options

Thanks to new scientific analyses, we now know that the ocean could provide a powerful source of solutions to slow down climate change. These would not supplant other parallel, terrestrial-based mitigation efforts, but when combined with them would enhance the likelihood that we can tackle climate change effectively and smartly.

Although earlier discussions about ways to mitigate climate change focused primarily on land-based solutions, we now have a newly appreciated, powerful suite of ocean-based tools to add to the climate mitigation toolbox. Moreover, many of these new tools could also bring multiple benefits to other parallel issues.

A report published last year by the High Level Panel for a Sustainable Ocean Economy (hereafter called simply the 'Ocean Panel') (Hoegh-Guldberg et al. 2019a; see also Hoegh-Guldberg et al. 2019b) concluded that a set of five ocean-based mitigation solutions could achieve as much as 1/5 of the carbon emission reductions needed to achieve the 1.5°C degree Paris Agreement target by 2050. The experts analyzed the potential emission reductions that could result from 5 different categories of actions: ocean-based renewable energy, ocean-based transportation and shipping, protecting and restoring coastal and marine ecosystems, seafood, and carbon storage in the seabed (Figures 1 and 2).

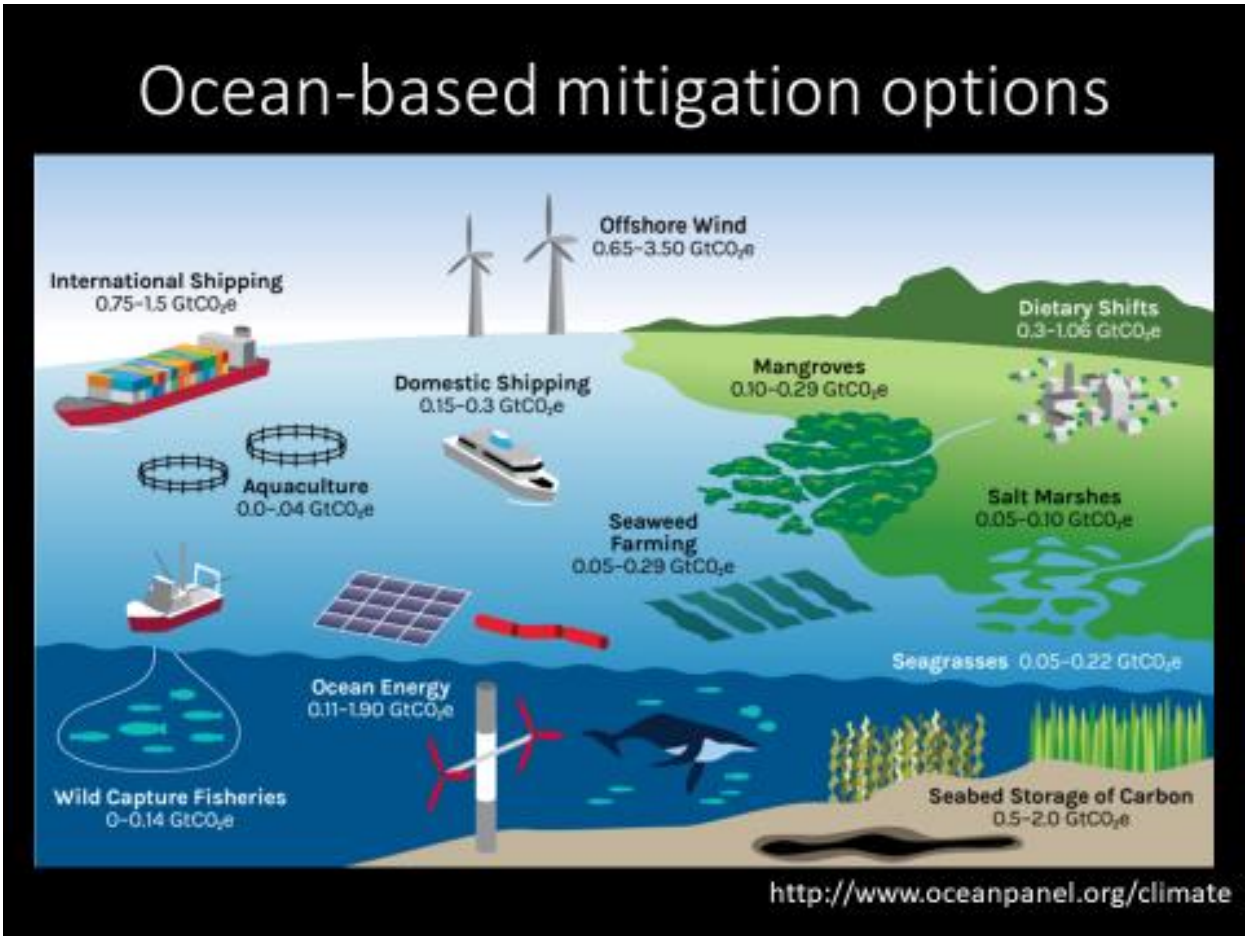

Figure 1. Ocean-based Mitigation Options Explored in Hoegh-Guldberg 2019a and their Associated Annual Mitigation Potential in 2050. From Hoegh-Guldberg 2019a.

