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Ban Overboard: Exploring Solutions to Ocean Pollution

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Heartbreaking photos and videos of wildlife harmed by plastics litter have rightly raised public concerns about plastics in the ocean. In response, state and local lawmakers have pursued policies that ban or tax many single-use plastic products—plastic bags, straws, cups, and other items. Meanwhile, legislation in Congress proposes to create a massive federal government-led "extended producer responsibility" program that would force packaging companies into the disposal business. Unfortunately, neither approach is likely to work, because these policies do not address the main sources and causes of the ocean pollution problem.

This paper provides an overview of the situation and offers some concrete solutions that promise to produce measurable results. It is the third paper in a series of four on the topic of plastics. The first two papers in this series detailed the tremendous benefits that plastics provide to both humans and wildlife—benefits that could be lost if more proposed bans and regulations are imposed. The fourth and final paper will detail the proposed federal program for "extended producer responsibility" regulations. It will explain why such policies are doomed to fail and points out their potentially devastating impacts on the U.S. plastics industry, its employees, and our economy.

For several decades, a considerable number of marine biologists and other researchers have been investigating the problem associated with plastics in the ocean, and the science continues to evolve. While some disagreement and uncertainties exist, which will be noted in this analysis, some consensus is developing regarding the scope and sources of the problem. The following provides an overview of that research and proposed solutions organized in a series of easy-to-digest questions and answers.

How Extensive Are the So-Called Garbage Patches in the Ocean? Plastics that are washed out to sea have accumulated in certain areas of the world's oceans because of rotating currents, referred to as gyres, which create floating patches of concentrated trash and fragments. Media hype in the past has suggested that these patches had become massive "islands" of concentrated consumer waste covering the ocean surface.[1] Some have suggested that one of these areas referred to as "the Great Pacific Garbage Patch" is essentially an island the size of France or Texas, and others claimed it could be seen from outer space. While the problems associated with ocean litter are serious, misinformation about the scope and character of the problem is unhelpful.

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Greenpeace founder Patrick Moore, in his book *Fake Invisible Catastrophes and Threats of Doom*, exposes many false claims related to the size and density of the garbage. For example, one of the photos media outlets published shows a massive collection of waste with a subtitle of "A Part of the Great Pacific Garbage Patch." Yet, land is visible in the background, while the gyres are nowhere near land, so obviously the photo was taken somewhere else. According to Moore, the image was taken after the massive 2011 Asian tsunami that pulled tons of debris from land out to sea.[2]

Researchers report that the waste is dispersed and fragmented. Angelicque "Angel" White, an oceanography professor at Oregon State University, dispelling the idea that the patches amount to islands of waste, pointed out after a 2011 expedition to the Great Pacific Garbage Patch: "You might see a piece of Styrofoam or a bit of fishing line float by at random intervals after hours or 20 minutes."[3]

According to the U.S. National Oceanic Atmospheric Administration (NOAA), these garbage patches "are not forming 'islands of trash.' Instead, this debris is continually mixing and is spread throughout the water column, from the surface all the way to the ocean floor." And more of the waste consists of small fragments of plastics that are "less than five millimeters in size, called microplastics."[4]

The question remains: what is the impact of these patches? NOAA notes: "Scientists rarely get to see the impacts of garbage patches on animals first hand."[5] In other words, we cannot verify problems or the nature of such problems. NOAA then details some cases where plastics can be a problem: old fish nets trapping wildlife, wildlife eating plastics and feeling full although they get no nutrition, and the possibility of the plastics transporting non-native species to different parts of the world where they do not belong and thereby "disrupting ecosystems."[6]

Fortunately, there are some private groups offering helpful insights on what the patches consist of and even how we might reduce ocean plastic problems. The nonprofit The Ocean Cleanup has taken a closer look at the problem and how to solve it.[7] This ambitious effort deployed 30 ships equipped to collect a wider range of debris sizes than before and repurposed military aircraft equipped with sensors to detect trash. After collecting and counting more than a million pieces of trash, the researchers then categorized the size of the patch and what it contains.

The resulting study maintains that the Pacific patch covers a larger area than estimated elsewhere—around three times the size of France—and included waste pieces that are larger than previously estimated. They did not claim it was a solid mass, like an island, but dispersed debris. It is important to remember however, that the gyres are constantly moving, so the size is hard to track, and it is constantly changing. They also estimated that up to 20 percent of the mass may have resulted from the 2011 Tohoku tsunami, which sucked trash out to sea. Some of the waste, such as food packaging, included written material that indicated a significant portion came from Asia. Of these, 30 percent were labeled in Japanese and 30.8 percent were in Chinese.[8]

The Ocean Cleanup maintained that there is more waste than is visible in these patches because much of it hovers within the water column below the surface. However, Patrick Moore disputes that idea, noting that most plastic is either more or less dense than the ocean water. Hence, it would either float or sink to the bottom of the ocean—with little trash in between.

Where Does the Plastic in the Ocean Originate? In addition to understanding the types and amount of litter involved, efforts to control it must consider where and why it enters oceans in the first place. Studies indicate that poor waste disposal practices, such as allowing open dumps, in Asia and developing nations are the main sources of ocean garbage. A 2015 study published in *Science* magazine reported the number one contributor to waste in the oceans is China, which mismanages 76 percent of its trash overall and 27.7 percent of plastics waste.[9] The *Science* study also revealed that China and 11 other Asian nations are responsible for 77 percent to 83 percent of plastic waste entering the oceans because of their poor disposal practices.[10]

Similarly, a 2017 *Environmental Sciences & Technology* study reported that 88 to 95 percent of plastic waste enters oceans from one of 10 rivers—eight in Asia and two in Africa.[11] One of the study's authors eventually clarified this claim stating that the study concluded that 88-95 percent of ocean plastics "coming from rivers" originated in just 10 rivers. Additional ocean plastics might be originating from other, non-river sources, such as shorelines, although we do not know the quantity. The original study and its press release were confusing, as one "fact checking" site pointed out:

> The confusion possibly came from a press release about the study, published on October 17, 2017 on the UFZ's website that stated that UFZ researchers "have also calculated that the ten river systems with the highest plastic loads (eight of them are in Asia and two in Africa) — areas in which hundreds of millions of people live, in some cases — are responsible for around 90 percent of the global input of plastic into the sea."
>
> Schmidt also recognised that a section of his paper that refers to how "the 10 top-ranked rivers transport 88–95% of the global load into the sea" could be misinterpreted at first glance. Schmidt said he regretted the misrepresentation of his study in a number of news articles.[12]

However, the study remains an important source of information regarding the origins of a large share of the plastics in the oceans, because rivers are likely the most significant vehicles for waste entering oceans. The Ocean Cleanup did an additional in-depth study on this topic in 2019, which reported that "the majority of MPW (91%) are transported via watersheds larger than 100 km^2 suggesting that rivers are major pathways for plastic litter to the ocean."[13] The study's findings support the idea that most of the waste comes from rivers in Asia and less developed nations that have poor waste management practices, which is the key point.

