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Before

The United States Senate Environment and Public Works Committee

Subcommittee on Fisheries, Water and Wildlife of the Environment and Public Works

Hearing on

Marine Debris and Wildlife: Impacts, Sources and Solutions

May 17, 2016

Good morning. Thank you for inviting me to speak with you about the preponderance of plastics that are gathering in our seas and on our coastlines, affecting fisheries, marine mammals and potentially human health. My name is Nicholas Mallos, and I am director of Ocean Conservancy's Trash Free Seas® program. Ocean Conservancy works across sectors, bringing businesses, conservationists and governments together to address systemic challenges and find lasting solutions. In all we do, we work with a range of partners to find scalable, implementable solutions that make a difference for the ocean and the communities that depend upon it. Ocean Conservancy is supported by a diverse funding base that currently includes individual donors, public and private foundations, corporations and U.S. government support.

Plastic debris exists in every region of the ocean from consumer products floating in the ocean's five major gyres to fibers buried in deep sea sediments and from microplastics embedded in Arctic sea ice to a wide diversity of plastics found on beaches worldwide. Today, I intend to convey the need for a new, interdisciplinary research agenda to better explain the scale and scope of the impact of plastics on marine ecosystems so that better-informed policies can confront these risks. Advancing this science requires a funding commitment from decision-makers who recognize that controlling plastic inputs to ocean ecosystems is a necessary condition for the ocean to provide the services upon which we depend.

More than 13 million short tons (12 million metric tons) of plastics now enter the ocean every year, and without intervention, the ocean could contain as much as 1 ton of plastics for every 3 tons of finfish by 2025. When plastics enter the ocean, they do not decompose. They become brittle and break down by mechanical means, fragmenting into smaller and smaller pieces over time, persisting even at the microscopic level. The resulting microplastics (generally less than 5 millimeters in size, roughly the width of a pencil) are more likely to be ingested by small ocean animals and filter feeders, like oysters and scallops, which purify up to 50 gallons (189 liters) of water per day per animal.

IMPACTS ON OCEAN WILDLIFE AND THE ECONOMY

Plastic debris of all sizes impacts many elements of marine life. More than 690 species of marine wildlife have been documented to be impacted by plastic debris, from the smallest zooplankton to the largest marine mammals. Sea turtles are particularly at risk since they often mistake plastic bags and other forms of plastics as food. A 2015 study published in *Global Change Biology* calculated that more than half the world's sea turtles have ingested plastics. This research followed on the heels of a separate study that estimated nearly all of the world's seabirds would be contaminated by plastics by 2050 without prompt intervention. Sea turtles along the east coast of the United States are among those at greatest risk, especially the olive ridley species. This species of turtle has a broad diet and tends to selectively ingest plastics that look like sea jellies and other floating animals. The researchers also determined that as little as 0.5 grams of ingested plastics, a mass equal to ¼ teaspoon of sugar, can kill a juvenile turtle. Contamination rates for sea turtles have increased over time with 52 percent of the world's remaining sea turtles presently having plastics in their digestive systems. For seabirds, 62 percent presently have plastics in their digestive systems.

As a marine biologist, I have witnessed firsthand the contamination and damage posed by plastic debris far too many times. In 2010, I completed an assessment of plastics' impacts on marine wildlife inhabiting Midway Atoll in the Northwestern Hawaiian Islands. Part of the Papahánaumokuákea Marine National Monument, Midway Atoll is one of the most remote islands in the world, situated nearly 2,100 miles from the closest population center in Honolulu. Despite its isolation, each year nearly 5 short tons (4.5 metric tons) of plastic debris is brought onto Midway solely from the stomachs of adult albatross. Mothers and

fathers forage at sea for weeks in search of fish eggs, squid and other prey in hopes of nourishing their newly hatched chicks that wait anxiously hundreds or even thousands of miles away. However, all too often they return to Midway with a bounty of plastic debris. Unlike their parents, albatross chicks do not possess the ability to regurgitate; thus, once consumed, plastics are often fatal to chicks through a variety of mechanisms including starvation, stomach rupture or asphyxiation.

