

# How Plastic Pollution Endangers Ocean Ecosystems

Massive quantities of plastic, produced largely for single-use products, are impacting critical ocean ecosystems. Despite growing concern about plastic, the world continues to produce and dispose of an ever-increasing quantity of plastic with little attention to the impact that the waste has on the environment. Plastic in the oceans has wide-ranging, deleterious environmental impacts that, especially when combined with climate change, pose a serious threat to the world. Once the plastic enters the environment, it is unlikely to leave, lasting hundreds of years. The evidence is clear: we must take action to stem the glut of plastic.

## Plastic waste is a rapidly accelerating problem

Plastic production is booming. According to one industry group, 390 million metric tons of plastic were produced in 2021, more than 90 percent of which was produced from fossil fuels.<sup>1</sup> The global plastic products market is projected to grow 45 percent from 2022 to 2026, becoming a \$1.4 trillion industry.<sup>2</sup> The United Nations anticipates that annual plastic production will double from 2020 to 2035 and quadruple by 2050, reaching 1,600 million metric tons.<sup>3</sup> Around 44 percent of this plastic is used for packaging,<sup>4</sup> which creates materials that are immediately thrown away.<sup>5</sup>

The management of this plastic waste is woefully inadequate. For example, the United States recycles only



<sup>a</sup> Microplastics are plastic particles that are smaller than 5 millimeters across. Microplastics either are present in commercial products or form from the natural fragmentation and use of larger plastics.

6 percent of its plastic<sup>6</sup> and illegally dumps between 0.14 and 0.41 million metric tons of plastic waste.<sup>7</sup> While 40 percent of all plastic waste is unaccounted for, large volumes of plastic waste enter the ocean where it remains for decades.<sup>8</sup> We know that at least 9.2 million metric tons of plastic, including 3.0 million metric tons of microplastics<sup>9</sup>, enter the environment every year.<sup>9</sup> Rivers bring as much as 2.7 million metric tons of plastic to the ocean every year.<sup>10</sup>

## Plastic is long lasting and dangerous

Plastic lasts for hundreds to thousands of years, and the toxic remains of plastic pose serious challenges.<sup>11</sup> Discarded plastic fills up increasingly limited and expensive landfill space.<sup>12</sup> As water percolates through these landfills, it picks up toxins, generating super-polluted runoff that is harmful to human health and the environment.<sup>13</sup> Recycling processing facilities may also release dangerous plastic chemical additives into the environment.<sup>14</sup> As plastic breaks into smaller pieces, it releases the potent greenhouse gases ethylene and methane.<sup>15</sup>

Plastic products are inherently toxic and can become a vehicle for other pollutants.<sup>16</sup> Many plastics contain hazardous chemicals and thousands of different additives, which may leach out as the plastic ages.<sup>17</sup> These risky additives can make up half of plastic by weight.<sup>18</sup> Some are extremely noxious, many have been linked to chemical toxicity, and some are classified as endocrine disruptors, which can alter hormone function.<sup>19</sup> These additives can seep from plastics into food and the environment, accumulating over time.<sup>20</sup>

Plastic waste is also a vector for the accumulation of heavy metals, pathogens, and chemicals.<sup>21</sup> Microplastic particles act as vectors for disease and other environmental pollutants that adhere to and accumulate in plastic.<sup>22</sup> This creates additional pathways for exposure to viruses and chemicals when small plastic particles are consumed or inhaled by humans or other animals. Inhaling and eating microplastics can cause health problems ranging from inflammation to cancer.<sup>23</sup>

Microplastics are ubiquitous, finding their way into our oceans but also the food we eat and the air we breathe.<sup>24</sup> Even indoor air can have high concentrations of microplastics from household products and synthetic textiles, which accumulate in people's lungs after being inhaled.<sup>25</sup> Plastic particles have been found in tap water, beer, and sea salt, and one study even found them in 93 percent of bottled

water.<sup>26</sup> In Europe, shellfish consumers eat as many as 11,000 microplastic particles every year.<sup>27</sup>

Microplastics cause liver toxicity in fish, accumulate toxic chemicals in the fat tissue of sea birds, and impair cell function in mussels; exposure to microplastics also kills sea urchin embryos.<sup>28</sup> As larger animals eat smaller ones, these toxins move up the food chain and bioaccumulate in larger marine life, posing serious systemic risks.<sup>29</sup>

## Massive amounts of plastic trash inundate our oceans

In the central Pacific Ocean, four major ocean currents have brought this waste into a slow-moving “plastic soup.”<sup>30</sup> Dubbed the Great Pacific Garbage Patch, the world's largest dump is four times the size of California.<sup>31</sup> Many discarded plastics join this rapidly growing, floating mass of trash, which is just one of five gigantic plastic trash heaps polluting the ocean.<sup>32</sup>