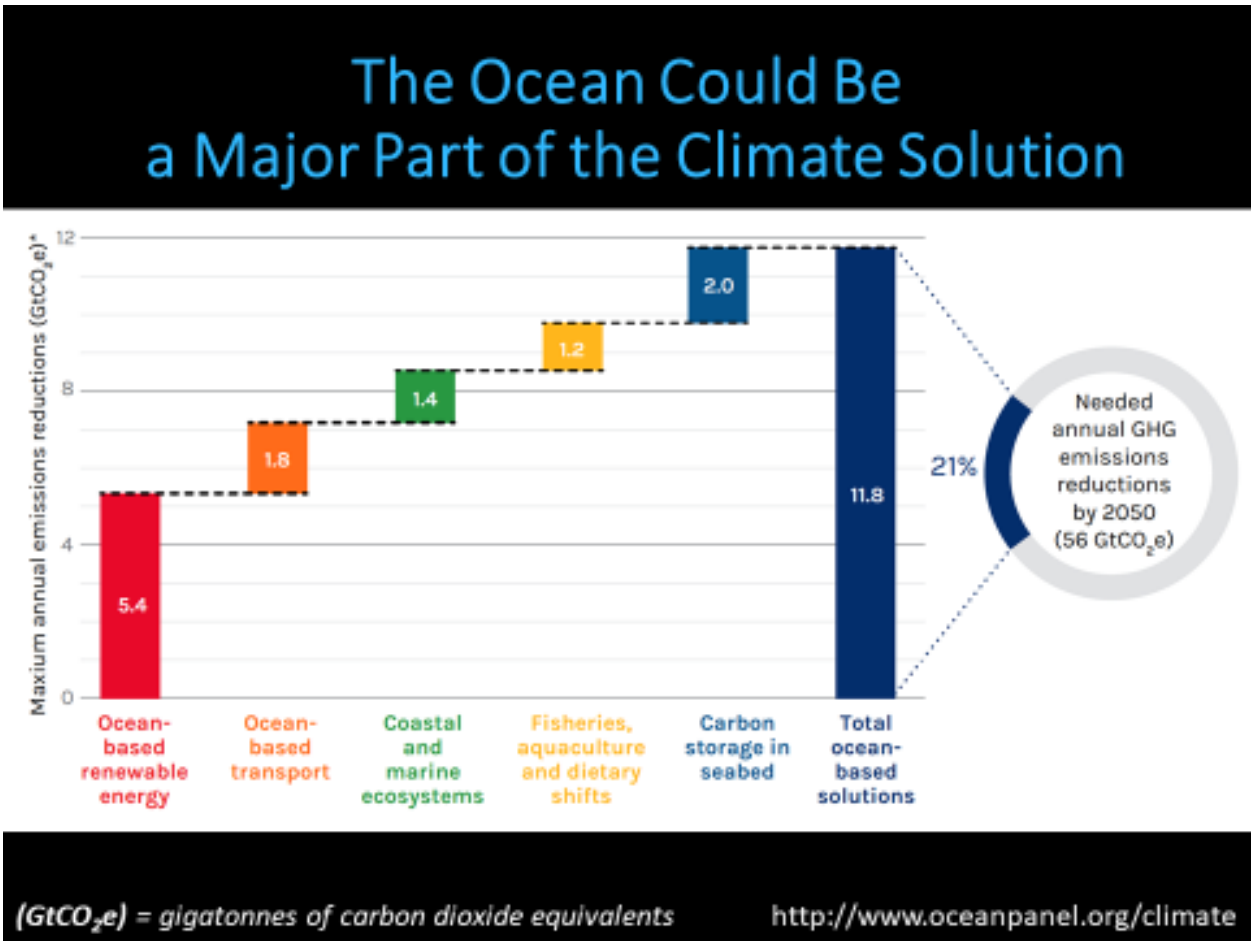

Figure 2. Contribution of Five Ocean-based Climate Action Areas to Mitigating Climate Change in 2050 (Maximum gigatonnes of carbon dioxide equivalents). From Hoegh-Guldberg 2019a.

As shown in Figures 1 and 2, each of these solution categories can contribute to the emission reductions needed. But the power lies in using multiple solutions. Together they reduce emissions by up to 21% of the annual greenhouse gas emission reductions needed by 2020 to achieve the 1.5° target (Figure 3).