By analyzing the stomach contents of one of the many thousand deceased albatross chicks, I further deconstructed the plastic-albatross relationship. The stomach contents of this one albatross included nine plastic bottle caps, two strands of dental floss, one five-inch orange fishing float, 103 miscellaneous plastic pieces, six pumice stones and 60 squid beaks—the latter two items being the only naturally occurring components of an albatross diet. The total mass of the bird's synthetic stomach contents was roughly 100 grams—about the same mass as a quarter-pound hamburger.

When broken down into micro-particles (less than 5 millimeters) plastics can become doubly dangerous in the marine environment. The chemical compounds added to plastics during production can leach into surrounding environments, and the harmful substances already present in the water can attach to plastic surfaces. While perhaps counterintuitive, as plastic debris fragments into smaller pieces, the total surface area of plastic debris concentrates background levels of chemical contaminants in seawater up to a million-fold. These contaminants include coolant fluids such as polychlorinated biphenyl (PCB), insecticides such as dichlorodiphenyltrichloroethane (DDT) and flame retardants, among others. Studies have shown the most common chemical contaminants impact animal health and human health. Once ingested, they accumulate up the food chain, ultimately collecting in the seafood that humans eat, thus making marine debris a potential human health issue.

Globally, roughly half of the world's human population relies on seafood for 20 percent of the animal protein in their daily diets. Plastic debris is not a "coastal issue," but a global issue as seafood is shipped and consumed all over the world. And with as many as 51 trillion pieces of microplastics estimated to be circulating in the ocean globally, risk of fishes and shellfish ingesting plastics is high. In 2015, Dr. Chelsea Rochman assessed the presence of plastic debris in the global seafood supply. Samples were taken from markets in Makassar, Indonesia, and from Half Moon Bay, California. In Indonesia, debris was found in 28 percent of individual fish and in 55 percent of all species. Similarly, in California, debris was found in 25 percent of individual fish and in 67 percent of all species. Plastic debris was also found in 33 percent of individual shellfish sampled. A 2016 study published in the *Proceedings of the National Academy of Sciences* revealed that ingested plastics so adversely affected the Pacific oyster's digestive systems that their ability to reproduce was reduced by almost 50 percent.

Plastic debris also poses a threat to the U.S. economy through its negative impacts to the domestic and international fishing industries and the global seafood trade that relies upon them. The Brookings Institution valued the economic contributions of the U.S. fishing industry at $90 billion annually and supporting 1.5 million jobs. Globally, the cost of plastic debris in the ocean is conservatively estimated at $13 billion per year, according to the United Nations Environment Programme (UNEP), and this includes the impact to the fishing industry. The environmental and economic harms of plastic debris have been well known to Ocean Conservancy since its beginning.

INTERNATIONAL COASTAL CLEANUP®AND SCIENCE

For more than 30 years, Ocean Conservancy has been at the forefront of the marine debris problem, tackling it at every point in the pollution vector. Beginning on the beach of South Padre Island, Texas, in 1986, Ocean Conservancy's International Coastal Cleanup® (Cleanup) is an unparalleled effort that mobilizes people in all 50 states, the District of Columbia and U.S. territories, and more than 150 countries around the world toward a single purpose: Keep trash off of the beach and out of waterways and the ocean. Beginning with 2,800 participants in 1986, nearly 800,000 volunteers now turn out annually to do their part to collect marine debris data and ensure trash never has a chance to enter the ocean and threaten marine wildlife, like the Kemp's ridley sea turtle which relies on the Gulf of Mexico waters along South Padre Island as vital habitat.

Since the Cleanup's inception, more than 11.5 million volunteers have recorded and removed greater than 225 million individual items of trash weighing in excess of 110,000 short tons (100,000 metric tons). The data are compiled by Ocean Conservancy and aggregated to create the Ocean Trash Index, an item-by-item, location-by-location database of the most persistent forms of trash littering our beaches and ocean. The Ocean Trash Index is the largest such database of its kind. Yet, this database offers only a glimpse into the problem. Globally, the magnitude of debris far exceeds what is documented during the Cleanup because much of the world's coastline remains undocumented.

