The Effects of Paint Microplastics on Aquatic Ecosystems and Humans

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Abstract

Paint is a common, yet overlooked, source of microplastics in the ocean. As a result of weak regulations and lack of awareness on the subject, toxic chemicals are seeping into oceans, disrupting aquatic ecosystems. They do so by altering the fishes' neurological systems to inhibit acetylcholine breakdown and disrupting the food pyramid in a given system. Consequently, through means such as eating fish, humans can become contaminated too, whether by the microplastics themselves, or from toxic metals as a result of being soaked up by the microplastics.

Introduction

Small fragments of plastic, also known as microplastics, were first found in the ocean in the 1970s. Since then, the issue has become increasingly more alarming, with microplastics being discovered in unexpected places: Antarctic snow, peaks of mountains, and potentially the most unnerving, human blood. While most research on the effects of these microscopic pieces of plastic is somewhat recent, the studies that have already been completed have already shown some of the adverse consequences. For example, DNA damage, organ dysfunction, and reproductive/developmental toxicity have already been identified as a result of microplastics (Li et al., 2023). However, humans aren't the only ones who are vulnerable to these effects. Aquatic systems are arguably the most susceptible, as it's estimated that the ocean contains 10,000x more microplastics when compared to land (Imbler, 2022). It is necessary to identify leading causes of the pollution and take precautions to prevent any future contamination.

These microplastic particles in the ocean come from a variety of sources, but one stands out the most: paint. According to Swiss-based Environmental Action, paint accounts for approximately 58% of all microplastics in the ocean (approximately 1.9 million tons). This number is substantial, especially when the previous estimate was between 9%-12% (Hailstone, 2022). Paint is slipping into bodies of water right below our nose, but it's often an overlooked source. As the ocean interacts with paint, parts chip off and microplastics slowly seep into the water. One example of this is the George Washington Bridge. Although it is fully repainted every 10 years, there is constant maintenance in order to keep its iconic white color (Miller, 2022). As a result, there is a constant supply of paint that is exuding into the ocean.

Besides bridges, oil rigs and general boat use have a substantial contribution towards the pollution of the ocean by paint particles. Plastic polymers from their rigs end up in the ocean and have dire environmental consequences. According to Pinovo (an ocean based company), 18% of the pollution is due to normal wear and tear and 37% of the pollution is due to waste mismanagement. Every year, these rigs cause 1,100 kg of pollution from paint, which would account for 100,000 plastic bottles (Hailstone, 2022). According to the United States Environmental Protection Agency, the use of boats also chip into this negative effect. Solvent, oil, and most importantly paint seep into the groundwater, thus contaminating the surface water (NSCEP, 2001). While these three issues don't carry all of the weight, they still have a considerable impact while still having the possibility of being solved.

In typical microplastic studies, researchers often neglect the sources of microplastics in their sample. Additionally, when the sources are studied, paint is commonly overlooked. However, different sources have proved that not all microplastics have the same effects on organisms. In fact, paint microplastics have been shown to be more harmful to organisms, specifically fish, compared to other forms of microplastics. Also, through the ingestion of fish (and many other kinds of food), humans are exposed to microplastics daily, reaching a point where it becomes nearly impossible to avoid them. Microplastics are an infamous contaminant in a variety of organisms and, as mentioned above, produce adverse effects that not only affect the organism itself, but also its entire environment. For example, when certain organisms polluted with microplastics are ingested, specifically humans and fish, the microplastics are transferred between species. However, this same effect can occur with different substances. Additionally, microplastics have a unique ability to absorb contaminants, worsening the idea that pollutants can spread across species.

How Microplastics are Ingested in Fish and Their Prominence

Paint chips of all different colors and sizes affect the ocean, but some characteristics show up more often than others. For example, in his 2021 study Turner analyzes fish intestines, looking for paint chips and classifying them by color, quantity, and sources when applicable. Paint chips that blended in with their environment (especially blue chips) were the most commonly ingested. The microplastics that fish were least likely to suspect were ingested more often than obvious microplastics. Fish can't tell the difference between plastic and food, so they eat whatever they think looks like food. For example, a paint chip could look like zooplankton, leading to the fish eating it and getting poisoned. This isn't an uncommon occurrence either. In fact in the same study, microplastics through paint were found in around 35% of fish. While paint microplastics may be overlooked in studies, they are still very prevalent, and their effects on wildlife cannot be ignored.

The Negative Health Effects of Microplastics

The ingestion of contaminated fish with microplastics by humans has led to some of the same toxic chemicals poisoning people. These plastics primarily target the liver, leading to conditions such as nonalcoholic fatty liver disease (NAFLD). Bisphenol A (also known as BPA) is a plasticizer which is commonly used in plastics and paints, but it is also found in human samples. BPAs not only led to newfound liver issues, but also worsened existing conditions, such as diabetes mellitus (Cheng et al., 2023). While they may be tiny and seem like they would have no real impact on a living organism, the chemicals used to produce the microplastics are what cause a majority of the harm. Ignoring the real implications of paint microplastics can lead to permanent health effects as well as other defects in future generations.

While the microplastics themselves seep chemicals from the manufacturing process into the bodies of those who ingest them, they can also absorb other toxic chemicals through other means, poisoning organisms. For example, in a study by Barboza et al. (2023), paint microplastics were found to increase levels of absorbed mercury in fishes' brains. If these fish were eaten by natural predators, the mercury would spread throughout the ecosystem, causing harm and potentially derailing entire habitats. Additionally, when some of these fish are ultimately eaten by humans, the mercury spreads to people, causing permanent damage to the body. While the issue of absorption may not be an exclusive result of a single kind of microplastic, paint microplastics are one of, if not the most prominent source

Conclusion

While paint is a commonly overlooked source of microplastics in the ocean, the negative implications for aquatic ecosystems and human lives are dire. Through their ability to seep toxic chemicals into their victims, to camouflage within their environment and as food, or to absorb other, just as harmful chemicals, into organisms. Microplastic contamination is a problem in itself, yet one of the most common sources of it is largely ignored. In order to protect ecosystems and human lives, solutions such as different, more sustainable forms of paint need to be engineered, and better regulations have to be put into place. Without proper intervention, these toxic microplastics have the ability to destroy entire ecosystems and take humans’ lives.

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