CORA Cork Open Research Archive
Cartlann Taighde Oscailte Chorcaí

Title	Marine microplastic pollution and misinformation in the public sphere: a systematic review
Authors	Agnew, Sonya;Kopke, Kathrin;Power, Orla Peach;Dozier, Amy;Fitzgerald, Eimear
Publication date	2024-11-04
Original Citation	Agnew, S, Kopke, K, Power, O P, Dozier, A & Fitzgerald, E 2024, 'Marine microplastic pollution and misinformation in the public sphere: a systematic review', Discover Oceans, vol. 1, 30, pp. 1-16. https://doi.org/10.1007/s44289-024-00033-6
Type of publication	Review
Link to publisher's version	https://www.scopus.com/pages/publications/105039491951 - 10.1007/s44289-024-00033-6
Rights	© 2024, authors. This article is licensed under a Creative Commons Attribution-NonCommercial-NoDerivatives 4.0 International License, which permits any non-commercial use, sharing, distribution and reproduction in any medium or format, as long as you give appropriate credit to the original author(s) and the source, provide a link to the Creative Commons licence, and indicate if you modified the licensed material. - https://creativecommons.org/licenses/by-nc-nd/4.0/
Download date	2026-11-07 10:52:42
Item downloaded from	https://hdl.handle.net/10468/19373

UCC
University College Cork, Ireland
Coláiste na hOllscoile Corcaigh

CORA Cork Open Research Archive
Cartlann Taighde Oscailte Chorcaí

Title	Marine microplastic pollution & misinformation in the public sphere: a systematic review
Authors	Agnew, Sonya;Kopke, Kathrin;Power, Orla Peach;Dozier, Amy;Fitzgerald, Eimear
Publication date	2024-11-04
Original Citation	Agnew, S, Kopke, K, Power, O P, Dozier, A & Fitzgerald, E 2024, 'Marine microplastic pollution & misinformation in the public sphere: a systematic review', Discover Oceans, vol. 1, no. 1, 30, pp. 1-16. https://doi.org/10.1007/s44289-024-00033-6
Type of publication	Review
Link to publisher's version	https://www.scopus.com/pages/publications/105039491951 - 10.1007/s44289-024-00033-6
Rights	© 2024, authors. This article is licensed under a Creative Commons Attribution-NonCommercial-NoDerivatives 4.0 International License, which permits any non-commercial use, sharing, distribution and reproduction in any medium or format, as long as you give appropriate credit to the original author(s) and the source, provide a link to the Creative Commons licence, and indicate if you modified the licensed material. You do not have permission under this licence to share adapted material derived from this article or parts of it. The images or other third party material in this article are included in the article's Creative Commons licence, unless indicated otherwise in a credit line to the material. If material is not included in the article's Creative Commons licence and your intended use is not permitted by statutory regulation or exceeds the permitted use, you will need to obtain permission directly from the copyright holder. To view a copy of this licence, visit http://creativecommons.org/licenses/by-nc-nd/4.0/. - https://creativecommons.org/licenses/by-nc-nd/4.0/
Download date	2026-09-24 09:46:29
Item downloaded from	https://hdl.handle.net/10468/19310

University College Cork, Ireland
Coláiste na hOllscoile Corcaigh

Discover Oceans

Review

Marine microplastic pollution & misinformation in the public sphere: a systematic review

Sonya Agnew[1] · Kathrin Kopke[1] · Orla-Peach Power[1] · Amy Dozier[1] · Eimear Fitzgerald[1]

Received: 31 July 2024 / Accepted: 22 October 2024
Published online: 04 November 2024
© The Author(s) 2024 OPEN

Abstract
Marine microplastic pollution is a persistent global issue that has gained scientific attention for over two decades. Nevertheless, knowledge gaps remain, particularly in how inconsistencies in communicating scientific evidence can lead to misinformation. A systematic review was conducted to identify how previous research has examined miscommunication about microplastics in the public sphere. Of the 274 scientific publications identified, 15 were found eligible for inclusion in the study. These publications were analysed to establish (i) the methodologies employed to investigate microplastic communication in the public sphere, (ii) how existing information contributes to microplastic miscommunication, and (iii) what level of awareness and knowledge around microplastic pollution has been established. Our analysis revealed two primary study types: participant-based (e.g., via surveys, focus groups) and text-based studies of media content (e.g., newspapers, digital platforms). The participant-based studies showed misperceptions about impacts on human health and their pathways into the natural environment, even among well-informed or professionally involved individuals. The text-based studies revealed inexact media reporting involving scientific referencing, content accuracy, representation of microplastic pollution, and sensationalist tones. The findings highlight the need for further research into the miscommunication of microplastic pollution to facilitate best practice in the communication of scientifically accurate information across audiences.

1 Introduction

Human life and the oceans are intricately connected and understanding this complex relationship plays a crucial role in recognising and maintaining the balanced and sustainable use of ocean resources without causing harm [1, 2]. Microplastic pollution is caused by human activity—mainly the production, consumption, and waste management processes of plastics and microplastics—and plays a significant part in the decline in overall ocean health [3–6]. Many of the current concerns about microplastics relate to their potential negative impacts on environmental and human health, their transboundary and persistent traits, and the lack of available mechanisms to remove them from the environment [7–11]. As a result of these growing concerns, microplastic pollution research has been steadily increasing over the past two decades [12], with scientific findings also receiving significant attention across society [13–17]. Despite this extensive research, there are still many information gaps that require further scientific assessment, for example, knowledge around the risks of exposure to microplastics on human and environmental health still remains

Supplementary Information The online version contains supplementary material available at https://doi.org/10.1007/s44289-024-00033-6.

✉ Sonya Agnew, sagnew@ucc.ie | [1]MaREI, University College Cork, Cork, Ireland.

inconclusive [18–20]. This proliferation in microplastic pollution research combined with persistent knowledge gaps has given rise to concerns particularly in relation to how scientific information is being communicated beyond specialist or academic communities to the general public [21].

While research has highlighted that microplastics are perceived by the public as harmful to human, environmental, and marine health, public awareness of the sources and ways to mitigate microplastic pollution is low [11, 17, 22]. Scientists have voiced concerns regarding misinformation highlighting the magnitude of public debate in relation to the potential risks associated with microplastics pollution [12, 18, 21, 23, 24]. These concerns are not without merit, as current research has recorded inconsistencies, confusion, and a perceived lack of transparency when communicating evidence-based scientific findings regarding microplastic pollution [21] to the public. Here, science communication plays an important role in mitigating for information gaps and misinformation.

The science communication landscape has undergone substantial transformations over the past two decades with the emergence of new technologies, innovative methodologies, digital mediums, as well as shifts in social and cultural behaviours and attitudes [25–27]. The media, in its various formats—for example documentaries, news reports, and social media—is the main pathway in the communication of evidence-based knowledge to audiences [28, 29], and traditional media such as television, radio, and newspapers remain important in informing the public and have the potential to influence public opinion and drive social action [30, 31].

Changes in communication norms, such as the proliferation of social media channels, allows for scientific information to be more accessible, interactive and immediate [21, 32], generating better connectivity and dialogue between communities, amplifying scientific content (e.g. retweeting, sharing functionality) and bridging gaps of scientific representation beyond the scientific domain and academic circles [21, 26, 32–34]. However, the increasing digitalised ways in which information is communicated and digested is occurring in tandem with an overall decline in specialist scientific journalism [35]. Associated research points to less reliance on official sources and notable ambiguity between scientific fact and unverified information reported by non-professional journalists in social media content [36, 37].

Scientific research is characteristically complex and often communicated in academic journals and lengthy technical reports, which can be challenging to translate in a comprehensive and understandable way for different audiences [10, 21, 34, 38]. Evidence based science communication therefore plays a crucial role in communicating about microplastic pollution by raising awareness, facilitating informed decision making, and ensuring that associated mitigation measures, environmental policy, and legislation are supported throughout society [21, 34]. Due to the opposing characteristics of scientific inquiry and modern media, where science is a slow process with frequent framing of uncertainties compared to digital media which characteristically seeks to convey more immediate and certain information [39], modern media has the potential to spread erroneous or incomplete information [12].