Over the decades of collecting information, items made of plastic have always been at the top of the list. Plastics make up roughly 84 percent of all items collected during the Cleanup. Every year, the 10 most common items found are predominantly the plastic items we use in our everyday lives to eat, drink and recreate. Plastic bags, beverage bottles, bottle caps and lids and an array of other single-use, disposable plastic products are found in greater abundance than other items. This sheer volume of plastic debris is almost incomprehensible, and there is considerable economic cost passed on to state and local governments to remove marine debris from their riverbanks and coasts. However, the greater damage is ecological.

Scientific literature is replete with anecdotal information of marine wildlife impacted by marine debris items. However, derelict fishing gear, including nets, fishing line, traps and buoys, were found to pose the greatest overall threat across all types of marine wildlife, largely through entanglement, in a 2016 study published in *Marine Policy*. Given that fishing gear is purposefully designed to catch animals, this result is not surprising, but it does suggest that focused attention is needed to reduce the threat of derelict fishing gear on marine species. Among the other items examined in the study, plastic bags emerged as the next most impactful item for marine wildlife. Non-plastic debris items are found only at the bottom of this list. The results of this work suggest a comprehensive approach to plastic debris is needed, given that a whole host of plastic products endanger marine life.

While data supporting the conclusion that negative impacts of plastic debris on both ocean and wildlife health is increasing steadily, little data has existed until recently on how much material is entering the ocean and from where it is coming. Up to 80 percent of marine debris is thought to come from land-based sources, and rivers are a primary vector by which material moves from land to the sea. A major new analysis published in the journal *Science* in February 2015 quantified—for the first time—the global scale of the problem and identified the scope of what must be done to stem the tide. As part of a scientific working group at the National Center for Ecological Analysis and Synthesis (NCEAS) at the University of California, Santa Barbara, Dr. Jenna Jambeck and colleagues showed that more than 13 million short tons (12 million metric tons) of plastic debris enter the ocean each year. This is three orders of magnitude

greater than what can be found floating in the ocean gyres, and it is equivalent in mass to the yearly, global tuna harvest.

COLLABORATION ON GLOBAL SOLUTIONS

Plastic debris is a global phenomenon. No country or region can claim to be untouched by the issue; all 192 countries with coastal access contribute to the problem, but research now exists that suggests a significant proportion of this plastic debris enters the ocean from a relatively concentrated geography. The majority of it comes from rapidly developing economies where there is a mismatch between the amount of plastics being used and the capacity of the in-country waste management system to handle this influx of waste. Currently, more than half of global plastic debris originates from five countries in Southeast Asia: China, Indonesia, the Philippines, Vietnam and Sri Lanka. This is not deliberate, but rather an unintended consequence of rapid development that will soon surface in other countries in Asia and Africa. However, there is only one global ocean; and, thus, large plastic debris inputs from Southeast Asia travel via Pacific surface currents and ultimately threaten wildlife and commerce in the U.S. Exclusive Economic Zone.

In 2013, I traced 75 percent of debris sampled on remote Alaskan coasts (Gore Point, Hallo Bay, and Kodiak Island) to Asia by identifying the country/language associated with the brands of the debris, underscoring the interconnectedness of the Pacific. Thus, while the largest sources of plastic debris may be "out of sight" across the Pacific, these inputs ultimately threaten the robust fisheries and marine wildlife that depend on the Gulf of Alaska, Bristol Bay and the Bering Sea. Consequently, stopping plastic debris from entering the ocean from rapidly developing economies must be a major component of marine debris solutions for the United States.

