Article:
Sheridan, K.J. orcid.org/0000-0002-9389-3578, Blackburn, R.S. orcid.org/0000-0001-6259-3807, Prendergast-Miller, M.T. et al. (3 more authors) (2025) Letter to the Editor: Misclassification of fibres in Ramage et al. (2025) and implications for microplastics research. Chemosphere, 391. 144712. ISSN: 0045-6535

https://doi.org/10.1016/j.chemosphere.2025.144712

Letter to the Editor: Misclassification of Fibres in Ramage et al. (2025) and Implications for Microplastics Research

Dear Editor,

We read with interest the recent article by Ramage et al. (2025), "Microplastics in agricultural soils following sewage sludge applications: Evidence from a 25-year study" published in Chemosphere. The long-term dataset is a welcome contribution to the field; however, we are concerned that key aspects of the fibre identification methodology—and the conclusions drawn from it—may be flawed. These issues have broader implications for how microfibre contamination is understood and reported.

We highlight two central concerns:

1. Misclassification of cotton fibres as synthetic microplastics

Ramage et al. report that 60% of the microplastics identified were microfibres, of which 10% were characterised using FTIR. While partial subsampling is valid, the concern lies in the exclusive reliance on FTIR, without supporting methods or expert cross-validation. FTIR is a reliable tool for distinguishing synthetic polymers from natural fibres when applied correctly, but misidentification can occur when spectra are ambiguous or matched using automated libraries without sufficient scrutiny (Woodall et al., 2015).

Although the study's focus was on synthetic microplastics, the absence of an acid digestion step—commonly used to remove organic material, including natural fibres—increases the likelihood that natural fibres, particularly cotton, were retained in the samples. Previous research shows that natural fibres often outnumber synthetics in environmental matrices (Kechi-Okafor et al., 2023; Stanton et al., 2019; Ladewig et al. 2015), making their exclusion or misidentification a critical point of concern.

Notably, visual inspection of fibres shown in Figure 5 (a, b, c, possibly e, f, h) suggests that at least 5 of 8 of those shown are cotton not synthetic microfibres. Their flattened ribbon-like shapes, convoluted structure, and surface texture are characteristics all consistent with natural cellulosic fibres not synthetics; in several images it is also possible to see a lumen, which is only present in plant fibres (Greaves and Saville, 1995). If these fibres were reported as synthetic microfibres, this points to a

misclassification error, likely arising from misinterpretation or overreliance on FTIR spectral matching tools.

While the study presents some example supplementary FTIR spectra, there is insufficient information to fully evaluate the identification process. However, the morphological evidence raises the broader question: how many fibres reported as synthetic microplastics were, in fact, of natural origin?

This reflects a broader challenge in microfibre pollution research: insufficient methodological rigour and lack of interdisciplinary input. As we argue in Stanton et al. (2024), conflating microfibres with microplastics overstates synthetic content and misguides both environmental assessments and policy. Microfibres encompass both synthetic and natural materials, and this distinction is essential for accurate data interpretation and regulatory relevance.

2. Misinterpretation of dye-related features in indigo-dyed cotton fibres

The study attributes fibre discoloration to dye degradation in synthetic microplastics. However, several fibres shown—particularly in Figure 5 (a, b, c)—are consistent with indigo-dyed cotton, most likely from blue denim. Indigo-dyed cotton is globally ubiquitous, with billions of denim garments produced annually (Paul et al. 2021; Haaf, et al. 2019; Paul, 2015; Grieve et al., 2006), and blue denim representing one of the most distinguishable fibre types in some environmental samples (Athey et al. 2020). These fibres are identifiable by their bright blue hue and uneven dye penetration—a result of the complicated dyeing process and how indigo adsorbs onto cotton, not a sign of environmental fading. What the authors interpret as dye loss is more plausibly an artefact of initial dye application (Paul et al. 2021).

The article also notes that fibres visually similar to Fig 5 a, b, and c were present “in such large numbers that these became a category of their own,” though no data are provided. If indigo-dyed fibres were especially abundant after 2001, this may reflect shifts in denim production and use—not polymer degradation (Athey et al. 2020).

Similarly, Figure 5 (d) shows a colourless fibre presumed to be a faded synthetic. Yet many fibres enter the environment undyed. Bleached cotton, viscose, and polyester are widely used in white textiles, and many undyed fibres are used for nonwoven applications such as baby wipes – all appear colourless under microscopy. Without detailed spectral confirmation and contextual textile understanding, such fibres are easily misclassified as degraded synthetics.

Together, these issues illustrate how limitations in fibre characterisation—whether through exclusive reliance on FTIR, lack of morphological validation, or misinterpretation of colour—can result in the misidentification of fibres and misrepresentation of their sources. This not only inflates the estimated prevalence of synthetic microplastics, but also obscures the real complexity of fibre pollution, which includes substantial contributions from natural and semi-synthetic textiles.

In conclusion**,** the study by Ramage et al. offers valuable long-term data particularly from the terrestrial environment where such data is lacking. But its interpretation of fibre content is undermined by methodological gaps and insufficient interdisciplinary oversight. For microplastics research to provide accurate, actionable insights, it must distinguish clearly between fibre types and incorporate expertise from textile science, fibre experts, and material analysis. We encourage the adoption of integrated, validated methodologies to improve the reliability of fibre classification—so that environmental assessments and regulatory decisions are built on sound, comprehensive evidence.