In relation to microplastics pollution, ongoing research and the changing science communication landscape presents numerous opportunities for education and information exchange, but the notable uncertainties in scientific research also pose a risk for miscommunication and misinformation along with non-fact-based assumptions to spread rapidly across digital media channels [16, 40, 41]. There are many causes for misinformation within scientific communication all of which can have negative repercussion such as emphasis given to a particular element of an issue without regard for the entire context of the evidence [42].

Research into the communication and perceptions of microplastic pollution across different audiences is on-going and diverse [13, 17, 43, 44]. Although nascent research findings reveal ambiguity in public understanding of scientific information in relation to microplastic pollution [21], there is limited research exploring how the issue of misinformation on microplastic pollution is being scientifically examined. To address this knowledge gap, this systematic review focuses on studies addressing miscommunication, misperception and misinformation around microplastic pollution. To our knowledge there is no existing systematic review conducted on the miscommunication of microplastics in the public sphere. Systematic reviews are particularly useful to gauge existing research and to identify knowledge gaps concerning a topic in the relevant peer reviewed literature, while minimising bias [45] and are applied in diverse research areas such as medical and health sciences, social sciences, environmental management, and policy [46, 47].

For this study 'misinformation' is defined as *"publicly available information that is misleading or deceptive relative to the best available scientific evidence and that runs contrary to statements by actors or institutions who adhere to scientific principles"* [48]. This study also draws on the work of Burns et al. [49] which defines 'public' as every person in society.

2 Methods

This systematic review has followed the PRISMA guidelines (Preferred Reporting Items for Systematic Reviews and Meta-Analysis) [50], and is guided by three main research questions:

2.1 Research questions

1. Which methodologies have been used in the studies investigating microplastic communication in the public sphere?
2. In which ways does information in the public sphere contribute to miscommunication of microplastics?
3. What level of awareness and knowledge around microplastic pollution emerged in the eligible studies?

2.2 Data collection

Data collection for this systematic review was conducted in a three-stage process underpinned (see Fig. 1) by the PRISMA guidelines.

Stage one involved the identification of appropriate keywords and the development of key search terms to conduct a comprehensive search of publications available on the Web of Science (WoS) database to gather available literature on communication and miscommunication regarding microplastics. WoS was chosen as it is a reputable and comprehensive database of research across disciplines. The keywords identified as relevant for the search were ALL = ((microplastic*) AND ((miscommunicat* OR perception OR misperception OR misinform*) OR communicat*)). This initial search was undertaken on June 14th, 2023, and generated a dataset of 278 publications. The publications were then filtered for 'English language' only, resulting in 274 articles which were then exported by excel for analysis. There was no restriction on publication date of the articles or the geographical location of articles in the database search.

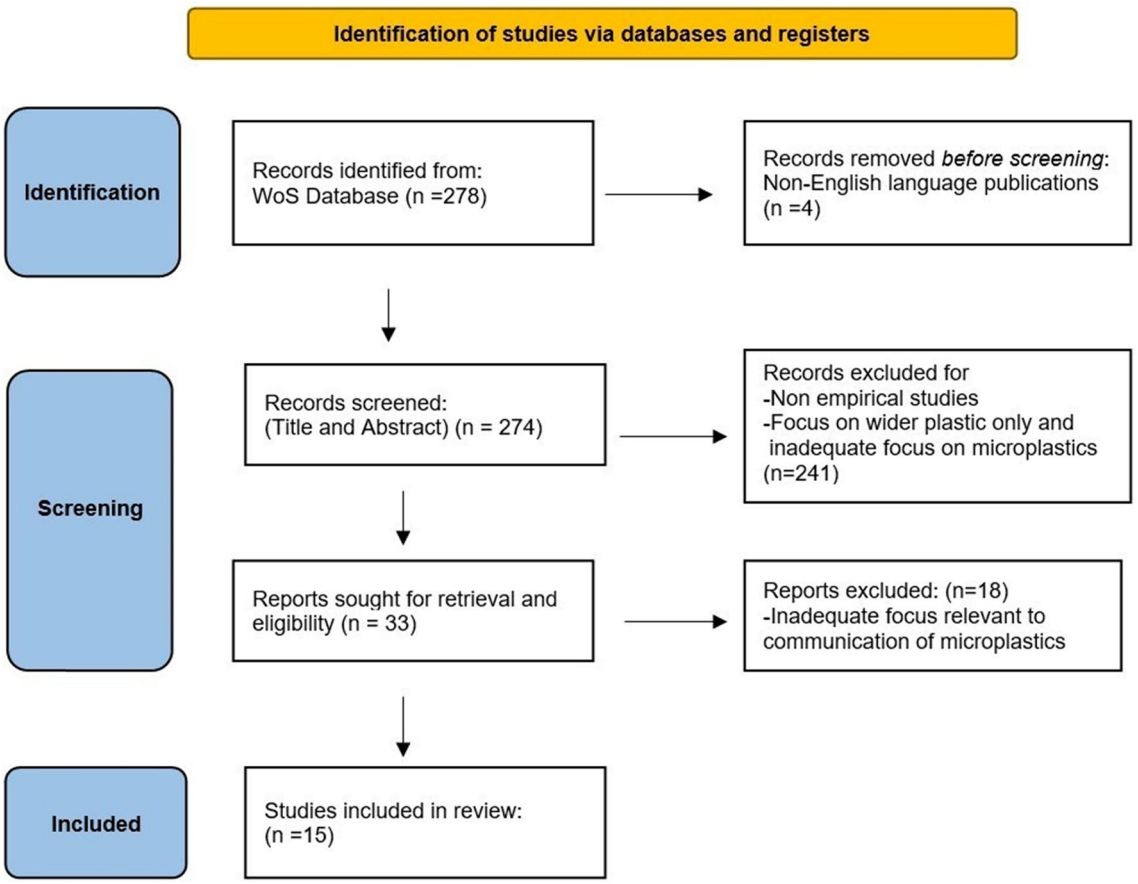

Fig. 1 PRISMA flow diagram of selection process [50]

The second stage involved the screening of the titles and abstracts of the 274 publications for any existing duplications, and the remaining publications were assessed in July 2023 using the following systematic exclusion criteria: (i) publications that did not focus on the communication of microplastics, (ii) publications dealing with broader aspects of plastics but did not focus on microplastics, and (iii) publications with insufficient focus given to microplastics. This process resulted in a dataset of 33 publications.

The third and final stage took place in August 2023 and involved a full textual analysis of the remaining publications (n = 33) to ascertain inclusion or exclusion. To meet the inclusion criteria, only peer-reviewed, primary research publications that explicitly included the inquiry into communication of microplastics in the public domain in the study's methods or results were included in the final dataset (n = 15).

3 Results

The eligible studies with original data addressing the subject of communication of microplastics in the public domain (n = 15), were published between 2016–2023 (see Fig. 2 in Supporting Materials). Of these studies 66.7% (n = 10) collated and assessed direct participant involvement and survey responses (n = 3500) [20, 51–59] while the remaining 27.3% (n = 5) focused on reviewing digital and print media [4, 16, 60–62]. Based on these criteria, the studies have been categorised as participant-based and text-based studies.

Of the ten participant-based studies, eight (n = 8) were conducted in Europe and included: Germany (n = 2), Sweden (n = 2), and the UK (n = 2), Italy (n = 1), and one comparative study (n = 1) involving participants in Germany and Italy. Of the remaining studies, one (n = 1) was undertaken in Asia (Shanghai) while the remaining study (n = 1) involved a global survey. With regards to the textual-based studies (n = 5) text content was collated from Japanese, Danish, US, UK, and German digital and print media sources.