At its core, however, plastic debris is not an ocean problem; it is a people problem. And because people are at the center, this means we can solve it if we have the vision and the courage to confront the problem head-on. Everyone has a role to play: individuals, scientists, governments and businesses. Ocean Conservancy founded the Trash Free Seas Alliance® (Alliance) in 2011 to unite thought leaders from industry, conservation and academia to create pragmatic, real-world solutions focused on the measurable reduction of plastic debris. Building upon the growing body of science on plastic debris, Ocean Conservancy and its Alliance partners conducted rigorous, in-country analyses in key plastic debris geographies focusing on the scale and realities of waste management needs, specifically targeting the factors that lead to plastic debris leakage into the ocean. Ocean Conservancy's 2015 report, *Stemming the Tide,* identified plastic debris leakage points where, if active efforts were initiated now, we could reduce plastic debris entering the ocean by 45 percent globally by 2025. *Stemming the Tide* stresses that efforts to mitigate, manage and minimize plastic debris must begin now and be implemented simultaneously to effectively eliminate threats to marine wildlife and commercially valuable species.

The plastic debris challenge facing our marine environments is immense, but solutions built on the actions of individuals, businesses and elected officials are at hand. More robust science is a critical foundation upon which to build data-driven policy solutions to stop plastics from entering the marine environment—a goal for which we all must strive. Solutions will be most effective, however, when based on a regionally specific understanding of the sources, distribution, fates and impacts of plastics in the ocean. Leading scientists around the world stand ready to confront this challenge, but additional financial resources are vitally needed to fund robust science to quantify the risk of plastic debris to ocean health and human well-

being. Doing so is critical if policymakers are to ensure the ocean continues to provide the goods and services upon which citizens depend.

THE PATHWAY FORWARD

As outlined in detail in an open letter dated February 2, 2016, from 14 leading marine scientists to the Trash Free Seas Alliance®, scientists and policymakers urgently need more information in four broad priority areas: the sources, distribution, fates and impacts of plastics in the ocean. The current state of knowledge provides a high level understanding about the quantities and impacts of plastics entering the ocean; what is needed is an even more refined understanding. In particular, determining the consequences of microplastics in wild and farmed fish and shellfish for human consumption is imperative to ensure healthy and sustainable fisheries in the United States for future generations.

We thank the Congress for passing the Marine Debris Research, Prevention and Reduction Act of 2006 which authorized the creation of the Marine Debris Program (MDP) within the National Oceanic and Atmospheric Administration (NOAA). The NOAA MDP has been instrumental in informing and catalyzing marine debris research and solutions in the United States and abroad. Current funding level for the NOAA MDP, however, is not adequate to meet these new research needs. We respectfully request the Congress to consider increasing funding to support research in this important area. This investment will enable NOAA to advance independent research into the four priority areas identified by the marine debris science community.

I thank the Senate Committee on Environment and Public Works for inviting me to provide testimony about marine debris today. Ocean Conservancy stands ready to continue its work protecting the health of American consumers, supporting the fishing industry, cleaning up our riverbanks and coastlines, and serving as a leader in the international arena to solve the issue of accumulating plastic debris in our oceans.

APPENDIX A

February 2, 2016

Dear Members of the Trash Free Seas Alliance:

As members of the scientific community with expertise on plastic debris in the ocean, we thank you for your ongoing leadership to address this growing pollution problem. We are pleased that you recognize that rigorous science must be the foundation upon which effective interventions are based. We greatly appreciate the Alliance's efforts to raise awareness about the need for more independent science and the financial resources to do so.

As you well know, the amount of mismanaged plastic waste entering the ocean continues to grow, having already caused substantial economic and environmental damage. This issue gained global notoriety among industry and policymakers in February 2015 when *Science* published a groundbreaking study that quantified both the mass and distribution of land-based inputs of plastic waste into the global ocean.