Specifically, The Ocean Cleanup researchers estimate that 80 percent of all river-transported, plastics that end up in the ocean emanate from 1,000 rivers. The group's website includes a map indicating which rivers pose the greatest problems, and it identifies only one U.S. river. Most of the others appear to be in Asia and developing nations in Africa and in South America. While The Ocean Cleanup study indicates that the problem rivers may be more extensive than reported in the 2017 study, both studies indicate that most of the problematic river sources are found in Asia and developing nations. Such findings are particularly valuable for those entities—such as The Ocean Cleanup—that are developing technologies to clean the oceans and prevent more wastes from entering them. Indeed, The Ocean Cleanup study notes: "The results from this study are important for the prioritization and implementation of mitigation strategies."[14]

For example, they identified one U.S. river in Delaware as part of the 1,000, which opens to the ocean.[15] If correct, this finding should trigger actions in the United States to promptly address the source of this plastics waste, be it unusually high litter rates or poor waste management practices. But in the end, the problem will not be solved if we do not address the key sources of the problem: poor waste management overseas, which is why domestic bans on plastics will not achieve much at all.

The United States ranked 20th among nations contributing to ocean trash, responsible for an estimated 1 percent of the waste, according to the 2015 *Science* study. Although we can make improvements, considering the size and significant population of the United States, our contribution is low thanks to relatively good waste management practices. The article reports that the United States mismanages about 2 percent of its total waste stream and only 0.9 percent of plastic waste.[16]

Notably, some of the researchers who originally placed the U.S. contribution at 1 percent more recently suggested that the United States is actually the number one contributor to waste in the ocean.[17] It is curious why they would suddenly make the opposite claim, but their reason for shifting the blame is not particularly compelling. They maintain that the U.S. is responsible for waste that flowed off the shores of China into the ocean because many U.S. cities and towns have exported some waste there for recycling. As a result, some of that U.S. waste may have entered the oceans, although we do not know exactly how much. While it may have been naive for U.S. cities and towns to expect the Chinese to manage the waste well, waste that flows off the shore of China is the result of *mismanagement in China*. Of note, China has drastically reduced the amount of U.S. trash it will accept for recycling because the materials were not sorted properly in the past, and therefore were too difficult to recycle.

This study suggested that illegal dumping of waste today in the United States is a significant source of ocean pollution, which, if it is occurring, certainly needs to be addressed. It remains uncertain whether these estimates are correct, but dumping can be a problem when cities and towns have unrealistic and needlessly expensive waste management policies. For example, recyclable wastes have been known to pile up in cities where the local government mandated recycling yet lacked markets for the materials.[18] Public officials need to consider

such realities when finding ways to better manage solid waste, as will be detailed in a later section of this paper.

What Type of Plastic Wastes Are Most Common in the Ocean? The Ocean Cleanup produced some interesting observations about the type of waste found in the Great Pacific Garbage Patch. Although these are only estimates, they provide helpful insights on the types of wastes that present a problem and the potential portions of each. The Ocean Cleanup found that the primary culprits were not single-use plastics—straws, cups, and grocery bags—which are often cited as the source of the problem and are often the target of regulations. Forty-six percent of the trash was composed of fish nets, which, combined with ropes and fishing lines, amounted to 52 percent of the trash.[19] The nets and ropes are a particular concern because they can ensnare wildlife. The rest included hard plastics ranging from large plastic crates and bottle caps to small fragments referred to as microplastics, which they maintained comprise 8 percent of the floating debris.[20]

Even though microplastics are estimated to make up only 8 percent of the ocean plastics, there is a great deal of concern about them. These small bits of plastics range from visible pieces of plastics to small microbeads that are hardly detectible to the human eye to pieces so small they are not visible to the naked eye. According to the National Ocean Service, any plastics "less than five millimeters in length," about the size of a sesame seed, can be called a microplastic.[21] Of the estimated 8 percent of plastics in the ocean that are considered microplastics, an estimated 36 percent is from synthetic fabric lint from washing machines, 28 percent from the erosion of automobile tires, 24 percent from city dust, 7 percent from road markings, 4 percent from marine coatings, 2 percent from personal care products, and 3 percent are plastic pellets.[22]Again, most of these sources are not from single-use plastics.

How Much Plastic Continues to Accumulate? The total volume of plastics that continues to enter the ocean today is a subject of some debate. A report published by the World Economic Forum contended: "In a business-as-usual scenario, the ocean is expected to contain 1 tonne of plastic for every 3 tonnes of fish by 2025, and by 2050, more plastics than fish (by weight)."[23] Such claims are bandied about regularly with little supporting scientific evidence. Meanwhile, there are good reasons to question whether such assessments substantially overestimate the amount of waste entering oceans.

Journalist Clare Goldsberry, who has reported on the plastics industry for over 30 years, observes:

> Nearly every time I read an article about plastic waste, particularly in the mainstream news media, the first few paragraphs trumpet huge numbers. There are 5.25 trillion pieces of macro and micro plastic in our oceans—46,000 pieces in every square mile weighing up to 269,000 tonnes, said one article. Every day, eight million pieces of plastic enter the oceans, said another. Yet another piece noted that eight million tons of plastics are dumped every year into the oceans.
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> Can anyone interpret that for me? Just who counted those 5.25 trillion pieces of macro and micro plastics? I love the one about how soon there will be more pieces of

> plastic in the ocean than fish. Is that done by computer model? Observation? And who's counting?
>
> Big numbers don't mean much without context, and context comes from data obtained by scientific observation. Observation is key to determining reality from projections. Computer modeling is not scientific "observation."[24]

Similarly, one *Science* journalist points out why the estimate claiming there will eventually be more fish than plastics is highly suspect:

> The estimate for ocean plastic comes from a 2015 study that only predicts the world's plastic output up until 2025 and uses data from just one place—San Francisco Bay—to calculate how much of this gets into the ocean. And then there's the fish. The estimate for fish mass comes from a 2008 report that guesses at the global mass of *all* marine animals based on how much phytoplankton is on the surface of the sea. Since then, the same research group has concluded that there may be many times that amount of ocean biomass. And, says the lead researcher, it's still really hard to tease out how much of that biomass is made of fish. There's no question that accumulating ocean plastic is a problem—but simple factoids can mask the fact that we still have a lot to learn about what's in the world's oceans.[25]

In fact, researchers have struggled to find enough plastics in the ocean to justify what appears to be outlandish overestimates. To their credit, many of these groups are doing great work trying to help solve problems related to plastics waste, but they fail to consider that they may have simply overestimated the amount of waste entering oceans. Michael Shellenberger notes, in *Apocalpse Never: Why Environmental Alarmism Harms Us All*, that when researchers examined the amount of plastics in the ocean they were surprised to observe that the weight of plastics found on the ocean surface was just 0.1 percent of global production and the amount of microplastics they measured was "a hundred of times" less than they expected.[26]

In 2019, The Ocean Cleanup published a study on the topic, noting that given the increase of plastics use over the past few decades, plastic litter in oceans is not appearing where expected. "[A] major fraction of positively buoyant plastic is missing" and the amounts found "are far from the predicted tens of millions of metric tons that should be floating in the global ocean by now," the group noted.[27]

Originally, The Ocean Cleanup surmised that as plastic entered the gyres it would float for a while and then sink. In that case, one would expect that the older waste would sink, and more recent waste would be found at the surface. But after a systematic effort to collect waste from the ocean surface and determine the age of the waste, The Ocean Cleanup researchers found that most of it dated from the 1990s and prior years going back to the 1970s. Apparently, much of the old waste is not sinking, and not as much newer waste has appeared as expected.

Rather than adjust their estimates about how much waste is entering the oceans, The Ocean Cleanup researchers developed a new hypothesis: More recent plastic waste is being captured by shorelines where it may be washed in and out of the oceans for many years until eventually it washes out into one of the several gyres.[28] The plastics that reach the gyres eventually break down into tiny pieces of microplastics and allegedly reach the ocean floor, although this appears to be a guess rather than an evidence-based observation. If true, that would present an opportunity for those who seek solutions: Set up aggressive efforts to clean shorelines. While this approach seems obvious in any case, if that is where waste first appears once it enters the oceans, shoreline cleanup could be a powerful tool in solving problems.

However, the shoreline collection hypothesis may or may not be true and probably does not completely explain the plastics sink issue. For example, in *The Plastics Paradox*, plastics material scientist Chris De Armitt reports that, based on an extensive review of the scientific literature, most beach litter is left there by people who visit the beaches rather than being washed up on the shore. The litter on remote beaches comes mostly from fishing boats and the majority is fishing nets and ropes. While some litter might drift to remote beaches from land, it is most likely the result of fishing boats dumping trash directly into the ocean.[29]

More recently, a study conducted by researchers at the University of Barcelona notes that the reason researchers cannot find enough trash in the ocean is because their estimates are wrong. The abstract to the article, published in *Science*, notes:

> On the basis of an in-depth statistical reanalysis of updated data on microplastics—a size fraction for which both ocean and river sampling rely on equal techniques—we demonstrate that current river flux assessments are overestimated by two to three orders of magnitude. Accordingly, the average residence time of microplastics at the ocean surface rises from a few days to several years, strongly reducing the theoretical need for a missing sink.[30]

If this recent analysis is correct, the common estimates about the amount of plastics entering oceans are way off the mark. As one of the University of Barcelona researchers underscores in a university news release: "The problem is that the estimates made for plastics flowing from the rivers are tens to hundreds of times higher than the quantity of plastics floating on the ocean's surface."[31]

Overestimating the amount of waste entering the oceans does help raise money and attract attention to the problem, but misleading information is not helpful in developing targeted solutions to legitimate problems. In fact, some activists use such alarming estimates to pursue radical approaches, such as plastic bans that will not solve the problem and instead divert the public's and policy makers' attention away from finding workable solutions.

How Long Do Plastics Take to Degrade? One reason that there may be less plastic found in the oceans than researchers estimate is because plastics may be biodegrading much faster than expected. Supposedly, plastics are not particularly biodegradable and simply break down into increasingly smaller pieces that persist for hundreds to 1,000 years. Those

who originate such claims carefully craft their statements to be true yet promote a widely misleading picture. For example, one website warns:

> Plastic waste is one of many types of wastes that take too long to decompose. Normally, plastic items can take up to 1,000 years to decompose in landfills. Even plastic bags we use in our everyday life take anywhere from 10 to 1,000 years to decompose, and plastic bottles can take 450 years or more.[32]

That may sound scary, but it is not as alarming as it sounds when one carefully examines some facts. First, the assertion that plastics may take 1,000 years to degrade in a landfill is neither surprising nor alarming. Landfills are designed to mummify waste—sealing out the air and sunlight necessary for biodegradation. In fact, when researchers excavated landfills during the 1990s, they found very little degradation of waste buried many decades earlier. They even found a bowl of guacamole with intact chunks of avocado that was 25 years old.[33] While some people may lament the fact that the waste does not biodegrade, sanitary landfills keep the waste out of the environment and ensure safe, long-term disposal.

The notion that it can take 10 to 1,000 years for a plastic bag to biodegrade highlights the fact that plastic bags can decompose in 10 years. The 1,000-year estimate, again, likely refers to a plastic product's lifespan in a landfill, where it is not expected to decompose. And the author does not detail under what circumstances it takes a plastic bottle 450 years to decompose.