The demographics varied across the eligible participant-based studies (n = 10) and involved direct participant involvement (n = 3500) in the form of surveys, questionnaires, interviews and focus groups. Six (n = 6) of the studies targeted members of the general public/citizens, while others focussed on specific groups of individuals professionally involved in some capacity with microplastics (n = 2), and a further two studies (n = 2) involved students. Some 91.5% (n = 3201) of the study respondents were identified as members of the public, more specifically students, citizens, or lay people while the remaining 8.5% (n = 299) respondents were categorised as experts or individuals professionally engaged with the topic of microplastics. In the studies involving professionally engaged participants these included journalists, representatives from SEPA (Swedish Environmental Protection Agency), local politicians, industry representatives, and experts [58], politicians and representatives from the waste management sector, governmental organisations and interest groups (e.g. environmental NGOs) [57] and those who were or had previously worked on the topic or conducted research '*with plastic as an environmental contaminant*' [56].

In 90% of the participant-based studies (n = 9) participant gender was explored (see Fig. 3 in Supporting Materials). Seven studies (n = 7) gathered metrics on participant age. Three of these studies (n = 3) provided a mean age: 40.1 years [59], 20.3 years [55] and 22.5 years [52]. A further four studies (n = 4) organised participants into age ranges. Within these studies, the largest number of participants (68%, n = 15) in Anderson et al. [51] fell into the 18–25 age group, in Kramm et al. [20] the largest age group was the 60+ age group, (33.8%, n = 277.8), in Deng et al. [53] almost half of the participant belonged in the 18–30 age group and in the study from Thiele and Hudson [56], the largest age group representation fell into the 25–44-year bracket.

3.1 Results in context of research questions

3.1.1 Research Question 1: Which methodologies have been used in the studies investigating microplastic communication in the public sphere?

The data collection methods used in these studies were varied (see Tables 1 & 2), but could be broadly placed within two distinct categories, namely participant-based and text-based data collection.

The text-based studies on microplastics (n = 5) included methodologies combining the identification and collation of: scientific peer reviewed publications and online media articles (n = 2), spanning 2006–2018 [61] and 2016–2020 [60]; national newspaper content (n = 2) published between 2004–2018 [16], and between 2010–2019 [4]; and edit history information on one Wikipedia web page (n = 1) between 2014–2020 [62]. The text-based studies included the examination

Table 1 Methodological approaches across text-based eligible studies

Study	Methodological approach	Analysis method	Sample group	Geographical focus
Fu et al. [61]	Text analysis	Coding	Journal articles (n = 190) Online news articles (n = 162)	Asia (Japan)
Volker et al. [60]	Text analysis	MAXQDA analytics Pro 2018	Peer reviewed scientific papers (n = 464) Media Articles (186)	Media articles UK & USA
Fu et al. [62]	Text analysis	Content analysis	Wikipedia Page (n = 1)	Asia (Japan)
Ballantyne et al. [4]	Text analysis	Grounded theory	Danish National Print News Media Articles (n = 117)	Europe (Denmark)
Schönbauer and Müller [16]	Text analysis	Constructivist grounded theory	Print News Media Articles (n = 195)	Europe (Germany)

Table 2 Methodological approaches across participant based eligible studies

Study	Methodological approach	Analysis method	Sample group	Sample size (n)	Geographical focus
Abalo and Olausson [58]	In person & online interview	Thematic analysis	Professionally engaged	15	Europe (Sweden)
Zilinskaite et al. [57]	Online interview	Grounded theory	Professionally engaged	33	Europe (Sweden)
Janzik et al. [59]	Online semi-structured interview	Content analysis	Citizens	30	Europe (Germany & Italy)
Anderson et al. [51]	Focus group (N = 4)	Framework analysis	Members of public	22	Europe (England)
Henderson and Green [54]	Focus group (n = 6)	Thematic analysis	Members of public	42	Europe (UK)
Cammalleri et al. [52]	Questionnaire	SPSS-statistical analysis	Students	151	Europe (Rome)
Deng et al. [53]	In person questionnaire	Ordered logistic regression model	Members of public	437	Asia (Shanghai)
Kramm et al. [20]	Online survey	regression analyses	Citizens	822	Europe (Germany)
Thiele and Hudson [56]	Online questionnaire	Statistical analyses	Lay & expert	1681	Global (Global)
Raab and Bogner [55]	Paper & pencil questionnaire	Content analysis	Students	267	Europe (Germany)

of scientific articles (n = 654), print media articles (n = 317) from different published newspapers (n = 17), online news articles (n = 186), and a temporal study of a non-peer reviewed online information website (n = 1). In the text-based studies the analysis methods employed were varied (see Table 1). Two studies (n = 2) used inductive approaches to establish themes from the media content such as grounded theory [4] and constructivist grounded theory [16]. Similarly, a qualitative approach was taken by Fu et al. [62] with a comparative content analysis of the Japanese Wikipedia's edit history page. The study by Volker et al. [60] used statistical methods to analyse the data gathered and conducted thematic and interpretive analysis of both the scientific and media text-based data. The text- based study conducted by Fu et al. [61] also applied statistical methods to their analyses.

The participant studies (n = 10) used a range of methods to analyse the collected participant data (see Table 2). Five studies (n = 5) employed a range of statistical approaches and included: an in- person questionnaire (n = 1) with single and multiple choice questions conducted in June 2019 [53]; an online survey (n = 1) with closed questions and one open question conducted in March 2020 [20], and two (n = 2) consisting of all closed questions, with one (n = 1) conducted between September 2018- May 2019 [56] and one study (n = 1) employed a questionnaire conducted on three different days within the same academic year [52], and one study (n = 1) including open, multiple choice and single choice questions[55]. Two of the eligible studies (n = 2) [53, 56] presented participants with hypothetical inquiries, the first focused on microplastics and human health problems and ask participants to identify which statements about microplastics were perceived to be true or false, while Deng et al. [53] included hypothetical scenarios concerning seafood and participant behaviour as well as common use products and participant knowledge if those contained microplastics.

Different qualitative methods were employed in five of the participants studies (n = 5), where online interview formats were used in two studies (n = 2) including one comparative study of citizens in German and Italy [59] and an online and in-person interview approach (n = 1) [58]. The remaining two studies worked with focus groups (n = 2) [51, 54].

Four (n = 4) of the eligible studies [51–54] used supporting materials or information about microplastics in their approaches such as an information brochure [52] or images, video recordings and a film trailer of a Plastic Ocean documentary [54]. Anderson et al. [51] presented products containing microbeads and extracted samples of microbeads from these products to focus group participants and the fourth study [53] offered text-based information about microplastics including a definition of microplastics and how they are generated.

Two studies (n = 2) employed a pre- and post-participation evaluation [52, 54]), to establish baselines prior to using supporting materials and to gauge if participants perceptions changed around microplastic pollution. Cammalleri et al. [52] showed that the supporting material increased participants concerns about microplastic pollution and Henderson & Green [54] highlighted participants' surprise at the scale of the microplastic pollution problem.

3.1.1.1 Summary conclusion: research question 1 The review identified a broad scope of approaches which reflect the specific purpose and target audience of the research that was being conducted. This highlights that not one method fits all and presents researchers with the opportunity to apply diverse methodological frameworks to their research questions, however, it also presents difficulties in providing comparative analysis of the results. It also indicates that the existing diverse methodological approaches can be built upon to gain insights concerning miscommunication around microplastics in the public domain.

3.1.2 Research Question 2: In which ways does information in the public sphere contribute to miscommunication of microplastics?

The eligible text-based studies (n = 5), as shown in Table 1, all involved analysis of media news content and included both digital and print sourced articles [4, 16, 60–62]. Several themes emerged from analysis of the eligible text-based studies as follows: (i) scientific reference in text-based content; (ii) content accuracy; (iii) representation and (iv) the tone of the media content.

i. **Scientific reference in text-based studies**

All the text-based (n = 5) studies considered the inclusion of scientific publications, sources, and information in digital and print media datasets, albeit in different ways [4, 16, 60–62]. Volker et al. [60] found that reference was made to 63 different scientific publications in their analysis of media articles (n = 186). These media articles also contained direct quotes from a range of commentators including scientists, NGO and industry representatives, and politicians [60]. Schönbauer and Müller [16] found examples of statements from scientists and highlighted that over time the inclusion of scientific references and commentator statements and perspectives shifted from the scientific community to involve more diverse perspectives from policymakers and public officials, NGOs, and representatives of lobby groups. The examination of

content on the Japanese microplastics Wikipedia page, showed various inconsistencies from original scientific source material due to the editing of the original text [62]. Ballantyne et al. [4] assessed the inclusion of references to scientific publications in the media content examined, however it was stated that very few references were found.