References:

Athey, S.N., Adams, J.K., Erdle, L.M., Jantunen, L.M., Helm, P.A., Finkelstein, S.A. and Diamond, M.L., 2020. The widespread environmental footprint of indigo denim microfibers from blue jeans. Environmental Science & Technology Letters, 7(11), 840-847. https://doi.org/10.1021/acs.estlett.0c00498

Haaf, M.P.; Piemonte KM, McQuade DT, Cotton L.; Blackburn, R.S. (2019) In situ fabric coloration with indigo synthesised in flow. Coloration Technology, 125(2), 127-132. https://doi.org/10.1111/cote.12383

Greaves, P. H., & Saville, B. P. (1995). Microscopy of textile fibres (Microscopy Handbooks, No. 32). BIOS Scientific Publishers. https://doi.org/10.1201/9781003076971

Grieve, M.C., Biermann, T.W., Schaub, K., (2006) Use of indigo derivatives to dye denim material. Sci & Just, 46(1), 15-24. https://doi.org/10.1016/S1355-0306(06)71563-5

KeChi-Okafor, C., Khan, F.R., Al-Naimi, U., Béguerie, V., Bowen, L., Gallidabino, M.D., Scott-Harden, S., Sheridan, K.J., (2023) Prevalence and Characterisation of Microfibres along the Kenyan and Tanzanian Coast. Front. Ecol. Evol., 11:1020919. https://doi.org/10.3389/fevo.2023.1020919

Ladewig, S. M.; Bao, S.; Chow, A. T. (2015) Natural fibers: a missing link to chemical pollution dispersion in aquatic environments. Environ. Sci. Technol., 49(21): 12609−12610. https://doi.org/10.1021/acs.est.5b04754

Paul, R., (2015) Denim – Manufacture, Finishing and Applications Woodhead Publishing Ltd, Cambridge, UK

Paul, R., Blackburn, R.S. and Bechtold, T. (2021) Indigo and Indigo Colorants. In Ullmann's Encyclopaedia of Industrial Chemistry. https://doi.org/10.1002/14356007.a14_149.pub3

Ramage, S.J.F.F., Coull, M., Cooper, P., Campbell, C.D., Prabhu, R., Yates, K. Dawson, L.A., Devalla, S., Pagaling, E., (2025) Microplastics in agricultural soils following sewage sludge applications: Evidence from a 25-year study. Chemosphere, 376, 144277. https://doi.org/10.1016/j.chemosphere.2025.144277

Stanton, T., Johnson, M., Nathanail, P., Macnaughtan, W., and Gomes, R. L., (2019) Freshwater and airborne textile fibre populations are dominated by 'natural', not microplastic, fibres. Sci. Total Environ. 666, 377–389. https://doi.org/10.1016/j.scitotenv.2019.02.278

Stanton T, James A, Prendergast-Miller M.T., Peirson-Smith A., KeChi-Okafor C., Gallidabino M.D., Namdeo A., and Sheridan K.J., (2024) Natural Fibers: Why Are They Still the Missing Thread in the Textile Fiber Pollution Story?. Environ. Sci. Technol. 58(29): 12763–12766. https://doi.org/10.1021/acs.est.4c05126

Woodall, L. C., Gwinnett, C., Packer, M., Thompson, R. C., Robinson, L. F., and Paterson, G. L. J. (2015). Using a forensic science approach to minimize environmental contamination and to identify microfibres in marine sediments. Mar. Pollut. Bull. 95, 40–46. https://doi.org/10.1016/j.marpolbul.2015.04.044

Acknowledgements

This research was supported by the IMPACT+ Network, funding by the UKRI Circular Fashion and Textiles Programme: NetworkPlus—a trilateral initiative from the Natural Environment Research Council, Arts and Humanities Research Council and Innovate UK (Grant Ref: NE/Y004035/1).

Title Page (with author names and complete affiliations)

Title

Letter to the Editor: Misclassification of Fibres in Ramage et al. (2025) and Implications for Microplastics Research

Authors

Kelly J. Sheridan[1]*, Richard S. Blackburn[2], Miranda T. Prendergast-Miller[3], Josephine Jones[4], Ray Palmer[1^], Thomas Stanton[5]

Affiliations

1. Department of Applied Sciences, Faculty of Health & Life Sciences, Northumbria University, Ellison Building, NE1 8ST, Newcastle upon Tyne, UK
2. Leeds Institute of Textiles and Colour, School of Design, University of Leeds, Leeds, LS2 9JT, UK
3. Department of Geography and Environmental Sciences, Faculty of Engineering and Environment, Northumbria University, Ellison Building, NE1 8ST, Newcastle upon Tyne, UK
4. National Forensic Centre, Swedish Police Authority, 581 94 Linköping, Sweden
5. Geography and Environment, Loughborough University, Loughborough, LE11 3TU, UK

* Corresponding author (e-mail: kelly.sheridan@northumbria.ac.uk)
^ Ray Palmer is now retired

Contact email addresses

Kelly J. Sheridan kelly.sheridan@northumbria.ac.uk
Richard S. Blackburn r.s.blackburn@leeds.ac.uk
Miranda T. Prendergast-Miller miranda.prendergast-miller@northumbria.ac.uk
Josephine Jones josephine.jones@polisen.se
Ray Palmer dr.ray.palmer@mail.com
Thomas Stanton t.stanton@lboro.ac.uk

Declaration of interests

☐The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

☒The authors declare the following financial interests/personal relationships which may be considered as potential competing interests:

Kelly J. Sheridan reports a relationship with The Microfibre Consortium that includes: employment. If there are other authors, they declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.