The point is that plastics do biodegrade and they do so at rates more rapid than the anti-plastics hype suggests. De Armitt, in his book on the topic, demonstrates how plastics degrade over decades rather than over a millennium, as others have claimed. "It is not open for debate. There are thousands of scientific articles on it, and a whole journal called *Polymer Degradation and Stability* devoted to the topic," he explains.[34] Plastics break down with exposure to sunlight and air, and the byproducts are the same as when organic matter degrades: methane gas, carbon dioxide and water. A polyethylene plastic grocery bag, he notes, will break up into tiny pieces in less than a year, and those pieces will continue to break down until they are converted into carbon dioxide and water. Other plastics degrade over a few decades rather than 1,000 years, and significant degradation of a 15-year-old PET bottle pulled from the ocean, reveals that plastics will degrade on land and *in water*.[35]

Moreover, one of the more maligned plastics, polystyrene—which makes foam cups and food containers—is one of the more biodegradable plastics available. While cities and towns have banned foam cups in favor of paper cups—which are often lined with plastics—the polystyrene alternatives will not persist in the environment for hundreds of years as often claimed, and require much less energy and water to produce. One 2019 research study by researchers from the Woods Hole Oceanographic Institution in Massachusetts concluded:

> Numerous international governmental agencies that steer policy assume that polystyrene persists in the environment for millennia. Here, we show that polystyrene is completely photochemically oxidized to carbon dioxide and partially photochemically oxidized to dissolved organic carbon. Lifetimes of complete and

> partial photochemical oxidation are estimated to occur on centennial and decadal time scales, respectively.[36]

To speed up the plastics biodegrading process, many people advocate increased reliance on "bioplastics" or biodegradable plastics, but there are many challenges that will likely prevent these products from solving plastic litter problems.[37] First, bioplastics are not the same as biodegradable plastics. You can make bioplastics with cellulose from plants or other "natural" sources, but the final product is not substantially different from any other plastic. Bioplastic products do not necessarily biodegrade any faster than plastics from fossil fuels.

Plastics that are designed to be more rapidly biodegradable can hinder other goals. If mixed or combined in the same package with other plastics, biodegradable plastics hinder recycling efforts because they are not particularly recyclable. In addition, the more rapidly biodegradable plastics do not perform their functions as well as other plastics. In fact, plastic manufacturers add chemicals to slow biodegradation that could compromise product functions. For example, ensuring the integrity of plastics is essential to ensuring a safe and long-lasting food supply, meeting medical supply needs, and many other necessities. Marine biologist Christian Lott, who studies plastic biodegradation in the oceans, notes that developing a material that degrades completely in a short period of time while maintaining its functionality, simply, "not going to happen."[38]

Are Microplastics a Major Problem, and If So, How Serious? Myriad articles in scientific journals have sought to address concerns about microplastics building up in the ocean. Studies make far-reaching claims about how they impact wildlife and the environment, yet none have been able to scientifically demonstrate a discernable effect. After reviewing the literature, De Armitt describes much of the microplastics research as "junk science." He explains:

> As a reviewer for scientific journals, I would have rejected every one of these articles and blocked their publication. If I had funded their research, I would have demanded a refund. This is shamefully poor junk science, but it makes headline news because it purports to show dangers, albeit fictional ones.
>
> It is not just my opinion that the work was poorly done. [Robin] Lenz and [Torkel Gissel] Nielsen [of National Institute of Aquatic Resources at the Technical University of Denmark] found that out of ten studies on microplastics, all showed actual microplastic concentrations in the range 1ngL-1 and 1μgL-1. Then they looked at the concentration used when checking for possible toxic effects and noted that toxicity studies were all done using 100 to 10 million times more microplastic than we actually find in the ocean.
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> That's bad science. They actually called out those other scientists for using such unrealistically high concentrations and implored them to do better in future. As a scientist myself, I have never in my career seen another instance where studies were done so poorly that fellow scientists felt the need to point it out and demand better. It

> is impossible to know why the studies were done so poorly, but it is easier to get funding when your results are dramatic, even if they are not realistic.[39]

In fact, there is neither a body of solid evidence nor a consensus on whether microplastics cause significant harm. Instead, there appears to be more of a political, rather than a scientific, consensus about the need to reduce the use of plastics in general. While researchers admit that microplastics science is largely inconclusive, they still advocate for plastic bans and regulations—expressing a political preference for precautionary policies that lack supporting science.

An October 2019 article in the *Guardian*, for which the authors interviewed three scientists to gain their thoughts on this issue, illustrates this phenomenon. All the interviewed experts said that people should reduce their use of plastics because there *might* be a problem, yet none of them could offer hard evidence of actual problems related to microplastics. In fact, they all indicated that microplastics might not pose a significant problem—at least not yet—or they had yet to prove it.[40]

The University of New South Wales's Mark Browne explains: "There's an absence of science here ... We need studies that expose organisms or models to these doses to see if they cause problems." Yet later in the article he maintains that humans need to manage and reduce exposure to plastics because, "[t]here's enough evidence of harm that we should be doing that," although the article does not detail any evidence. To his credit, Brown does caution that misguided campaigns to rid the world of plastics could have unexpected, adverse outcomes. "If we are going to do that, we should make sure that as we intercept or redesign products we don't cause more problems," he says. [41]

Environmental scientist Kevin Thomas noted that human consumption of microplastics *might* have adverse health effects if the plastics are small enough to enter cells. Such exposure might result from eating seafood or meat from other animals that have consumed plastics. Yet, he then notes: "Personally, I think there's little risk to our health based on what we know ... but then, who knows what we might find in the future." Later in the article he notes, "I eat seafood, for example, but I don't use plastic chopping boards at home."[42] So basically, he does not see a big problem associated with microplastics in seafood but alludes to the idea that maybe bits of plastic from his cutting board might pose a risk, although he offers no evidence of that either.

Lauren Roman, at CSIRO Oceans and Atmosphere, an Australian government-supported consultancy, pointed out that larger pieces of plastics can be a problem for wildlife, yet her observation is not particularly relevant to the potential impact of microplastics. She then expresses concerns about chemicals used to make plastics but noted: "We don't know yet if they are affecting the health of the animal." She adds that "nothing serious has been found yet suggests to me that we must be looking for small effects and, remember, that we are exposed to lots of things in our lives. Is this something to get our knickers in a knot about? I'm not sure."[43] Yet she repeats the political mantra that people should reduce the use of plastics.

To be fair, these researchers probably engaged in a much longer conversation with the *Guardian* and their comments are quoted piecemeal in the article. But the key point remains the same: Researchers lack solid data on the impact of microplastics on wildlife or humans, and often take a precautionary approach based on ideology rather than hard science.

Similarly, in *Nature,* environmental scientist Albert Koelmans, from Wageningen University in the Netherlands, says that microplastics will continue to build up in the environment even if we stopped using them completely because, somehow, they will escape landfills and other locations to pollute the environment. He goes as far as to say that microplastics are building up in the environment enough to be considered a "plastic time bomb." Yet in the next sentence of the piece he goes from calling the problem a timebomb to saying that he is "not that frightened today," but is "a bit concerned about the future if we do nothing." [44] Which is it—"a time bomb" or "a bit" concerning?