Fu et al. [61] assessed the stages at which scientific information is communicated to different stakeholder groups and by whom, and subsequently categorised the textual material included in their study into three stages of communication based on audience accessibility and specialisation: intra-specialist stage (information shared among peer specialists in one discipline); inter-specialist stage (information published for specialists by journals across multiple disciplines) and popular stage (information published in journals open to the public). It was found that the most influential authors of scientific publications published across all three stages indicating that they communicate directly with the public (the popular stage) [61].

ii. **Content accuracy**

There were several notable findings in the eligible text-based studies highlighting inaccuracy in the reporting of microplastics in news media [4, 16, 60–62]. Two studies showed that the terminology used to describe microplastics was often inconsistent across media articles and switched between scientific and lay definitions [4, 62]. Three studies identified examples of hypothetical risks associated with microplastics (i.e. the potential impacts of microplastics on human health) being communicated as scientifically proven risks [16, 60, 62], and the framing of scientific 'estimation' as scientific 'exactness' [62]. Further examples of inaccuracies in media content related to the inclusion of subjective and incorrect text, the omission of relevant and contextual information, and the insufficient updating and dissemination of emerging scientific evidence [62]

Schönbauer and Müller's [16] study highlighted changes in the characteristics of microplastic reporting in German media over time and categorised the articles into three phases. Here, phase one (2004–2010) was characterised by scientific findings of microplastic pollution, sources of microplastics were linked to household products, their 'invisibility' in the environment and their role as conduits for toxic contaminants. In the second phase (2010–2015) the articles often framed the hypothetical risks of microplastics as scientifically proven, included an increase of reporting to the 'sinks' where microplastics had been found (e.g. streams, lakes, and consumer products such as food and beer) and often included commentary from scientists. The third phase (2015–2018) was marked by debate on the actual risk of microplastics, the focus on the role of consumers and increased 'calls for political action' [16]. Fu et al. [61] also revealed changes in how the issue of microplastics was communicated over time—namely, how the scope of microplastic related information broadened in both online media and scientific sources. Here, research showed that topic breadth in online media was limited and peaked in 2019 before declining, while in contrast, the content in scientific literature continued to increase both in topic scope and publication quantity until 2020 (end of data collection phase) [61].

iii. **Representation**

The eligible studies also revealed instances where narratives about microplastics were represented in an unbalanced way in media reports. Schönbauer and Müller [16] study highlighted that consumer choices along with policy inaction are often reported as major contributors to microplastic pollution. The study highlights how consumer is frequently portrayed as being central in driving change regarding policy, leading to an inordinate focus on the citizen and their responsibility in tackling the microplastic problem [16]. Here, both the Ballantyne et al. [4] and Schönbauer and Müller [16] studies stress that the misaligned balance in media content points to the omission of an encompassing discourse to other drivers of microplastic pollution such as the lack of commentary from industry stakeholders such as those involved in cosmetic, textile or car tyre production. This emphasis on the role of the consumer the contribution of consumer consumption practices as a major source of microplastic pollution compared to discourse around the role of industry in media was also highlighted in Ballantyne et al. [4]. Over representation of microbeads in media reporting was highlighted as an example for creating an unbalanced narrative, where they may be perceived as more than a contributary factor of microplastic pollution [4, 16].

iv. **Tone**

Three of the eligible studies (n = 3) referred to the tone of the narrative text used in the media to describe microplastics [4, 16, 60]. Two studies (n = 2) [4, 16] highlighted an 'alarmist' tone in the media content of their studies, which pointed to the potential impacts of microplastics in an exaggerated way. When focusing on the expressions of concern in media articles, Volker et al. [60] found that in 32% of the articles examined (n = 97), negative terminology such as '*hazard', 'threat', 'toxic', 'bad'* was used, alongside commentary from experts who expressed worry or concern. Interestingly, it was

found that articles reporting on scientific findings on the presence of microplastics in seafood were 'more likely' to be communicated with higher levels of concern [60]. Moreover, their analysis also revealed that only 7% of those articles examined focused solely on the factual reporting of the available scientific information and did not include any further interpretation or speculation [60].

3.1.2.1 Summary conclusion: research question 2 The eligible text-based studies revealed four main characteristics which may contribute to the miscommunication of microplastics: (i) missing and inaccurate scientific references in text-based content; (ii) insufficient content accuracy; (iii) unbalanced representation and (iv) misleading tone of the media content.

3.1.3 Research Question 3. What level of awareness and knowledge around microplastic pollution emerged in the eligible studies?

The third research question aimed to establish people's awareness and knowledge of microplastics pollution. Ten (n = 10) of the final eligible studies (n = 15) involved participant-based inquiry—all of which investigated participant awareness of microplastics, albeit in diverse ways [20, 51–59].

Three (n = 3) studies involved participants associated with microplastics in a professional capacity. Of these, two studies (n = 2) [57, 58] included participants connected with microplastics in a professional capacity *only,* while the third (n = 1) combined both experts and lay people in its participant sample [56]. The first study [58] conducted interviews with journalists, editors, public officials, politicians, industry representatives and experts (n = 15), that were all associated with artificial turf. A certain prior level of knowledge around microplastics could be assumed with those participants, considering artificial turf had featured in the media. The second study [57] involved a range of stakeholders (n = 33) and included politicians, and representatives from government authorities, the industry sector, environmental and research organisations, NGOs, and a farming association. Here, it is important to note that the participants in the study were sought out because of their engagement with organizations 'with an interest in the broad field of sludge management from wastewater treatment plants'. Nevertheless 15% of the participants stated they lacked knowledge regarding microplastics. The study also found that some participants (12%) were unaware of existing guidelines (these were all politicians). A further study carried out an online questionnaire with the final sample (n = 1681) including both expert (n = 251) and lay (n = 1430) participant's responses. The expert participants were identified in the survey as either currently or having previously worked '*on the topic of plastics as an environmental contaminant* (*e.g. microplastics, plastic pollution*)', or if they were previously or currently involved in research activity on the issue [56].

Two studies (n = 2) [20, 59] involved screening to include participants with prior knowledge only. The first study [59] included '*only participants who felt they had an idea what microplastics were*' and the second with participants (n = 822) that had "*ever heard of microplastics before this survey*' [20]. Similarly, in another study [51] consideration was given to involve participants with some prior awareness regarding microplastics, for example, members of a local marine environment group, university students who were 'anticipated to have a range of knowledge' and beauty therapy trainees who work with products containing microbeads.

Four (n = 4) of the participant-based studies explored if participants had prior knowledge of microplastics [52–55]. One study involving members of the public (n = 437) established that less than one third of respondents (26%) had heard of microplastics, with 67% unaware of microplastics and the remaining 7% of respondents unsure [53]. In contrast, a study of undergraduate and recently graduated students established that two thirds of participants had prior knowledge [52]. A further study [55] asked the participants (students) what they understood about the term microplastics. Due to the open-ended nature of the question the responses were varied, and analysis showed that most students (78%) described them as small plastic particles and some references were made by participants to the source (i.e. primary or secondary) as well as to the effects of microplastics. The study does not include data on whether any participant *did not* have prior knowledge about microplastics [55].