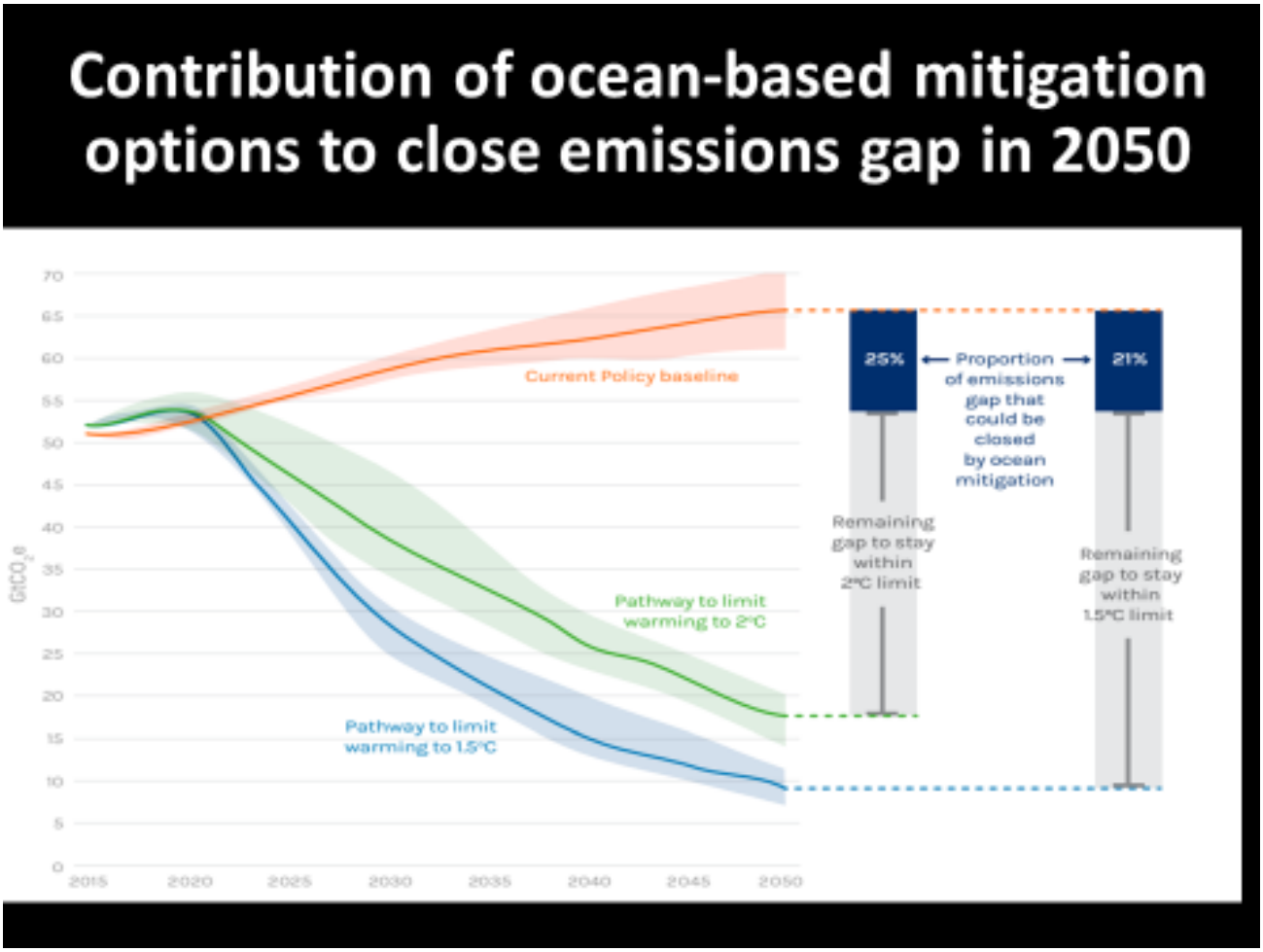

Figure 3. Contribution of Ocean-based Mitigation Options to Closing the Emissions Gap in 2050. From Hoegh-Guldberg et al., 2019a.

The analysis further suggests that the first four of these mitigation solutions would provide immediate opportunities for action while the fifth – sequestering carbon on the seabed – is not ready for deployment, and requires significantly more research and analysis before it might be considered for adoption. The four categories that are ripe for action, and the Ocean Panel Report's description of each include:

1. Ocean-Based Renewable Energy: Reduce barriers to scaling up offshore wind (fixed and floating turbines) and invest in new, innovative ocean-based energy sources such as floating solar photovoltaics, wave power, and tidal power.
2. Ocean-Based Transport: Implement available technologies to increase energy efficiency now (e.g., improved hull design), and support the development of low-carbon fuels as

part of a broader decarbonization of ocean industries and energy supply chains, including port facilities. Start with decarbonizing domestic fleets.

3. Coastal and Marine Ecosystems: Conserve existing "blue carbon" ecosystems (mangroves, seagrass beds, and salt marshes) to prevent further release of greenhouse gas emissions and scale up effective restoration efforts.
4. Fisheries, Aquaculture, and Dietary Shifts: Reduce emission intensity of fisheries and aquaculture by optimizing wild catch and shifting to low-carbon feed options. Shift diets toward low-carbon marine sources such as sustainably harvested fish and seaweed including kelp as a replacement for emissions-intensive land-based sources of protein.

