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Marine ecosystems perceived as highly impacted by microplastic pollution: insights from a public awareness survey

Barbara Urban-Malinga [1,*], Agnieszka Szkudlarek-Pawełczyk [2], Anetta Ameryk [1], Aneta Jakubowska [2]

Abstract
Microplastics, a persistent by-product of global plastic overuse and inadequate waste management, continue to accumulate across environmental compartments. As their large-scale removal remains technically unfeasible, fostering individual responsibility may be crucial to mitigating this pollution. This study assessed public knowledge and awareness regarding microplastic contamination among 407 respondents across various age groups (< 20, 20–40, 40–60, and > 60). The results indicate high awareness of microplastic transport into marine and freshwater systems, as well as its potential harmful effects on biota. However, recognition of atmospheric pollution and domestic sources remains limited. Notably, 91% of respondents acknowledged individual responsibility for reducing plastic waste. These findings underscore the need for targeted education and awareness-raising initiatives to foster behavioural change and safeguard the oceans.

Keywords
Plastic pollution; Public perception; Environmental education

[1] *National Marine Fisheries Research Institute, Kołłątaja 1, 81-332 Gdynia, Poland;*
[2] *National Marine Fisheries Research Institute, Research Station in Świnoujście, Plac Słowiański 11, 72-600, Świnoujście, Poland*
***Correspondence**: bmalinga@mir.gdynia.pl (B. Urban-Malinga)

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Microplastics (MPs), originating from the mass production and widespread use of plastics from both primary (i.e., intentionally produced) and secondary sources (i.e., from the breakdown of larger plastic fragments), have become a serious and persistent environmental pollutant. Their accumulation in the environment, driven by global overconsumption of plastics and inadequate waste management, continues to rise, while their removal remains technically unfeasible (e.g., Ziani et al., 2023). It is estimated that millions of tonnes of plastic waste enter the oceans each year (e.g., Lebreton et al., 2017). The conservation of marine environments ultimately depends on human choices, prompting increasing calls for sustainable management and policies that promote behavioural change (Henderson and Green, 2020). Effective public engagement, however, requires adequate education and awareness. This study aimed to assess the level of public knowledge and awareness of microplastic pollution, and to identify potential gaps that may hinder environmentally responsible behaviour.

Table 1. Characteristics of the respondents (n = 407).

Item	Response	No	%
Gender	Female	242	59.5
	Male	165	40.5
Age	< 20	137	33.7
	20–40	122	29.9
	40–60	96	23.6
	> 60	52	12.8

We applied a quantitative social survey method. The written questionnaire consisted of 13 questions, of which nine were single-choice statements rated on a three-point scale ('Agree', 'Disagree', 'No opinion'), and four were multiple-choice questions, allowing respondents to select more than one answer from a list of predefined options. Respondents also indicated their gender and age. A total of 407 individuals (242 females and 165 males) from two southern Baltic voivodeships (Pomeranian and West Pomeranian) participated in the survey conducted in 2020. To obtain insights into different age groups (< 20, 20–40, 40–60, > 60) (Table 1), the questionnaire was distributed among