Three of these studies (n = 3) all of which with a survey/questionnaire type methodological design, specifically addressed the participant's source of information on microplastics [52, 53, 55]. These studies established that the most popular sources of information were media formats such as the internet, and television [52, 53, 55]. The study by Raab and Bogner [55] also found that formats such as television documentaries, film, as well as print media and radio were also popular among participants. The fourth study, by Henderson & Green [54] found that the most accessed sources for environmental news were media formats including the internet, television, and newspapers. This focus group study [54] also revealed more detail on specific sources and included national broadcasting channels (BBC), newspapers and magazines (e.g. The Guardian, Independent), NGOs (e.g. Greenpeace), radio, and social media platforms

(e.g. Facebook, Reddit), light entertainment programmes (e.g. *QI*), documentaries (e.g. *David Attenborough*), reality television (e.g. *Bear Grylls, The Island*), and fictional film (e.g. plastic pollution in the film *Happy Feet*). A further study [51] did not explore the source of information on microplastics directly but did reveal that social media platforms (i.e. Facebook) were a useful way for participants to connect with like-minded individuals and organisations to learn more about microbeads.

Three main themes emerged in the analysis of the eligible sample studies about the accuracy of perceptions held by respondents particularly in relation to the impacts of microplastics on human and environmental health, the source and sinks, and the perception of responsibility in relation to microplastic pollution.

i) Inaccurate perceptions

In relation to participants who felt they were informed about microplastics, results showed that participants thought that microplastics are carcinogenic (e.g. skin and intestinal tumours), cause damage to internal organs, lead to genetic mutation, and would accumulate in the body because they cannot be metabolised and could eventually interfere with biological processes and form larger entities and damage internal organs [59]. Further examples of perceptions linking microplastics and cancer were expressed by both experienced (33%) and lay (37%) respondents with both cohorts (28% and 31% respectively) of the opinion that this had been scientifically proven, with over half of each cohort uncertain if this had been scientifically confirmed [56]. This study also revealed the most stated health effect from survey options chosen by lay and second-most by experienced respondents was that respiratory problems are linked to microplastics [56]. In turn one study revealed that participants who stated they had good awareness regarding the topic, expressed uncertainties regarding the accuracy of their knowledge during the study itself [59].

Four (n = 4) participant-based studies revealed respondents' concerns about the impacts on human health from eating fish and seafood due to the presence of microplastics in the marine environment [20, 51, 53, 59]. Three (n = 3) studies highlighted that participants perceived that fish consumption was one of the main ways microplastics enter the human body and to reduce or to stop eating fish altogether would be a way to avoid consuming microplastics [20, 53, 59]. This aligns with findings from similar research with experts within the scientific community [21].

ii) Perceptions of microplastics- source to sink

In addition to misperceptions about human and environmental impacts of microplastics, studies revealed a lack of awareness among participants about the source of secondary microplastics. Here, one study found that most participants identified items such as drinks bottles and computer components (69.11%) as products made from plastic but less than 20% thought that synthetic fibres (13.73%), plastic paint (15.56%) and plexiglass (12.81%) were made from plastic [53]. Results also pinpointed a lack of awareness among participants of the connection between using plastics in everyday situations and how they end up in the marine environment [54].

A further example concerned microbeads, highlighted that participants thought microbeads dissolved and did not persist in the environment after use [51]. Similarly, the study by Abalo and Olasson [58] found that both journalists and politicians (identified as professionals engaged in the area of microplastics in the study) were unsure of what happened to granules from artificial turf and suggested that if they became attached to clothing, microplastic pollution could be minimised by vacuuming the clothing as it would '*disappear*' and not end up in the water system. Inaccuracies were also revealed by participants about the '*Great Pacific Garbage Patch*' as they said they had seen footage on television programmes and referred to it as 'a giant mass of plastic [54]. In certain instances, the studies also described respondent knowledge of microplastics as 'superficial' with evident 'blind spots' [55] or indicated that respondents had 'vivid ideas' and 'assumptions' [59] surrounding the issue of microplastics.

iii) Responsibility

The study by Janzik et al. [59] revealed participants perceived microplastic pollution as an issue over which they had little power and measures undertaken at individual level would have negligible impact. A further study mirrored this sentiment although participants commented that to avoid personal exposure to microplastics they could change their behaviour (e.g. avoiding sea food or by using organic and biodegradable products) [54]. This study also highlighted participant perception that larger companies would change if there were different demands made on them, although it was unclear if this indicated public or political demand or both [54]. There was also the idea of 'top-down responsibility' conveyed by participants suggesting that action should be taken by the government, in terms of regulation, and that specific actors, including industry, are pushing the use of packaging and plastic use onto the consumer [54]. Another study revealed that participants had reservations that industry would take voluntary mitigation measures (e.g. regarding microbeads) and thought NGOs and the government should play a role in enforcing change and that public awareness would also influence change but to a lesser extent [51].

3.1.3.1 Summary conclusion: research question 3 It was found that all participant-based studies considered prior knowledge of participant knowledge of microplastics in some way. All participant-based studies revealed examples of uncertainty and inaccurate understanding regarding scientific-based knowledge—including those studies with participants who are professionally involved in some capacity with microplastics.

Although not all studies inquired about the source of participant information, the review of eligible studies points to the internet and television as the main sources of information on microplastics for participants albeit with variations.

4 Discussion and conclusion

The aim of this systematic review was to establish the extent of knowledge regarding misinformation of microplastic pollution in the public sphere. The structure of *Research Question 1* allowed the authors to distinguish which studies could be used to answer *Research Questions 2* and *3*. The text-based studies critically analysed available sources of public information, which allowed the authors to directly seek answers to *Research Question 2*, while participant-based studies evaluated the level of awareness and knowledge respondents had in relation to miscommunication of microplastic pollution and therefore allowed for more analyses in relation to *Research Question 3*.

Overall, the review found that none of the eligible studies focused solely on miscommunication around microplastic pollution. Whilst the diversity of methodologies and research objectives adopted across the studies presented difficulties regarding conducting comparative analysis, nevertheless examination of the publications has provided a deeper understanding of the methods of inquiry, knowledge and perspectives of diverse audiences, the sources of information accessed by participants, and the characteristics of the information on microplastics in the public sphere. The participant-based studies revealed a broad scope of respondents involving qualitative approaches such as focus groups [51, 54] and structured-type interviews [57–59], and whilst not statistically representative, are characterised by conversational and open-type questions facilitating deeper exploration about participant experience of microplastic pollution [21, 63, 64]. On the other hand, the questionnaire and online survey approaches allowed for the inclusion of large numbers of participants which were in some cases specific public groups such as students, lay people, or topic experienced [20, 52, 53, 53, 55]. For example, whilst the focus group conducted by Henderson and Green [54] did not explicitly examine the source of participant information on microplastics (Table 3), the conversational and informal structure of this form of inquiry afforded an insight into more nuanced information emerging from group conversation (e.g. reality television and fantasy film), providing a valuable insight into the different mediums of communication which may influence perceptions of microplastics in some way.

All participant-based studies in the final sample exposed uncertainties and gaps in knowledge in some form including those conducted with participants deemed as experts and those engaged within a professional capacity with microplastics (Table 3). Whilst the text-based studies involved examination of a broad geographical range of content, the final sample subject data was limited to news media, a non-peer reviewed online information platform and included analysis of scientific publications indicating there is a lack of knowledge regarding potential inaccurate information in other formats of microplastic communication in the public sphere.

The studies that identified the sources of participant information on microplastics [51–55] and other environmental issues found that the media including internet and television as well as radio and print media were the main mediums for accessing scientific information, mirroring other research findings in the US and Europe [30, 65, 66]. Moreover, they highlighted that television broadcasts, documentaries, reality programmes, social media platforms, and film formats are used by the public to get information about microplastics and other environmental issues. This is not necessarily surprising considering the rise in popularity of environmental and ecologically themed documentaries, such as the 2017 BBC Blue Planet II series in recent years [67]. Whilst such formats help to highlight the impacts of marine plastic pollution across public, media, and political spheres [67–69], there are concerns regarding the validity, objectiveness, and accuracy of 'factual' content in some documentary programmes. For example, the recent '*Seaspiracy*' documentary has called into question the need for more stringent ethical standards to ensure the reliability of the information presented in documentaries [69, 70].