After analyzing each of the above options through multiple lens of geophysical, technical, economic, and social/political feasibility and potential, the Ocean Panel report authors concluded that these four options, while not necessarily easy, are feasible and ready for adoption. Many of these options are included in H.R. 8632.

Blue Carbon

Of the above four solutions, the 'blue carbon' category might be useful to consider in greater detail because this ocean-based mitigation solution is less well known. 'Blue carbon' is simply the carbon that is captured and stored by the world's ocean and coastal ecosystems. ('Green carbon' is the carbon that is captured and stored by trees and other plants on land.) Capturing carbon alone is not sufficient to create climate mitigation benefit. The carbon must also be stored, or sequestered so that it is functionally removed from the atmosphere. In Blue Carbon ecosystems, the plants capture carbon from the air and effectively lock it away in the sediment.

Three blue carbon ecosystems are particularly important from the standpoint of capturing and sequestering carbon: seagrass beds, mangrove forests and salt marshes. These three habitats sequester carbon at a much faster rate than do forests and they can sequester carbon for centuries to thousands of years as long as they are not damaged or destroyed. If these habitats are damaged or destroyed, the massive amounts of the carbon they have stored, sometimes for millennia, are released into the atmosphere, contributing to climate change.

So, first and foremost, preventing the destruction of these wetlands is a smart and powerful climate-mitigation action. Moreover, because these coastal habitats also provide protection from storm surge, nursery habitats for commercial and recreational fisheries, and recreational opportunities, their protection brings multiple benefits.