Understanding what these materials consist of and how they enter the environment is important. The first step in that process might be to find a better definition of microplastics, which currently appears to be very broad. In an article for *Environmental Toxicology and Chemistry*, researchers from the University of Toronto and the Society for Conservation Biology explain that microplastics "come from a multitude of sources; comprise different sizes, shapes, colors, and types of materials; and include a mixture of diverse chemicals. They migrate through nature via diverse pathways and affect biota and ecosystems in different ways."[45] Accordingly, they cannot be lumped together as a single problem. The impact of each type and source demands greater exploration so that researchers can identify whether problems exist, where they exist, and tailor solutions to each one. They note:

> Indeed, there is no one-size-fits-all solution to microplastic pollution, and diverse strategies should be considered that are relevant to specific types, sources, and pathways. For example, microfibers are among the most common types of microplastics found in environmental samples, and we know washing clothing is one source. As such, filters on washing machines may be a simple solution to prevent the release of microfibers into the environment. In addition, tire wear particles are estimated to be a large fraction of microplastics in storm water runoff that leads to the environment. If bioretention cells or rain gardens were added to storm drains, we may reduce the amount of tire wear particles that are entering urban watersheds. By designing research programs that consider the diversity of microplastics to inform sources, we can inform decision-makers of the most relevant sources of microplastics on which to focus.[46]

While managing plastics of all kinds is advisable, research about microplastics will only be helpful if it is based on hard scientific findings. Only then can we find solutions to address specific issues that might exist. A precautionary policy approach, by contrast, would divert policy makers' attention away from the real issues.

Are Ocean Plastics Really "Toxic" and Harmful to Humans and Wildlife?

Environmental activists have deemed a number of products as dangerous because of chemical additives known as plasticizers. Manufacturers use plasticizers to produce certain

attributes in their final products, including flexibility, clarity, or durability. Yet, despite all the hype, these chemicals pose only negligible risks because their exposure levels are simply too low to have any human health effects.

Most of the plastics found in the ocean are polyethylene and polypropylene, along with additives that have excellent safety records, explains De Armitt. He further notes that the Food and Drug Administration (FDA) approves these for food contact containers, without concern for any toxic effects. And the plastics themselves, are, by definition, inert because polymers are tightly bound and hence, there is little opportunity for them to have toxic effects.[47]

Yet activists drum up fears about certain chemicals used in plastics, particularly Bisphenol A, which is used to make clear, rigid plastics, as well as a category of chemicals known as phthalates, which are used to make clear, flexible plastics. These activists allege that these chemicals are "endocrine disrupters" that can create hormonal imbalances in our endocrine systems. It is true that synthetic chemicals found in consumer products are what researchers call "weakly estrogenic," but they pose no real risk. We are regularly exposed in our everyday diet to estrogen-mimicking compounds produced by plants, known as phytoestrogens, which are much more potent and are present in much higher exposures. Yet we suffer no ill effects because none of those chemicals are anywhere near as potent as human hormones. Phytoestrogens, for example, are found in legumes, with particularly high levels in soy. Exposure to natural phytoestrogens is 100,000 to 1 million times higher than exposure to estrogen-mimicking substances found in synthetic chemicals, according to data from a 1999 National Academy of Sciences study.[48]

Man-made chemicals may be "weakly estrogenic," but they are not potent enough to have health effects at existing consumer exposure levels.[49] For example, researcher Jonathan Tolman notes:

> Given the huge relative disparity between the exposure to phytoestrogens as compared to synthetic chemicals like BPA, the risk of BPA in consumer products appears to be about the same as a tablespoon of soy milk.[50]

We have little to fear from soy milk, so we have even less to fear from BPA and similar synthetic compounds.

After more than five decades of use, there are no verified cases of anyone suffering ill effects from BPA exposure from consumer products.[51] But activists focus on largely theoretical risks based on select research studies that find associations—which do not demonstrate cause and effect—between BPA and various health ailments and tests that show health effects in rodents dosed with massive amounts of BPA. These tests reveal little about risks to humans exposed to tiny amounts of BPA from consumer products. Scientific panels around the world have assessed the full body of research on BPA risks, and all have found that human exposures are too low to pose significant risks. These reviews and findings include research conducted by the U.S. FDA,[52] the European Food and Safety Authority,[53] Health

Canada,[54] the Japanese National Institute of Advanced Industrial Science and Technology,[55] and the U.S. National Toxicology Program."[56]

The low potency of synthetic chemicals in plastics should mitigate concerns about their effects on wildlife. Given the fact that wildlife is exposed to far more natural phytoestrogens with potencies multiples of times higher than that of plasticizers, any effects must be negligible. Concerns about plastics in the environment are reasonable, yet emphasis on toxicity is more of an alarmist tactic than a rational scientific concern.

What Is the Impact on Wildlife and the Environment? Images and videos of wildlife harmed by plastic products regularly circulate online and in media stories, highlighting serious concerns about the impact of plastics litter. A 2018 *National Geographic* story showcased images of wild animal encounters with plastics, revealing some heartbreaking realities. Among them was a turtle caught in plastic fishing lines, highlighting the serious problem associated with abandoned fishing gear, which, as The Ocean Cleanup discovered, makes up more than half of the plastics in the Great Pacific Garbage Patch. Others reflected problems associated with open dumps—such as a bird with a clear plastic bag covering its entire body atop a landfill in Spain.[57]

However, policy makers and the public should be aware that some commonly displayed images are suspect, as pointed out by several critics. For example, Chris DeArmitt expresses skepticism about the video in which wildlife advocates remove a plastic straw from a turtle's nostrils. He explains:

> If you listen to the audio on that video, you will hear that they thought the object was a "worm of some kind". Only later, after the video was made, did they claim it was a plastic straw. The object was brown and 15cm long, which is far shorter than a plastic straw. I checked to see how they knew it was a plastic straw. It turns out they never analyzed the object as any professional scientist would do. So, they had zero proof it was made of plastic! Think about that for a moment—a huge movement sweeping the world based on a video containing not one iota of scientific evidence. I don't think we should be banning plastic straws all around the world based on one unsubstantiated YouTube video.[58]

Financial Post columnist Terrance Corcoran also questioned whether the item was a plastic straw:

> One turtle video is worth 50-million Facebook data breaches, no matter how unlikely the chances are that more than one turtle has faced the plastic-straw problem. If the object in the unfortunate turtle's nasal passage was a plastic straw (was it analyzed?), it would have likely come from one of the thousands of tourists who visit Costa Rica to watch hundreds of plastics-free healthy turtles storm the country's beaches for their annual egg-hatching ritual.