This review highlighted prevailing perceptions among participants which diverge from current scientific evidence—such as the opinion that microplastics may lead to genetic mutation [59] and that it has been scientifically proven that microplastics are carcinogenic [56]. These findings align with other research that there is a notable disconnect between scientific evidence and public debate [18, 21, 23, 24]. Representations and perspectives of microplastic related topics in the media can be misdirected by, for example, the inaccurate reporting of, or misrepresentation of the uncertain or

Table 3 Overview to Inquiry to participant knowledge and information source across participant-based eligible studies

Study	Study design	Professional capacity only	Both expert & lay participants	Included participants with prior knowledge only	Directly Inquired about knowledge source	Revealed source of information	Revealed uncertainty
Janzik et al. [59]	Interview			Participants who 'felt they had an idea what microplastics were'			x
Abalo and Olausson [58]	Interview	x					x
Zilinskaite et al. [57]	Interview	x					x
Henderson and Green [54]	Focus group					x	x
Anderson et al. [51]	Focus group			Participants who were 'anticipated to have a range of knowledge'			x
Kramm et al. [20]	Survey			Participants who had 'ever heard of microplastics before'			x
Thiele and Hudson [56]	Questionnaire		x				x
Raab and Bogner [55]	Questionnaire				x	x	x
Deng et al. [53]	Questionnaire				x	x	x
Cammalleri et al. [52]	Questionnaire				x	x	x

hypothetical impacts associated with microplastics instead of emphasising and clearly communicating the cause, use, and waste streams of plastic pollution. This disproportionate emphasis on one thematic area or concern in microplastics reporting, can give rise to inaccurate reporting of microplastic pollution in the public domain [16, 23, 42, 60, 61]. In addition, the over emphasis or representation of participant concerns on specific themes aligns with findings from the text-based samples in the systematic analysis, such as the over representation of cosmetics (i.e. microbeads), when compared to other microplastic pollution in media reports as to the causes of microplastic pollution, and media articles reporting scientific uncertainty as fact e.g. the risk of consuming fish [60].

Scientific information does not automatically reach all audiences [71] and there has been increasing attention focussing on improving the scope of communication i.e. encouraging researchers and scientists to engage directly with audiences, as well as calls for addressing disconnects in communication between the science-policy-society interface, improved mechanisms for communicating nuance in relation to risk and uncertainty, and addressing local and regional aspects to the global issue of marine microplastic problem [21, 71, 72]. Moreover, the overall decline of specialist science and environmental journalism in recent years is driven by increasing trends in desk-based journalistic research, less rigor in using expert sources, issues of subjective funding and targeted writing for a particular readership, limited timeframes for reporting, all of which contribute to a decrease in scientific 'soundness' in media content [36]. The study by Abalo and Olausson [58] involving journalists and newsroom editors revealed that they found it challenging when reporting scientific information which included uncertainties or 'fuzzy-data' and highlighted the difficulty in aligning scientific evidence to media formats- leaving a vacuum for interpretation and inclusion of reporter's own experience. Similarly in the study by Fu et al. [62] the inaccuracies in the text on the Wikipedia webpage could also indicate subjective choice or lack of understanding of the original scientific information by the editor. Furthermore, ambiguity and a lack of access to accurate information or expert sources and inadequate training in communicating complex scientific information can result in less than scientifically accurate interpretation [73] and therefore impacts on the scientific soundness of media content.

The changes in the communication landscape are also characterised by the proliferation of ambiguity between fact and opinion [36], as it is becoming more common place for individuals and groups to experience and share unverified, inaccurate, and non-scientifically sound information [37]. Whilst information and indeed misinformation can be spread swiftly across digital platforms and geographical boundaries—challenges exist in correcting or retracting the content once published or posted [74–76], especially when outdated and inaccurate information remains accessible in the public sphere [62]. As highlighted in the text-based studies [16, 62], there is clear evidence that of out-of-date and inaccurate information can continue to exist and be re-referenced in the media despite the increased availability of newer scientific knowledge. The consequences of inaccurately reported or misrepresented information are varied—for example, can negatively impact public trust and misinform decision making [77, 78]—and are not necessarily easy to reverse through counteractive measures such as retraction of reported findings, promotion of detailed clarification or replacing the statements with new scientific evidence [76].

The systematic review has highlighted numerous divergences between scientific evidence, reporting and understanding of microplastic pollution in the public sphere. Whilst this systematic review does not necessarily represent a full picture of the miscommunication of microplastic pollution, it indicates that while a body of research applying diverse methodologies to gain more insight and knowledge exists, more research is needed to ascertain a best practice pathway of communicating scientific-based evidence about microplastics to diverse audiences including specialist stakeholders and decision and policymakers.

Author contributions SA, KK, OPP, AD and EF developed search criteria, methodology, final sample analysis. SA, KK and OPP wrote main manuscript text, conducted final draft review and edit. All authors reviewed the manuscript.

Data availability No datasets were generated or analysed during the current study.

Declarations

Competing interests The authors declare no competing interests.

Open Access This article is licensed under a Creative Commons Attribution-NonCommercial-NoDerivatives 4.0 International License, which permits any non-commercial use, sharing, distribution and reproduction in any medium or format, as long as you give appropriate credit to the original author(s) and the source, provide a link to the Creative Commons licence, and indicate if you modified the licensed material. You do not have permission under this licence to share adapted material derived from this article or parts of it. The images or other third party material in this article are included in the article's Creative Commons licence, unless indicated otherwise in a credit line to the material. If

material is not included in the article's Creative Commons licence and your intended use is not permitted by statutory regulation or exceeds the permitted use, you will need to obtain permission directly from the copyright holder. To view a copy of this licence, visit http://creativecommons.org/licenses/by-nc-nd/4.0/.