The second most important climate-mitigation action on the blue carbon front is restoring seagrass beds, mangrove forests, and salt marshes that have been lost or degraded. A recently reported exemplary success in effectively restoring seagrass beds comes from Virginia, where scientists from the Virginia Institute of Marine Sciences and The Nature Conservancy have

recovered over 3,000 hectares of seagrass beds in a number of bays and inshore lagoons (Orth et al. 2020). The restored beds now sequester on average about 3,000 metric tons of carbon each year, locking it away permanently. Moreover, recovering the beds has also enhanced water quality and benefitted several commercial and recreational fisheries.

Incorporation of blue carbon into Nationally Determined Contributions and carbon trading schemes would be useful tools to recognize the importance of this mitigation tool and provide resources and incentives to both reduce loss of and effectively restore blue carbon ecosystems.

Ocean-based Solutions for Adaptation

As noted earlier, climate change impacts on the ocean, fisheries, wildlife, and coastal and ocean ecosystems have been apparent for at least two decades and are accelerating. This in turn affects the people and economies that depend upon healthy ocean ecosystems for a wide array of benefits. Moreover, scientists have documented unprecedented rates of loss of biodiversity at the genetic, population, and species levels, in marine systems as well as on land and in freshwater (IPBES 2019). Therefore, in addition to forceful efforts to reduce emissions, strong, smart efforts are needed to enhance the resilience of coastal and inland communities, coastal and ocean ecosystems, fisheries, and other key sustainable uses of the ocean.

Fisheries. Supporting climate-smart and climate-ready fisheries is obvious and important. I am proud that our federally managed fisheries are a model for excellent stewardship and have been steadily improving, due in large part to visionary leaders within the fishing community, strong science, and well-crafted management policies stemming primarily from the 2005 Reauthorized Magnuson-Stevens Act. Fisheries managed by states, however, are highly variable, with the status of many stocks simply unknown. There is clear evidence that one of the best ways to minimize the impact of climate change on fisheries is to ensure they are well managed (Gaines et al., 2018). Therefore, ensuring that all U.S. fisheries are sustainably managed should be high priority.

However, fishery management needs to be more nimble, more precautionary, and more anticipatory than it is at present. This is especially true as stocks shift from their historic locations to new places, especially when they move across Fishery Management Council boundaries or national boundaries.

Policies to increase the fuel efficiency of fishing vessels without penalizing fishermen and women are needed. In addition, the U.S. can exert stronger leadership to eliminate fish and fuel subsidies through international agreements and management programs.

Marine Protected Areas (MPAs) are a well-known, but underutilized tool to protect biodiversity, provide safe havens for wildlife, help recover depleted stocks and species, restore the ecological balance within an ecosystem, protect stores of carbon, provide reference areas

for evaluating impacts of fishing, and enhance ecosystem resilience – on a permanent basis. For these benefits to accrue, an MPA must have good enabling conditions, including being well designed, resourced, managed and enforced.

Not all MPAs are the same. For example, they vary in the level of protection they provide from extractive and abatable destructive activities. Only *Fully Protected or Highly Protected MPAs* provide the benefits listed above; Lightly and Minimally Protected Areas simply do not. (The MPA Guide, 2019, explains these four types of MPAs.) At present, only 2.6% of the global ocean is in Fully to Highly Protected, Implemented MPAs (MPA Atlas 2020). And 23% of U.S. waters are in Fully and Highly Protected, Implemented MPAs (MPA Atlas 2020).

There is a compelling need for MPAs to help protect biodiversity. The international scientific assessment of biodiversity concluded that the biggest threat to marine biodiversity is fishing and impacts of fishing gear (IPBES 2019). Fully and Highly Protected MPAs provide safe havens from extraction and gear. Moreover, modern technology through remote sensing, machine learning and other tools coupled with international agreements to fight Illegal, Unregulated and Unreported (IUU) Fishing are enhancing the ability to protected MPAs from poaching.

