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The Impact of Tire and Road Wear Particles (TRWP) on Marine Animals

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Abstract

Tire and road wear particles (TRWPs) have been widely documented in scientific research as a hidden but significant contributor to microplastic pollution. However, outside academic circles, the term itself rarely sparks recognition. This project set out to explore the disconnect between existing research and public knowledge by reviewing literature on TRWP's chemical complexity and ecological risks and interviewing ordinary people about their understanding of TRWP's environmental impact. A small survey of 25 participants became the lens through which this gap was revealed. The responses told a familiar story: bottles, bags, and straws were named almost instantly as marine pollutants, while TRWPs drew blank stares. Fewer than one in five respondents had even heard of it, and even those with some environmental background seldom flagged it as a concern. Such results suggest that technical fixes like stormwater treatment or emission standards will matter little unless public awareness catches up. Education, community engagement, and clearer communication are not afterthoughts—they are part of the solution.

Keywords

Tire wear particles; TRWP; Marine pollution; Microplastics; Public awareness

1. Introduction

When we think about ocean pollution, floating plastic bottles or abandoned fishing nets might be the first images that come to mind. However, a less visible yet equally harmful pollutant comes from a surprising source—our vehicles. Tire and road wear particles (TRWPs) are small fragments made of synthetic rubber, heavy metals, and chemical additives that are released onto roads as tires degrade over time.

These microscopic particles are then washed into storm drains during rainfall and end up in rivers and oceans. Once in marine environments, they don't break down easily and can accumulate in sediments or enter the food chain [1]. TRWP contamination is one of the least discussed forms of microplastic pollution despite its significant presence in coastal zones.

This research aims to bridge the gap between scientific understanding and public awareness of TRWPs. Specifically, the objectives include reviewing current literature on TRWP toxicity and marine transport, and assessing the level of public awareness through surveys. The central research question is: How informed are people about TRWPs and their potential effects on marine life?

2. Methods

2.1 Design and Sample

This study employs a mixed-methods research approach, combining literature analysis with empirical investigation. The first phase involved a comprehensive review of recent studies on TRWP emissions, their toxic effects on marine

animals, and the differences between TRWPs and traditional microplastics.

Following the theoretical review, the second phase involved a structured survey conducted over four weeks in July 2025. A total of 25 individuals were surveyed, including high school and college students, family members, and beach visitors. The cognitive assessment questionnaire consisted of three open-ended questions:

1. Have you heard about tire dust before?
2. Do you think it can harm sea animals?
3. What do you think can be done to reduce it?

Responses were typed and recorded digitally. The goal was to assess general awareness of TRWPs and identify common perceptions or misunderstandings. The final phase of the study synthesized these survey results to develop educational recommendations aimed at increasing public, governmental, and corporate awareness about TRWP pollution in marine environments.

3. Results

The results of the survey revealed that nearly nine out of ten respondents could immediately recognize familiar sources of plastic pollution—items like bottles, bags, or straws. Yet when the focus shifted to tire and road wear particles (TRWPs), awareness dropped dramatically. Fewer than 20% had ever heard of them, and even fewer could describe their environmental impacts [2, 3].

This gap in awareness was not limited to the general public. Even participants with some background in environmental studies tended to cite plastic microbeads or packaging waste as the most concerning pollutants, while TRWPs rarely surfaced in their answers. It was as if tire dust existed outside the public imagination—an invisible hazard that consistently slips through public attention [4].

Table 1 summarizes the survey findings, depicting how recognition of common pollutants far exceeded awareness of TRWPs. While plastics dominated responses, TRWPs accounted for only a small fraction of answers. Figure 1 further illustrates this sharp disparity: awareness of visible waste towers over recognition of invisible particles like TRWPs.