References

1. Seys J, Cox L, Şahin Yücel E, Ezgeta-Balić D, Faimali M, Garaventa F, García-Martínez M-C, Gili C, Kopke K, Moreau K, Petrera F, Simon D, Villwock A, Zielinski T, Muñiz Piniella A. Marine Science Communication in Europe—a way forward. In: Muñiz Piniella A, Kellett P, van den Brand R, Alexander B, Rodriguez Perez A, Van Elslander J, Heymans JJ, editors. Future Science Brief 8 of the European Marine Board, Ostend, Belgium; 2022. https://doi.org/10.5281/zenodo.6444143. Accessed 21 Sept 2023.
2. Zielinski T, Kotynska-Zielinska I, Garcia-Soto C. A blueprint for ocean literacy: EU4Ocean. Sustainability. 2022. https://doi.org/10.3390/su14020926.
3. Gallo F, Fossi C, Weber R, Santillo D, Sousa J, Ingram I, Nadal A, Romano D. Marine litter plastics and microplastics and their toxic chemicals components: the need for urgent preventive measures. ENVIRON SCI EUR. 2018. https://doi.org/10.1186/s12302-018-0139-z.
4. Ballantyne AG, Péronard JPDC, Hansen RA, Gross A. Media issue crystallization: the case of microplastic in Denmark. Environ Commun. 2021. https://doi.org/10.1080/17524032.2021.1877761.
5. Devriese L, Verleye T, Boteler B, Del Savio L, Miño, C, Sandra M, Molenveld K, Dozier A, Maes T, Vlachogianni T, Kopke K. SOS-Zeropol2030: Deliverable D2.1 'The EU Zero Pollution Ambition'; 2023. https://doi.org/10.13140/RG.2.2.29551.20642. Accessed 10 Jan 2024.
6. Nafea TH, Chan FKS, Xu H, Wang C, Xiao H, He J. Status of management and mitigation of microplastic pollution. Crit Rev Environ Sci Technol. 2024. https://doi.org/10.1080/10643389.2024.2361502.
7. GESAMP. Sources, fate and effects of microplastics in the marine environment: part 2 of a global assessment. In editors Kershaw PJ, Rochman CM. 2016. Reports and studies. Joint group of experts on the scientific aspects of marine environmental protection No. 93, p. 220. http://www.gesamp.org/publications/reports-and-studies-no-90. Accessed 30 June 2024.
8. Yurtsever M. Glitters as a source of primary microplastics: an approach to environmental responsibility and ethics. J Agric Environ Ethics. 2019. https://doi.org/10.1007/s10806-019-09785-0.
9. Soares J, Miguel I, Venâncio C, Lopes I, Oliveira M. Perspectives on micro(nano)plastics in the marine environment: biological and societal considerations. Water. 2020. https://doi.org/10.3390/w12113208.
10. Garcia-Vazquez E, Garcia-Ael C. The invisible enemy Public knowledge of microplastics is needed to face the current microplastics crisis. Sustain Prod Consump. 2021. https://doi.org/10.1016/j.spc.2021.07.032.
11. Felipe-Rodriguez M, Böhm G, Doran R. What does the public think about microplastics? Insights from an empirical analysis of mental models elicited through free associations. Front Psychol. 2022. https://doi.org/10.3389/fpsyg.2022.920454.
12. SAPEA, Science Advice for Policy by European Academies. A scientific perspective on microplastics in nature and society. Berlin: SAPEA; 2018. https://doi.org/10.26356/microplastics. Accessed 10 Aug 2023.
13. Koelmans A, Besseling E, Foekema E, Kooi M, Mintenig S, Ossendorp B, Redondo-Hasselerharm P, Verschoor A, Wezel A, Scheffer M. Risks of plastic debris: unravelling fact, opinion, perception, and belief. Environ Sci Technol. 2017. https://doi.org/10.1021/acs.est.7b02219.
14. Hartmann NB, Hüffer T, Thompson RC, Hassellöv M, Verschoor A, Daugaard AE, Rist S, Karlsson T, Brennholt N, Cole M, Herrling MP, Hess MC, Ivleva NP, Lusher AL, Wagner M. Are we speaking the same language? Recommendations for a definition and categorization framework for plastic debris. Environ Sci Technol. 2019. https://doi.org/10.1021/acs.est.8b05297.
15. Hahladakis JN. Delineating the global plastic marine litter challenge: clarifying the misconceptions. Environ Monit Assess. 2020. https://doi.org/10.1007/s10661-020-8202-9.
16. Schönbauer S, Müller R. A risky object? How microplastics are represented in the German media. Sci Commun. 2021. https://doi.org/10.1177/10755470211030519.
17. Soares J, Miguel I, Venâncio C, Lopes I, Oliveira M. Public views on plastic pollution: Knowledge, perceived impacts, and proenvironmental behaviours. J Hazard Mater. 2021. https://doi.org/10.1016/j.jhazmat.2021.125227.
18. Catarino A, Kramm J, Völker C, Henry TB, Everaert G. Risk posed by microplastics: Scientific evidence and public perception. Curr Opin Green Sustain Chem. 2021. https://doi.org/10.1016/j.cogsc.2021.100467.
19. Vethaak AD, Legler J. Microplastics and human health. Science. 2021. https://doi.org/10.1126/science.abe5041.
20. Kramm J, Steinhoff S, Werschmöller S, Völker B, Völker C. Explaining risk perception of microplastics: Results from a representative survey in Germany. Glob Environ Chang. 2022. https://doi.org/10.1016/j.gloenvcha.2022.102485.
21. Agnew S, Kopke K, Dozier A, Power O-P, Fitzgerald E, Mateos-Cárdenas A, Regoli F. Science Communication of Marine Plastic Pollution. JPI Oceans-Funded Response Project. 2023. https://doi.org/10.13140/RG.2.2.15212.33928.
22. Forleo MB, Romagnoli L. Marine plastic litter: public perceptions and opinions in Italy. Mar Pollut Bull. 2021. https://doi.org/10.1016/j.marpolbul.2021.112160.
23. Rist S, Carney Almroth B, Hartmann NB, Karlsson TM. A critical perspective on early communications concerning human health aspects of microplastics. Sci Total Environ. 2018. https://doi.org/10.1016/j.scitotenv.2018.01.092.
24. Frias J, Nash, R. Perceptions about marine anthropogenic litter and microplastic pollution in Ireland—synopsis of the online survey; 2020. http://research.thea.ie/handle/20.500.12065/3457. Accessed 1 Jul 2023.
25. Väliverronen, E. Mediatisation of science and the rise of promotional culture; 2021. https://doi.org/10.4324/9781003039242-8.
26. Llorente C, Revuelta G, Dziminska M, Warwas I, Krzewińska A, Moreno CA. Standard for public consultation on science communication: the CONCISE project experience. JCOM. 2022. https://doi.org/10.22323/2.21030802.
27. Metag J, Wintterlin F, Klinger K. Editorial: science communication in the digital age—new actors, environments, and practices. Media Commun. 2023. https://doi.org/10.17645/mac.v11i1.6905.
28. Dempster G. The communication of scientific research in news media: Contemporary challenges and opportunities. JCOM. 2020. https://doi.org/10.22323/2.19030306.