> That the turtles are not in fact threatened by plastic straws would be no surprise. It is also hard to see how banning straws in pubs in London and fast-food joints in Winnipeg would save turtles in the Caribbean or the Pacific Ocean.[59]

Greenpeace co-founder Patrick Moore also expressed deep skepticism about the disturbing images of dead albatrosses with gobs of plastics found in their stomachs.[60] One of these photos, featured on the Smithsonian's website, is of a dead albatross chick lying on the beach with its stomach cut open, revealing a massive amount of plastics inside such as bottle caps and cigarette lighters. Environmental activists and journalists use these photos to claim that the birds mistake plastics as food and even feed it to their chicks.[61] Activists claim that these birds then die of malnutrition and the babies are so full of plastics they cannot fly, and are often left to die.

According to Moore, the photo must be staged because it is not possible for albatrosses to have that much in their stomachs, since when they swallow plastics it goes to the gizzard. "Unless the bird had a gizzard the size of its entire body," he says, the photo must be staged. Yet the photo is all over the internet and is found within news articles worldwide calling for plastics bans.

Moore points out that it is not surprising that albatrosses would consume plastic and even feed it to their young because the birds use hard objects to aid in digestion. If they were not going to consume the plastic, they could find pebbles, shells or beaks and bones from dead animals. The birds swallow hard objects—plastic or natural—that work within their muscular gizzards to break down the food before it goes to the stomach. Moore points out that the birds regurgitate the plastics or natural substances, releasing what is known as a bolus, a fact that the *Smithsonian* article failed to mention. Accordingly, the fact that plastics are found in the birds—dead or alive—does not necessarily mean they were the cause of death or even a problem. But the photos are highly questionable, according to Moore. "I stand to be corrected but I do not find these images credible as the amount of plastic shown is at least ten times as much as has been documented in the gizzards of albatrosses," he notes.

Moore also includes an excerpt from a research article he published on the topic with other scientists. They provide an overview of key scientific studies spanning several decades related to the impacts of plastics on albatrosses. The articles originally expressed concerns that the birds were consuming plastics by mistake, leading to nutritional issues and early mortality. Overall, the research determined that the birds intentionally seek out the plastics because it aids in digestion, is not a major threat, and can even be beneficial as a digestive aid.

A study published in July 2020, for which researchers looked at a sample of 12 species of albatrosses from a sample of 107 birds brought to wildlife hospitals in New Zealand and Australia, found that ingested plastics were found in 5.6 percent of the birds and were the cause of death for half of them. Based on that, the researchers estimated "ingestion of plastic may cause 3.4-17.5% of nearshore mortalities and is worth consideration as a substantial threat to albatross populations."[62]

In any case, most people agree that we want to prevent litter from affecting wildlife, even if we cannot agree on the scope of the problem. An honest assessment of the problem is most helpful, and unfortunately, it appears that some parties may have produced misleading imagery to back up some questionable claims.

What Is the Most Important Activity We Can Do to Prevent Plastics from Entering Oceans? The main cause of ocean pollution identified by many researchers relates to poor disposal practices, particularly overseas. Accordingly, the solution involves setting up effective and efficient waste management systems, which is best accomplished in a competitive marketplace.

In many places around the world, waste management markets and private property rights are absent or severely lacking, leading people to dump trash or throw it in the streets. In other places, waste management markets are plagued with governmental intrusions, and some are completely or partially government-owned. To the extent that competition and property rights exist, there are greater efficiencies, but government interference and ownership has created many of the problems we face today.

The ideal waste management system is a fully private one, governed by market competition, private property, and the rule of law. In those cases, private collection and competition between disposal options determines how waste is managed. Haulers compete for business from consumers, charging a fee for their services, and the haulers pay disposal companies to manage the waste, with price signals guiding where they take the waste. In places that are too rural to support a hauling business, consumers would be responsible to take their waste to a disposal company. Accordingly, there is competition between companies that provide disposal options that include recycling, landfilling, and incineration.

The cost of disposal would play a large role in how waste would be disposed. The price for each option represents its costs to society: the value of the water, energy, land, labor, and other resources that the disposal option requires. Hence, allowing competition between disposal options can enable the most resource-efficient—least expensive—option to prevail in any given case. This system recognizes that some portions of our waste are most efficiently recycled, some are most efficiently placed in landfills, and some may be burned in incinerators. The key is finding, through price signals, the mix of options that conserves the most resources, while protecting the environment.

For example, if recycling some portion of the waste saves resources, it would be more affordable for the haulers to divert that portion to recyclers. To achieve that goal, they could provide incentives for consumers to sort waste accordingly. Consumers who do not sort properly might be assessed a higher fee by the trash hauler, ensuring that the right types of products are available to recyclers. Pricing would guide waste that is too resource-intensive to recycle to landfilling or waste-to-energy incineration, whichever is more efficient. Of course, for a market-based system to work, the government must play a role in protecting both private property and public property from illegal dumping of waste.

The market process allows for regular adjustments depending on changing resource values and market conditions, and the incentives should always drive the system to the most efficient mix of disposal options. For example, recycling of plastics has long been a considerable challenge because plastics are so efficient to make, often requiring less energy, water, and other resources than many alternatives. As a result, the value and number of resources for virgin plastics can be less than the amount necessary to recycle them. There are also difficulties associated with separating various types of plastics so they can be recycled. In addition, recycling products back into the same product—such as melting down a plastic water bottle to use it to make new water bottles—can affect product performance. And there often are food contamination concerns related to recycled food packaging. Accordingly, in many cases, landfilling is the most affordable and efficient option for disposal of plastics.

However, that may change thanks to the emergence of a process known as advanced recycling or chemical recycling, which could substantially improve the recyclability of many plastic products. Rather than melt down plastics and use them to make the same product, advanced recycling can convert plastics waste back into their original chemical components and then use those chemicals to make virgin plastic resins, fuels, and other products, without having to compromise the integrity of the final product. Some advanced recycling technologies can process various types of plastics together, reducing the sorting costs that otherwise might make plastics recycling too expensive.[63] The many different advanced recycling processes under development are promising, and, eventually, could ensure much higher plastic recycling rates.