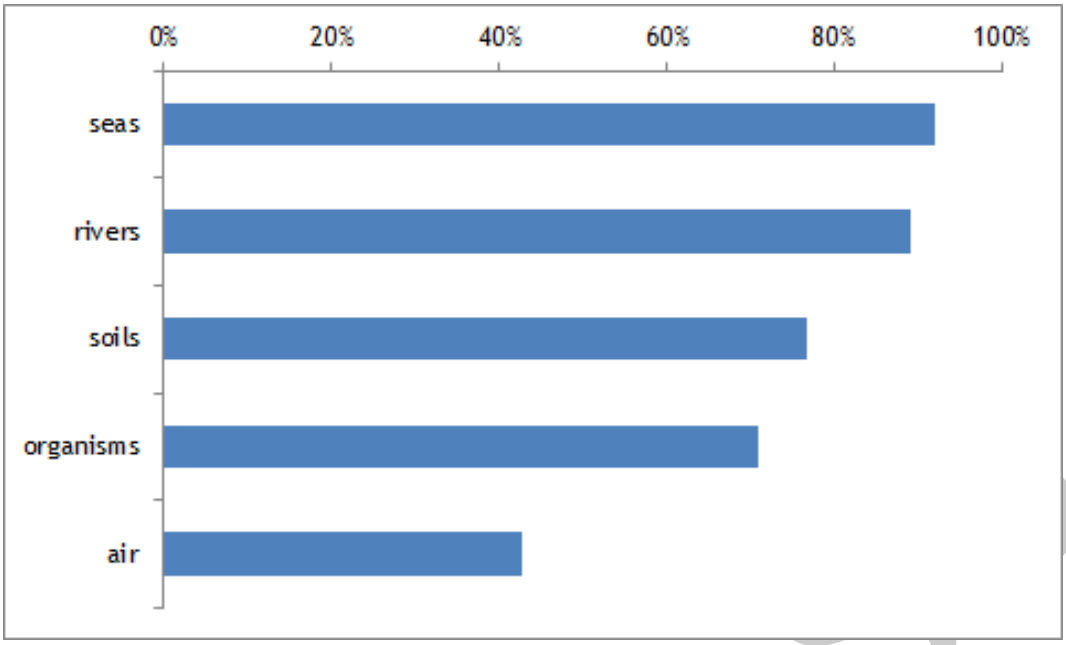

Figure 1. Responses to the question 'Where can microplastics be found?'

school pupils, students, working adults, and participants of a senior day-care centre. Participants were informed about the purpose of the survey, which was to explore their perceptions of MPs, including their sources and origins, environmental distribution, and potential consequences of their release into the environment.

Microplastics are ubiquitously distributed across all environmental compartments – marine, freshwater, terrestrial, and atmospheric (e.g., Jaszczyszyn et al., 2025), but the vast majority of respondents (92%) representing all age groups primarily associated MP pollution with marine ecosystems. This perception aligns with other findings (e.g., Deng et al., 2020; Felipe-Rodriguez et al., 2022; Khorsandi et al., 2025) and likely stems from the predominance of microplastic research conducted in marine environments, amplified by strong media narratives framing microplastics as primarily an 'ocean problem', while other environmental compartments have received less attention (Deng et al., 2020; Khorsandi et al., 2025). Nevertheless, as many as 89% of our respondents associated MPs with rivers and 79% with soils (Figure 1).

These results are consistent with other findings from Poland, where 91% and nearly 66% of respondents attributed MPs pollution to waters and soils, respectively (Oleksiuk et al., 2022). Although our participants demonstrated broad awareness of MPs in aquatic and terrestrial environments, their relatively limited recognition of the atmosphere as a relevant compartment for MPs pollution is noteworthy. Less than half of our respondents (43%) identified air as an environmental sphere where MPs can be found, compared to 60% in the industrialised Silesia region (Oleksiuk et al., 2022). This difference in public perception likely reflects local conditions – people in heavily industrialised areas such as Silesia may be generally more sensitive to air pollution than those living along the sea coast. An illustrative example comes from Shanghai, where, probably due to severe air pollution caused by respirable particulate matter, air was more often perceived as MP-polluted than rivers or soils (Deng et al., 2020).

A relatively high proportion of survey participants demonstrated a high level of awareness of the potential harmful effects of MPs on fauna. Awareness of MPs in the biota was substantial, with almost three-quarters of respondents (71%) recognising their presence in various organisms. The majority of participants indicated that MPs may be ingested when mistaken for food (91%), block digestive tracts (85%), impair respiration (74%), and cause other effects (71%). Although the current state of knowledge (e.g., de Ruijter et al., 2025) does not allow for unequivocal confirmation of MPs' toxic effects on fauna at naturally occurring concentrations, only four per cent of respondents perceived MPs as potentially having no harmful effect on fauna.

Most participants (83%) identified the degradation of larger plastic debris as the main source of MPs. This perception largely agrees with the opinions of the scientific community, which considers the breakdown of larger plastic fragments as the biggest source of plastic pollution (Andrady, 2017; Ajith et al., 2020). A smaller proportion of respondents (68%) was aware of intentional industrial production of MPs as raw materials for plastic manufacturing or as additives in cosmetics and personal care products. The majority of respondents (87%) agreed that MPs occur in households, from where they can be transported via

Figure 2. Distribution of responses and opinions across different age groups.

wastewater to rivers and ultimately to the sea. Among everyday items listed in the questionnaire, disposable tableware, plastic bags, and plastic straws were most frequently recognised as MP sources (87%, 85%, and 82% of respondents, respectively). In contrast, only about half of the participants were aware of MPs in household dust. Awareness of MPs in synthetic textiles was moderate: 57% acknowledged fleece garments as a potential source, while 67% were aware that fibres are released during washing.