In addition to large plastic waste, the oceans contain trillions of microplastic particles.<sup>33</sup> Studies have found microplastics in open oceans, freshwater sources, lake sediments, riverbeds, and the deepest ocean trenches.<sup>34</sup> While large plastic waste has the most visible impacts, ingesting small microplastics is extremely harmful to aquatic life and seabirds.<sup>35</sup>

## Plastics are a growing problem for important aquatic ecosystems

Plastic contamination is a significant threat to marine biodiversity, impacting more than 600 marine species.<sup>36</sup> Small size means that microplastics can be transported over tens of kilometers, expanding their impact into near-pristine or otherwise remote environments.<sup>37</sup> Frequently plastic debris floats at the ocean's surface, mixing with food sources, where it entangles, chokes, or is consumed by wildlife.<sup>38</sup> Entanglement from plastic waste is a huge problem for numerous species.<sup>39</sup>

Large chunks of plastic have accumulated in whales' stomachs, causing them to starve to death.<sup>40</sup> Sea turtles, including critically endangered leatherbacks, accidentally consume plastic bags, mistaking them for jellyfish.<sup>41</sup> Scientists have also found plastic pellets in endangered puffins' stomachs.<sup>42</sup> Potentially toxic plastic additives such as nonylphenol and bisphenol can leach from plastic and be taken up by marine organisms.<sup>43</sup>

Floating plastic also provides a vector for the spread of invasive species.<sup>44</sup> These invasive species are often a shock to ecosystems, impacting biodiversity and causing economic damage.<sup>45</sup> This additional disruption has the potential to magnify the already substantial damage done to natural environments by plastic.



## Climate change magnifies the impact of plastic pollution on the oceans

Climate change will make managing plastic waste significantly more difficult. More-frequent and extreme weather events will spread plastic pollution through flooding, potentially causing trash to escape landfills.<sup>46</sup> Additionally, strong winds and sea-level rise can bring plastic into the oceans.<sup>47</sup> Alongside weather, rising temperatures will bring more plastic into the oceans. Arctic ice is a major sink of microplastic, containing 38 to 234 particles per cubic meter. As this ice melts, microplastic particles will reenter the ocean.<sup>48</sup>

In addition to increasing the prevalence of plastic in the ocean, marine wildlife is impacted by the combined impacts of plastic and global warming. For example, rising temperatures and sea levels impact sea turtle reproduction by heavily skewing gender balances. At the same time, plastic waste strangles turtles and kills ones that eat it.<sup>49</sup> Likewise, rising temperatures increase the frequency of coral bleaching and mass mortality, while plastic waste has been shown to spread disease and directly damage coral.<sup>50</sup> These combined effects stress already fragile ecosystems.

## Plastic pollution may damage irreplaceable parts of the global carbon cycle

Plastic pollution can have discrete, overlapping, and unpredictable consequences, contributing to potentially catastrophic impacts on ocean ecosystems.<sup>51</sup> For example, plastic reduces the reflectiveness of ice, accelerating ice melt and warming.<sup>52</sup> The ocean plays a critical role in performing half of the planet's photosynthesis and absorbing massive amounts of carbon, but plastic pollution threatens parts of the ocean that sequester carbon.<sup>53</sup> Large quantities of plastic can block light and hinder photosynthesis by algae.<sup>54</sup> While photosynthesis at the ocean's surface pulls carbon from the atmosphere, large amounts of the carbon will re-enter the atmosphere unless it is sequestered deeper in the ocean.<sup>55</sup>

Many animals make up the "biological pump" that removes more than 10 billion tons of carbon from the surface ocean annually.<sup>56</sup> Critical to this process are 22 trillion pounds of plankton-eating fish that feed at the surface during the day and bring the carbon to the ocean depths at night.<sup>57</sup> Such fish account for more than 40 percent of the carbon sequestration in some parts of the ocean.<sup>58</sup> Unfortunately,

these fish are now consuming large amounts of plastic, potentially disrupting the natural sequestration process.<sup>59</sup> Microplastics also interfere with zooplankton, preventing carbon-rich debris from sinking.<sup>60</sup>

## Conclusion

While the plastic industry has emphasized the ability of end-of-life strategies to mitigate the environmental impact of plastic, decades of these efforts have failed to even

slow the amount of plastic that enters the ocean. Real efforts to address the issue must confront the unsustainable increase in the supply of plastic, which is aided in large part by a glut of inputs from hydraulic fracturing (fracking). Taking action to stop the production of plastic by stopping plastic manufacturing facilities, banning fracking, and ending the use of single-use plastic is critical to save the oceans.

## Endnotes

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