Currently, advanced recycling is being driven within the private marketplace, and plastics producers are participating in this process because their industry survival depends in part on their ability to ensure proper disposal. Such developments should be allowed to continue; those that ensure efficient resource management will prevail. Unfortunately, anti-plastics legislation in Congress proposes to halt permitting for advanced recycling facilities and essentially ban the process, which could completely halt the development of these technologies, the details of which are discussed in the fourth paper of this series.

Does the U.S. Waste Disposal Market Measure up? Waste management in the United States is driven in part by market forces along with a good amount of governmental management and collection, mostly at the local level. Not surprisingly, the problems we currently experience with U.S. waste disposal markets stem from the fact that there is too much government intervention. For decades, the federal government encouraged states and local governments to develop five- to 30-year plans for solid waste management that would have made Soviet economic planners proud.[64] These state and local waste management plans attempt to estimate how much waste a city might produce over decades and what kind of wastes—paper, plastic, glass, etc.—and the percentages of each. Then local government officials make decisions on how much they will recycle, landfill, or burn in a waste-to-energy plant.

Such political intervention in the waste disposal market creates incentives that distort market forces that otherwise could achieve more efficient waste disposal. In particular, decisions on how to dispose of waste are heavily impacted by political preferences rather

than economic or environmental realities. And even if officials could insulate their decisions from politics, they simply lack enough information about future waste streams and technologies to make informed decisions. And unlike private businesses, bureaucrats do not suffer financially for the poor decisions and bad investments they make.

While waste management bureaucrats and politicians rarely suffer for their bad decisions, taxpayers pay the price. Localities often spend precious tax dollars to either force or subsidize various players into the market—from consumers to haulers to recycling companies—to conform to political preferences rather than pay attention to market realities. Recycling is often pushed because it is politically popular, even though ill-conceived recycling programs are often expensive and unworkable.[65] They force homeowners to sort and clean recyclables, and then the city or county sends out special trucks to pick them up—even when there is no market for a large percentage of them.

Compulsory government recycling programs have created a host of problems. For example, some jurisdictions have stockpiled "recyclables" hoping to find a market for them, creating environmental hazards in the meantime. Other times, governments have spent money to collect recyclables separately only to send it to landfills anyway because there were no markets for them.[66] And political desires to recycle waste at almost any cost has prompted some communities to export waste to China for "recycling," when there were likely more affordable disposal options at home. Unfortunately, some of that waste may have eventually entered waterways because of mismanagement practices in China.

In addition, some portions of recyclable waste are recycled in a way that is more environmentally damaging than landfilling.[67] While market-driven recycling does save resources, government subsidized or forced recycling can use more energy, water, and emit more pollution than other disposal options. And because such programs can become an expensive drain on government coffers,[68] many cities and counties, in a vicious cycle, stop them only to restart them a few years later because of political pressure to "recycle."[69]

Government planning has also led local governments to issue bonds for massive waste-to-energy facilities that prove economically unsustainable because haulers chose to simply take waste to much more affordable landfills. So rather than cut their losses and learn to avoid bad investments, many towns and cities passed laws to force haulers to do business only with government-run waste-to-energy facilities, banning competition with private landfills.[70] Had such coercive action been taken in the private marketplace, it would probably constitute racketeering. Fortunately, private haulers took their case to the Supreme Court and won because such anti-competitive behavior proved an unconstitutional violation of free commerce between the states.[71]

In the United States, policy makers should place greater reliance on advancing a competitive marketplace for waste disposal, which should happen at the local level. Federal intrusion into this marketplace will exacerbate existing problems and lead to more mismanagement of solid waste.

How Do Waste Disposal Practices in Developing Countries Affect Ocean Pollution and What Can Be Done to Address Them? Addressing the volume of waste that enters oceans from overseas locations is more complicated because many developing countries lack systems for managing much of the waste. A 2015 report by the Ocean Conservancy maintains that 75 percent the waste that enters the oceans from sources in Asia and Africa results from uncollected waste, while the remaining waste escapes those nations' waste management systems.[72]

Unfortunately, many developing nations are ill-equipped to address disposal problems, lack the political will to do so, or both. Ultimately, they need economic development that can give them both the will and financial resources necessary to manage waste properly. Until that happens, activities focused on managing and containing waste as it flows into the oceans from rivers is essential. The Ocean Cleanup is working on some impressive technologies to help get that done, which are discussed below.

Similarly, efficient free-market solid waste management systems are unlikely to develop in socialist nations like China whose governments do not support the necessary institutions of economic freedom and private property. As a result, our best options probably include political pressures and the development of systems to penalize polluters, including governments. Private and nonprofit cleanup efforts can also help mitigate the impact of ocean pollution.

The Ocean Conservancy report offers some commonsense observations and offers various strategies to address the problem based upon the status of each country's waste management capacity. The report defines the problem as "waste leakage," and points out that nations with inadequate waste collection systems tend to "leak" more waste into the ocean.[73] Nations with good collection systems tend to contribute less to ocean pollution. Accordingly, the type of strategies deployed must be country-specific. Nations with poor waste collection and management systems need to focus on building that infrastructure, while those with good infrastructure need to focus on areas where they might still experience some leakage.

Addressing ocean pollution requires a major focus on the largest sources of the waste: countries without enough waste disposal infrastructure. According to the Ocean Conservancy report, 80 percent of the litter in the ocean comes from land-based sources, while 20 percent comes from fishing vessels. Half of the land-based sources are from five nations: China, Indonesia, the Philippines, Thailand, and Vietnam. On the positive side, the report notes:

> These countries have all succeeded at achieving significant growth in recent years, and they are at a stage of economic growth in which consumer demand for safe and disposable products is growing much more rapidly than local waste-management infrastructure. This creates a dual problem: the scale of collection and the retention of waste within the system itself. Our field research and interviews with public officials have also shown that these countries acknowledge the problem and are actively looking for collaborative solutions.[74]

Hopefully, the Ocean Conservancy is right that there is a growing desire within some Asian countries to begin developing sound waste management systems, which would help reduce leakage substantially. Until they do, they will need ways to better police and clean up the waste as it exits their rivers and empties into oceans.