A recent comprehensive, global analysis concluded that Fully and Highly Protected MPAs can also play a central role in helping provide healthy seafood to feed a growing human population (Cabral et al., 2020). The authors conclude that *at the global scale*, "protecting an additional 5% of the ocean could increase future catch by at least 20%, generating 9-12 million metric tons more food annually than in a business-as-usual world with no additional protection." Most of this benefit is achieved in countries where fisheries are poorly managed or not managed at all, not where they are relatively well managed such as in U.S. waters. Hence, this food provisioning benefit of MPAs is highly applicable elsewhere, but not particularly relevant for U.S. waters.

And finally, there is increasing evidence that MPAs hold great promise as a climate mitigation and adaptation tool (Roberts et al. 2017). In protecting genetic, population, and species diversity, Fully and Highly Protected MPAs can enhance the resilience of ecosystems, protect stores of carbon in the sediment, and protect the ability of blue carbon ecosystems to capture and sequester additional carbon. The greater the genetic diversity, the greater the likelihood there will be genotypes that are suited to a climate-impacted world.

Numerous scientific analyses have concluded that to achieve the biodiversity and climate benefits of MPAs, at least 30% of the ocean should be safeguarded in Fully and Highly Protected MPAs. The urgency of the biodiversity and the climate crises underscores the importance of moving rapidly toward this goal.

Note that even the best fishery management cannot substitute for effective Fully and Highly Protected MPAs in terms of protecting biodiversity or enhancing resilience of ecosystems to climate change. Good fishery management is necessary but not sufficient for a healthy ocean. Even the best-managed fisheries have impacts on target and non-target species. Simply removing massive amounts of biomass from fished areas has significant impacts on the other species in the ecosystem. Even well-designed, selective gear has unintended impacts on habitats and non-target species. We need both excellent fishery management, highly selective gear, and MPAs. They are not substitutes for one another. They have different goals, all of which are important and needed. Good fishery management and Fully and Highly Protected MPAs should go hand-in-hand.

Marine Spatial Planning that is science- and ecosystem-based and goal-oriented is a good tool to harmonize different uses of the ocean. Regional Ocean Plans are a smart approach that allows a range of stakeholders and interests to consider options for using the ocean in ways that address climate change, protect the integrity and resilience of the ocean ecosystem, and deconflict various uses.

Economic recovery opportunities in the aftermath of COVID-19.

A healthy ocean is the foundation of a vibrant economy. Fisheries, tourism, shipping, and other ocean industries have been disproportionately impacted by the COVID-19 pandemic, in the U.S. and around the globe. As leaders look to jump-start the economy, ocean-based opportunities have been mostly overlooked, but in fact provide some golden opportunities for smart investment. Another report from the Ocean Panel provides timely ideas and analysis of high-priority action items that could contribute directly to rebuilding economies, in ways that support a sustainable, equitable, and resilient ocean economy. Three of the five priority actions discussed in the report overlap with topics discussed above: (1) Investing in coastal and marine ecosystem restoration and protection, (2) Incentivizing sustainable ocean-based renewable energy, and (3) incentivizing the transition to zero emission marine transport (Northrup et al 2020). Two additional opportunities include (4) Investing in sustainable, community-led non-fed mariculture, and (5) Investing in sewerage and wastewater infrastructure for coastal communities. Many of these options provided economic, social and environmental benefits and should be seriously considered.

In summary

Climate change affects all Americans. It affects our health and safety and our economic opportunities. But it disproportionately affects the poor, people of color, and the elderly. This is true within the U.S. and it is true globally. The beauty of the action items discussed above is that they provide timely opportunities to address climate change while also boosting the economy, strengthening communities, benefitting health, and addressing racial inequities.

Many of the solutions provide both mitigation and adaptation benefit. Across all of these topics, investments in science, monitoring, assessment and training will pay off handsomely.

It is high time for ocean actions to be appreciated for the significant power they provide as solutions. The ocean connects and sustains us. It is our past and our future. When we pay attention to the ocean, people win, the economy wins, and nature wins.

I am happy to provide additional information on these and related topics if that would be useful to you.

Thank you.

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