Regarding cosmetic products, 73% of respondents recognised that MPs may be present in personal care items. Exfoliating scrubs (63%) and nail polishes (64%) were the most frequently identified products. However, despite providing 13 examples of cosmetic items, most participants identified only three to five, and 7% did not select any.

In conclusion, although the public demonstrated a relatively high level of awareness regarding microplastic pollution across various environmental compartments and

its potential ecological impacts, their knowledge about the sources and origins of MPs was less comprehensive and incomplete. Interestingly, the summary of all responses indicates the highest level of awareness among the oldest participants (40–60, > 60 years old). Younger respondents (< 20 and 20–40) more often gave the wrong answers or had no opinion on the given topic, suggesting that educational efforts should be focused primarily on these age groups (Figure 2).

Surprisingly, awareness of individual responsibility was remarkably high: on average, 92% of respondents agreed that each of us can help reduce the amount of MPs in the environment (only 11% of respondents < 20 years old disagreed, while 10% had no opinion). These findings are encouraging; however, for the public to contribute effectively to reducing microplastic pollution, targeted education, thoughtful awareness-raising initiatives, and the development of environmental literacy are essential.

Although individual responsibility for microplastic pollution is limited, as individuals have little influence on plastic waste management or on the atmospheric transport of microplastics, they can nevertheless take action to reduce plastic use in their everyday lives. Therefore, interventions aimed at enhancing public awareness of plastic pollution are crucial and should be implemented thoughtfully and consistently to protect the environment and safeguard the oceans.

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Conflict of interest

None declared.

References

Ajith, N., Arumugam, S., Parthasarathy, S., Manupoori, S., Janakiraman, S., 2020. *Global distribution of microplastics and its impact on the marine environment – a review*. Environ. Sci. Pollut. Res. 27, 25970–25986.

Andrady, A. L., 2017. *The plastic in microplastics: a review*. Marine Pollut. Bull. 119, 12–22

Deng, L., Cai, L., Sun, F., Li, G., Che, Y., 2020. *Public attitudes towards microplastics: Perceptions, behaviours and policy implications*. Res. Conserv. Recyc. 163, 105096. https://doi.org/10.1016/j.resconrec.2020.105096

de Ruijter, V.N., Redondo-Hasselerharm, P. E., Koelmans, A. A., 2025. *A brief history of microplastics effect testing: Guidance and prospect*. Environ. Pollut. 368, 125711.

Felipe-Rodriguez, M., Böhm, G., Doran, R., 2022. *What does the public think about microplastics? Insights from an empirical analysis of mental models elicited through free associations*. Front. Psychol. 13, 920454. https://doi:10.3389/fpsyg.2022.920454

Henderson, L., Green, C., 2020. *Making sense of microplastics? Public understandings of plastic pollution*. Marine Pollut. Bull. 152, 110908. https://doi:10.1016/j.marpolbul.2020.110908

Jaszczyszyn, K., Kiedrzyńska, E., Matuszewska, D., Xue, J., Kiedrzyński, M., 2025. *Micro(nano)plastics in the total environment – A holistic review*. Sci. Total Environ. 988, 179806

Khorsandi, J., Blank, L., Momchilov, K., Dagovetz, M., Batra, K., 2025. *From Ocean to Table: How Public Awareness Shapes the Fight Against Microplastic Pollution*. Urban Sci. 9, 418. https://doi.org/10.3390/urbansci9100418

Lebreton, L. C. M., van der Zwet, J., Damsteeg, J. W., Slat, B., Andrady, A., Reisser, J., 2017. *River plastic emissions to the world's oceans*. Nature Communicat. 8, 15611. https://doi:10.1038/ncomms15611

Oleksiuk, K., Krupa-Kotara, K., Wypych-Ślusarska, A., Głogowska-Ligus, J., Spychała, A., Słowiński, J., 2022. Microplastics in Food and Water: Current Knowledge and Awareness of Consumers. Nutrients 14, 4857. https://doi.org/10.3390/nu14224857