29. Jensen EA, Borkiewicz KM, Naiman JP. A new frontier in science communication? What we know about how public audiences respond to cinematic scientific visualization. Front Commun. 2022. https://doi.org/10.3389/fcomm.2022.840631.
30. Keller E, Wyles KJ. Straws, seals, and supermarkets: topics in the newspaper coverage of marine plastic pollution. Mar Pollut Bull. 2021. https://doi.org/10.1016/j.marpolbul.2021.112211.
31. Pop V, Ozunu A, Petrescu DC, Stan AD, Petrescu-Mag RM. The influence of media narratives on microplastics risk perception. PeerJ. 2023. https://doi.org/10.7717/peerj.16338.
32. Backhaus T, Wagner M. Microplastics in the environment: Much ado about nothing? A debate. Glob Chal. 2019. https://doi.org/10.1002/gch2.201900022.
33. Fauville G, Dupont S, von Thun S, Lundin J. Can Facebook be used to increase scientific literacy? A case study of the Monterey Bay Aquarium Research Institute Facebook page and ocean literacy. Comput Educ. 2015. https://doi.org/10.1016/j.compedu.2014.11.003.
34. Kopke K, Black J, Dozier A. Stepping out of the ivory tower for ocean literacy. FRONT MAR SCI. 2019. https://doi.org/10.3389/fmars.2019.00060.
35. Dempster G, Sutherland G, Keogh L. Scientific research in news media: a case study of misrepresentation, sensationalism and harmful recommendations. JCOM. 2022. https://doi.org/10.22323/2.21010206.
36. Van Witsen A, Takahashi B. Knowledge based journalism in science and environmental reporting: opportunities and obstacles. Environ Commun. 2018. https://doi.org/10.1080/17524032.2018.1455723.
37. Al-Rawi A, O'Keefe D, Kane O, Bizimana AJ. Twitter's fake news discourses around climate change and global warming. Front Commun. 2021. https://doi.org/10.3389/fcomm.2021.729818.
38. Reif A, Guenther L. How representative surveys measure public (dis)trust in science: a systematisation and analysis of survey items and open-ended questions. J Trust Res. 2021. https://doi.org/10.1080/21515581.2022.2075373.
39. Olausson U, Berglez P. Media and climate change: four long-standing research challenges revisited. Environ Commun. 2014. https://doi.org/10.1080/17524032.2014.906483.
40. ALLEA. Fact or fake? Tackling science disinformation. ALLEA Discussion Paper, 5. Berlin; 2021. https://doi.org/10.26356/fact-or-fake. Accessed 4 Jul 2023.
41. Wardman T, Koelmans AA, Whyte J, Pahl S. Communicating the absence of evidence for microplastics risk: balancing sensation and reflection. Environ Int. 2021. https://doi.org/10.1016/j.envint.2020.106116.
42. West J, Bergstrom C. Misinformation in and about science. Proc Natl Acad Sci USA. 2021. https://doi.org/10.1073/pnas.1912444117.
43. Grünzner M, Pahl S, White MP, Thompson R. Exploring expert perceptions about microplastics: from sources to potential solutions. Micropl & Nanopl. 2023. https://doi.org/10.1186/s43591-023-00055-5.
44. Vercauteren M, Zhang T, Janssen CR, Asselman J. Policy informing brief: Analysis on the link between microplastics, the environment and public health. Ghent University, Belgium; 2023. https://www.health.belgium.be/en/policy-informing-brief-analysis-link-between-microplastics-environment-and-public-health. Accessed 2 Nov 2023.
45. Mengist W, Soromessa T, Legese G. Method for conducting systematic literature review and meta-analysis for environmental science research. METHODSX. 2020. https://doi.org/10.1016/j.mex.2019.100777.
46. Bilotta GS, Milner AM, Boyd I. On the use of systematic reviews to inform environmental policies. Environ Sci Policy. 2014. https://doi.org/10.1016/j.envsci.2014.05.010.
47. Chapman K. Characteristics of systematic reviews in the social sciences. J Acad Libr. 2021. https://doi.org/10.1016/j.acalib.2021.102396.
48. Southwell BG, Brennen JSB, Paquin R, Boudewyns V, Zeng J. Defining and measuring scientific misinformation. Ann Am Acad Polit SS. 2022. https://doi.org/10.1177/00027162221084709.
49. Burns TW, O'Connor DJ, Stocklmayer SM. Science communication: a contemporary definition. Public Underst sci. 2003. https://doi.org/10.1177/09636625030122004.
50. Page MJ, McKenzie JE, Bossuyt M, Boutron I, Hoffmann TC, Mulrow CD, Shamseer L, Tetzlaff JM, Aki EA, Brennan SE, Cho R, Glanville J, Grimshaw JM, Hróbjartsson A, Lalu MM, Li T, Loder EW, Mayo-Wilson E, McDonald S, Moher D. The PRISMA 2020 statement: an updated guideline for reporting systematic reviews. PLOS Med. 2021. https://doi.org/10.1371/journal.pmed.1003583.
51. Anderson AG, Grose J, Pahl S, Thompson RC, Wyles KJ. Microplastics in personal care products: exploring perceptions of environmentalists, beauticians and students. Mar Pollut Bull. 2016. https://doi.org/10.1016/j.marpolbul.2016.10.048.
52. Cammalleri V, Marotta D, Antonucci A, Protano C, Fara G. A survey on knowledge and awareness on the issue "microplastics": a pilot study on a sample of future public health professionals. Ann Ig. 2020. https://doi.org/10.7416/ai.2020.2377.
53. Deng L, Cai L, Sun F, Li G, Che Y. Public attitudes towards microplastics: perceptions, behaviors and policy implications. Resour Conserv Recy. 2020. https://doi.org/10.1016/j.resconrec.2020.105096.
54. Henderson L, Green C. Making sense of microplastics? Public understandings of plastic pollution. Mar Pollut Bull. 2020. https://doi.org/10.1016/j.marpolbul.2020.110908.
55. Raab P, Bogner FX. Conceptions of university students on microplastics in Germany. PLoS ONE. 2021. https://doi.org/10.1371/journal.pone.0257734.
56. Thiele CJ, Hudson MD. Uncertainty about the risks associated with microplastics among lay and topic-experienced respondents. Sci Rep. 2021. https://doi.org/10.1038/s41598-021-86569-5.
57. Zilinskaite E, Futter M, Collentine D. Stakeholders' perspectives on microplastics in sludge applied to agricultural land. Front Sustain Food Syst. 2022. https://doi.org/10.3389/fsufs.2022.830637.
58. Abalo E, Olausson U. An environmental problem in the making: how media logic molds scientific uncertainty in the production of news about artificial turf in Sweden. JCOM. 2023. https://doi.org/10.22323/2.22010201.
59. Janzik R, Koch S, Zamariola G, Vrbos D, White MP, Pahl S, Berger N. Exploring public risk perceptions of microplastics: FINDINGS from a cross-national qualitative interview study among German and Italian citizens. Risk Anal. 2023. https://doi.org/10.1111/risa.14184.
60. Völker C, Kramm J, Wagner M. On the creation of risk: framing of microplastics risks in science and media. Glob Chal. 2019. https://doi.org/10.1002/gch2.201900010.
61. Fu M, Yang K, Fujigaki Y. Constitutive and material: an empirical analysis of the two dimensions of the communication on microplastics in Japanese journals. East Asian Sci Technol Soc Int J. 2023. https://doi.org/10.1080/18752160.2022.2148329.

62. Fu M, Yang K, Fujigaki Y. Introducing an "invisible enemy": a case study of knowledge construction regarding microplastics in Japanese Wikipedia. New Media Soc. 2023. https://doi.org/10.1177/14614448221149747.
63. Creswell JW. Research design: qualitative, quantitative, and mixed methods approaches. 3rd ed. Thousand Oaks: Sage Publications; 2009.
64. Gailing L, Naumann M. Using focus groups to study energy transitions: researching or producing new social realities? Energy Res Soc Sci. 2018. https://doi.org/10.1016/j.erss.2018.07.004.
65. Eurobarometer. Media & news survey; 2023. https://europa.eu/eurobarometer/surveys/detail/3153. Accessed 12 Mar 2024.
66. Liedke J, Wang L. Social Media and News Fact Sheet. Pew Research Center; Washington, DC; 2023. https://www.pewresearch.org/journalism/fact-sheet/social-media-and-news-fact-sheet/. Accessed 2 Feb 2024.
67. Males J, Van Aelst P. Did the blue planet set the agenda for plastic pollution? An explorative study on the influence of a documentary on the public, media political agendas. Environ Commun. 2020. https://doi.org/10.1080/17524032.2020.1780458.
68. Howlett K, Lee H, Jaffé A, Lewis M, Turner E. Wildlife documentaries present a diverse, but biased, portrayal of the natural world. People Nat. 2023. https://doi.org/10.1002/pan3.10431.
69. Burgos E. From cowspiracy to seaspiracy: discursive strategies in contemporary vegan advocacy documentaries. Commun Soc. 2024. https://doi.org/10.15581/003.37.1.115-130.
70. Yeo S, Silberg J. Environmental documentaries in a digital age should be ethical, not just captivating. One Earth. 2021. https://doi.org/10.1016/j.oneear.2021.05.016.
71. Humm C, Schrögel P. Science for all? Practical recommendations on reaching underserved audiences. Front Commun. 2020. https://doi.org/10.3389/fcomm.2020.00042.
72. Fischer L, Barata G, Scheu AM, Ziegler R. Connecting science communication research and practice: challenges and ways forward. JCOM. 2024. https://doi.org/10.22323/2.23020501.
73. Pinto B, Matias A. How European journalists cover marine issues. JCOM. 2023. https://doi.org/10.22323/2.22050802.
74. Stavale R, Ferreira GI, Galvão J, Zicker F, Novaes MR, Oliveira CM, Guilhem D. Research misconduct in health and life sciences research: a systematic review of retracted literature from Brazilian institutions. PLoS ONE. 2019. https://doi.org/10.1371/journal.pone.0214272.
75. Tang BL. On some possible ramifications of the "Microplastics in Fish" case. Sci Eng Ethics. 2019. https://doi.org/10.1007/s11948-018-0063-z.
76. Eva Q, Sakura O, Li G. Mapping the field of misinformation correction and its effects: a review of four decades of research. Soc Sc Inform. 2021. https://doi.org/10.1177/05390184211053759.
77. Dziminska M, Mendoza I, Pellegrini G, Rowland J. Climate change and public perception. Citizens' proposals for better communication and involvement. JCOM. 2021. https://doi.org/10.22323/2.20030209.
78. Schneider C, Freeman A, Spiegelhalter D, Van der Linden S. The effects of communicating scientific uncertainty on trust and decision making in a public health context. JUDGM Decis Mak. 2022. https://doi.org/10.1017/s1930297500008962.

Publisher's Note Springer Nature remains neutral with regard to jurisdictional claims in published maps and institutional affiliations.