How Can We Mitigate the Impacts of Poor Disposal Practices? In addition to advancing economic development, penalizing polluters, and encouraging the development of waste management systems, the impact of bad actors can be mitigated through cleanup efforts. The Ocean Cleanup has already begun by developing and deploying impressive cleanup technologies, which they maintain could remove more than 90 percent of the waste from the Pacific patch within five years.[75] Their technology includes equipment that collects the waste and removes it from the patches, as well as a device called the interceptor that collects waste as it flows out of rivers into the oceans.[76] Assuming the organization can achieve its goal with minimal impact on wildlife, its technology and efforts are impressive.

What Can Be Done in Developed Countries like the United States to Reduce Ocean Pollution? For places that already have sound waste management practices, "post-collection leakage should be reduced to about 1 percent," according to the Ocean Conservancy report. The United States may already have met the less than 1 percent leakage goal according to one estimate, but we certainly can focus on trying to reduce our contribution even further.[77] As noted, the U.S. waste management market should move toward privatization and market pricing to replace needlessly expensive government programs that have helped create many disposal problems.

In addition, ongoing and new cleanup efforts on land can help tremendously. Much can be accomplished by continuing to build on cleanup programs already in place that have proven successful—and which do not require federal bans and regulations on plastics. In the United States, private and nonprofit anti-litter campaigns on land have produced measurable reductions in litter that should serve as an example for what such groups could achieve for ocean cleanup.

Dating back to 1953, the nonprofit group Keep America Beautiful (KAB) successfully tackled litter problems through education and mobilization of the public, businesses, and local governments. Among its efforts were the powerful public service announcements during the 1970s that help raise awareness by featuring a weeping Native American. In fact, KAB reports that U.S. litter has declined by 61 percent between 1969 and 2009, and U.S. roadway litter was down 54 percent since 2009. In addition, De Armitt points out that improper disposal of fishing gear appears to be declining in frequency. "A very detailed study over 60 years showed that the entanglement of animals in plastic nets did increase from the 1950s onward and peaked in the 2000s, but has since begun to decrease," he notes.[78]

Keep America Beautiful continues to play a major role in combating litter. It conducts research to determine where problems exist and develops focused solutions to address them. Working with about 700 affiliates across the nation, KAB also organizes cleanup efforts and

conducts public outreach and education to help prevent future litter. The group recently published a comprehensive report on the scope of the litter problem along with plans on how to address it.[79] Key findings include:

- There are an estimated 50 billion pieces of litter along U.S. roadways and waterways, which is about 152 pieces of litter per U.S. resident.
- An estimated 207 million pieces of COVID-related personal protective equipment (PPE), such as gloves and masks, are ending up in the environment, but KAB points out it is a "relatively" small part of total litter; PPE litter is nearly equal to plastic straws at just 0.4 percent.
- Plastic products composed 38.6 percent of litter.
- 90 percent of the litter consists of pieces that are four inches or smaller.

Roadway litter may be a large source of litter that eventually reaches land along waterways, because 70 percent of waterways are located within a quarter mile of roads. Hence, cleaning roadway litter can likely reduce the amount of trash that eventually ends up along shorelines and eventually enters waterways.

However, KAB's report raises the concern that litter that does reach shorelines is often not subject to cleanup efforts. "There is no shoreline equivalent of street sweeping that cleans the shores of waterways on a large scale or on a consistent basis," the report explains. Along with The Ocean Cleanup's contention that waste can remain on shorelines a long time before being pulled out to the gyres, this observation strongly suggests that developing programs for regular shoreline waste cleanup is a key part of the solution. Accordingly, in the U.S. and around the world, nonprofit organizations could engage in more intensive efforts to clean up shorelines, providing measurable reduction in wastes that could possibly become ocean pollution, while reducing the impact to wildlife who live along shorelines.

What Else Can We Do? Ironically, with this final question, we strike at the heart of the problem: No one really owns the oceans. Oceans and many waterways that feed them represent a vast number of "commons"—largely unowned, or government-owned resources. As Garrett Hardin explained in his famous essay, "The Tragedy of the Commons," resources that are unowned tend to get abused because there is no steward/owner to protect them.[80] Therefore, one way to improve management is to assign ownership, which can apply to areas of the ocean, the surface, fishing rights, and even the land below the ocean. Ownership would create stewardship by empowering owners—be they individuals, companies, or nonprofits—to police the oceans and hold polluters accountable. For example, privatizing the so-called garbage patch areas might give owners greater power to combat wastes that flow into these areas, enabling them to seek legal remedies to stop polluters—whether individual shipping companies or governments—and gain compensation for damages. For example, groups like the The Ocean Cleanup may well be interested in gaining such property rights to help leverage the great cleanup efforts in which they are already engaging.

The Competitive Enterprise Institute has also long advocated for ways to privatize fisheries and other water resources to ensure their long-term viability, and there are existing

real-world cases.[81] For example, an informal set of property rights developed by Maine lobstermen has helped ensure the long-term sustainability of that industry.[82]

Economist Walter E. Block and engineer Peter Lothian Nelson have laid much of the groundwork for this idea in their 2015 book, *Water Capitalism: The Case for Privatizing Oceans, Rivers, Lakes, and Aquifers*.[83] They describe processes by which people can gain property rights through homesteading, just as has been accomplished on land. And mapping and monitoring private ocean resources is now a practical possibility, given the development of many technologies—such as drones, satellites, and GPS—that have enabled the mapping of nearly every inch of planet Earth. Block and Nelson mention specific technologies that could help, such as Loran (short for long-range navigation), a radio- based navigation system developed during World War II to track military ships and aircraft.[84]

Such efforts require global cooperation and certainly would be politically and technically challenging, but that does not mean they are less achievable than other policies, and the benefits could be substantial. How exactly one might achieve such privatization is beyond the scope of this paper, but it would be worthwhile for policy makers to explore the possibilities.

Conclusion. Commonly proposed solutions to plastic litter in the ocean—such as bans and regulations on single-use plastics—will not solve ocean pollution problems. Indeed, removing largely negligible sources of the problem, such as plastic straws, will yield negligible benefits and divert our attention away from legitimate, workable solutions. Solutions must be based on accurate information about the scope and nature of the problem. The best data available demonstrate that the key sources of ocean pollution are poor disposal practices in developing or socialist nations overseas, and the solution involves development of disposal infrastructure in those nations. In addition, waste management systems can be improved even in countries that have reasonably good disposal practices through increased privatization and market competition. To resolve existing ocean pollution, cleanup efforts conducted by nonprofits could be enhanced with policies to privatize ocean resources.

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