Marine litter is now viewed by the G7 leadership as one of the primary threats[1] to healthy and sustainable oceans. There is growing interest from local officials, national decision-makers and international leaders to devise and implement effective public and private sector policies to address the impacts of ocean plastic pollution. These solutions will be most effective when based on an accurate understanding of the sources, distribution, fates and impacts of plastics in the ocean. As independent scientists, we stand ready to meet this challenge, but additional financial resources are vitally needed to fund robust science to quantify the risk of plastic debris to ocean health and human well-being. Doing so is critical if policymakers are to ensure the ocean continues to provide the goods and services upon which we depend.

Fundamental knowledge gaps exist in four areas: the sources, distribution, fates and impacts of plastics in the ocean. A refined understanding in all four categories is critical to developing effective policies to reduce inputs and prevent impacts of plastics on ocean health.

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[1] Independent science has shown that plastic debris is distributed throughout the world's oceans, from the ocean surface to the deep sea, from the equator to the sea ice in the Arctic, and from the high tide mark to the farthest reaches of the open ocean. As many as 51 trillion pieces of microplastic now circulate in the oceans globally. Plastic debris is found inside a wide variety of marine wildlife, from small invertebrates to large whales, including many species of fish and seafood that humans consume. At last count, 690 different species have encountered plastic debris with primary risks including entanglement, ingestion and chemical contamination. Derelict fishing gear, plastic bags, disposable cutlery and balloons are thought to pose the greatest threat to seabirds, sea turtles and marine mammals. An estimated 8 million metric tons of plastic waste flows into the ocean yearly from the land. While all countries with coastal access contribute, nearly 60% of the total originates from just 5 rapidly developing nations in Asia. Plastics in the ocean are primarily the result of limited and ineffective waste management infrastructure (including insufficient financing) in those countries where plastics consumption is outpacing the ability of local communities to handle the waste. Biodegradable and oxo-degradable plastics are not a solution to plastics in the ocean, as their widespread adoption could make the problem even worse by accelerating the process of microplastics formation.

We recommend new resources be focused on the following key areas:

Sources:

- Undertake fine-scale, quantitative assessments of the terrestrial and maritime sources of plastic waste to the ocean, and the fluxes of different plastic materials between marine reservoirs.
- Develop a better understanding of the mechanisms by which materials escape waste management and how they move to the ocean, including the role of rivers and watersheds as conduits from land to the sea.

Distribution:

- Develop robust and efficient technologies to detect and quantify plastic debris globally on coastlines, at the sea surface and on the seafloor. This will require determining the size-frequency distribution of plastic debris from nanoparticles to large debris such as derelict fishing gear and debris from natural disasters.
- Identify "hot spots" of plastics accumulation that could have negative impacts on marine life or the ocean ecosystem, or that might be target areas for clean-up activities.
- Resolve the apparent disparity between the large yearly input of plastics to the ocean and the relatively small amount that can be accounted for at the ocean surface.

Fates:

- Perform quantitative assessments of the fates of plastics in the ocean from sources to sinks, with a focus on transformations within and pathways between coastal regions, the deep sea and the marine biota.
- Develop a mechanistic understanding of the means by which large plastic items degrade into microplastics, including the relative importance of physical and biological processes and the time scales of breakdown.

Impacts:

- Apply a risk assessment framework (integrating both exposure and impact) to quantify the risk of plastics to marine wildlife and human health, now and in the future.
- Measure the exposure of farmed and wild seafood species to plastics in the marine environment.
- Quantify the body burden, individual fitness and population consequences of toxicants in marine wildlife from the ingestion of plastics versus other routes of exposure.

Thank you again for your leadership in confronting the impact of plastic pollution in the world's oceans. As scientists, we remain dedicated to advancing the knowledge needed to solve this environmental problem.

Sincerely,

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APPENDIX B

Sea turtle caught in derelict fishing net.
Photo © NOAA.

Gull with can stuck around neck in San Francisco.
Photo taken by Nina Kristin Nilsen/Marine Photobank.

Stomach contents of deceased and examined albatross on Midway Island.
Photo taken by Nicholas Mallos.

More than 84,000 pieces of plastic sampled from a 1 square meter quadrat of Kamilo Beach, Hawaii.
Photo taken by Nicholas Mallos.