Table 1. Awareness of common pollutants vs. TRWPs among survey participants

Pollutant Type	Recognized (n=25)	Not Recognized (n=25)
Plastic bottles/bags	22 (88%)	3 (12%)
TRWPs	5 (20%)	20 (80%)

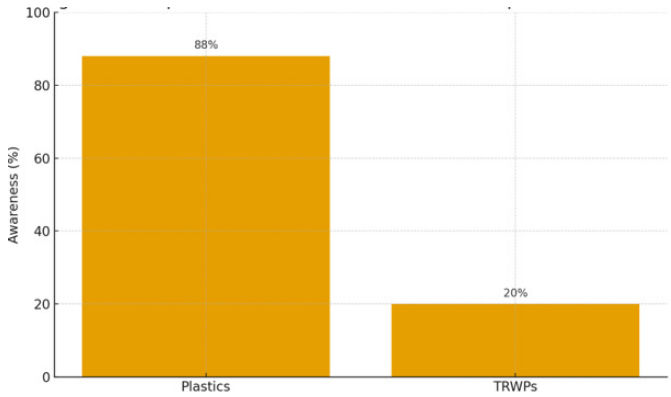

Figure 1. Comparison of awareness levels for visible plastic and TRWPs.

Looking at these numbers, it becomes clear how easily attention gravitates toward the waste we can see—items that wash up on beaches or pile up in landfills—while the hidden pollution woven into everyday activities, such as driving, remains overlooked. TRWPs fall squarely into this blind spot: difficult to detect, but steadily accumulating in marine environments.

4. Discussion

These results made me wonder: why is TRWP awareness so low? Part of the answer lies in visibility, since, unlike

plastic bags floating in rivers, tire dust doesn't confront us directly. With additional barriers to noticeability, such as the scientific difficulty of tracking these particles [1] and the limited media coverage, it's not surprising that most people overlook them. The trouble is, what we don't see can still harm us. Tire particles are everywhere—in road dust, in stormwater runoff, and eventually in the ocean.

If we take the survey as a warning sign, then the next step is thinking about responses. In the short term, cities could strengthen stormwater systems to filter microplastics before they reach waterways [7]. On a mid-range horizon, tire emissions might need to be regulated similarly to how car exhaust was, pushing companies to design cleaner tires. In the long run, even large-scale urban planning could play a role by reducing runoff in the first place.

Yet technology and policy alone won't be enough: public understanding has to catch up. Without widespread awareness, support for stronger measures and corporate efforts will remain shallow. As such, schools could easily add lessons about "invisible plastics" to their curricula, informing children from a young age of a lesser-known pollutant found in their daily lives; community workshops and beach cleanups could connect daily driving habits with marine pollution in a more tangible way [6]; and on a personal level, local agencies could encourage cutting back on car use or supporting the passing of environmental policies. These ideas don't form a single neat roadmap, but inherent to a pollutant such as TRWP, whose effects can't be mitigated within laboratories or the pages of research papers, an interdisciplinary approach will be needed. It is entangled with how we move, how we build cities, and how we think about responsibility. Ironically, the very fact that tire particles are hard to notice makes them more dangerous, and that invisibility is exactly why they need to be talked about again and again.

5. Conclusion

This research has reshaped my understanding of pollution. TRWPs are not dramatic pollutants—they don't float visibly or strangle marine life—but they accumulate quietly, embedding in ecosystems and threatening biodiversity in subtle ways. This invisibility makes them all the more dangerous.

Future studies should investigate the TRWP emissions of electric vehicles, which are often heavier than gas-powered cars and may cause more tire wear. Additional research is also needed on how TRWP accumulation in marine animals may eventually affect human health through seafood consumption.

Solving the TRWP problem requires a multi-pronged approach: improved road and vehicle design, smarter urban drainage systems, and greater public awareness. Education is especially vital—when people know better, they often do better. I hope this paper helps illuminate this hidden issue and sparks continued inquiry. TRWPs are not dramatic pollutants—they don't strangle sea turtles or wash up visibly on beaches. But their invisibility makes them even more dangerous. Addressing TRWPs requires treating them with the same urgency as single-use plastics.

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