Project Title	Rivers of Threads; Exploring Biofilm and Natural Fibre Dynamics in Freshwater Environments
University (where student will register)	University of Warwick
Which institution will the student be based at?	As above
Theme (Max. 2 selections)	Climate & Environmental Sustainability ☐ Organisms & Ecosystems ☒ Dynamic Earth ☐
Please explain how the project fits within the NERC remit	This project strongly aligns with the NERC remit as it investigates the environmental impact of natural textile fibers in freshwater environments, emphasizing interdisciplinary approaches and contributing to conservation and monitoring efforts. Furthermore, it aims to inform policies related to water management and environmental conservation while fostering skill development in environmental science, to advance environmental research and influence evidence-based policies.
Supervisory team (including institution & email address	**PI:** Sarah Cook (sarah.cook4@warwick.ac.uk) University of Warwick **Co-I:** Gary Bending (gary.bending@warwick.ac.uk) University of Warwick Soroush Abolfathi (soroush.abolfathi@warwick.ac.uk) University of Warwick Thomas Stanton (t.stanton@lboro.ac.uk) Loughborough University

Project Highlights:

1. This project addresses the critical environmental concern of textile pollution, emphasizing the significance of natural fibers in freshwater environments.
2. Employing an interdisciplinary research approach, it investigates the behavior and impacts of natural textile fibers through environmental science, biofilm studies, and ecological analysis.
3. Project outcomes aim to inform policy development on water management and environmental monitoring, potentially enhancing strategies to mitigate natural fiber presence in freshwater ecosystems.

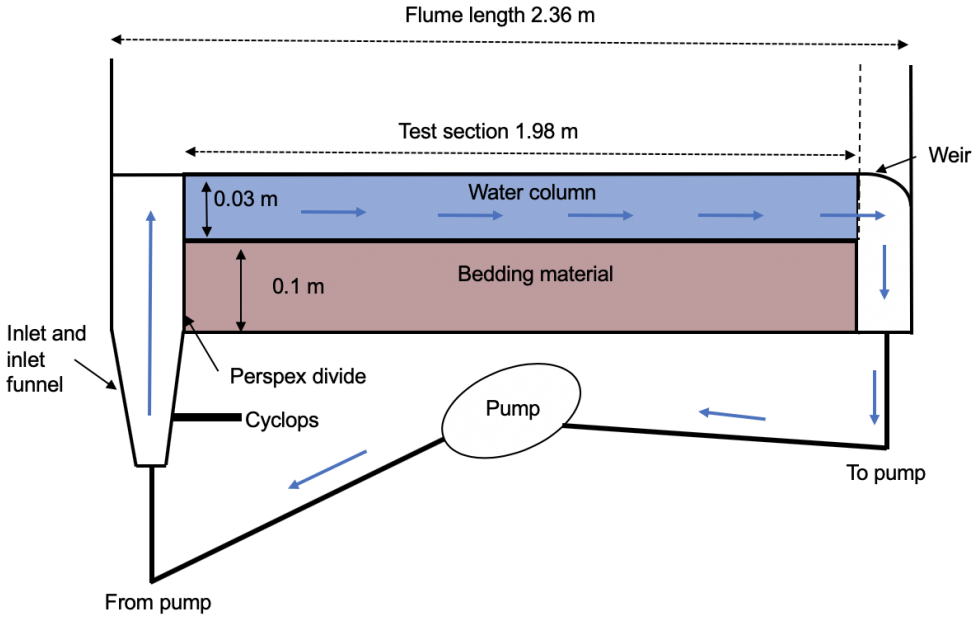
Overview (including 1 high quality image or figure):

Textile pollution, primarily linked to plastic fibers, poses a pressing environmental issue (Hazlehurst et al. 2023). In response, natural textile fibers like cotton have been championed as environmentally friendly alternatives. Recent research highlights that natural fibers, often overlooked, substantially dominate environmental surveys of textile fibers in freshwater (Stanton et al. 2019). Furthermore, early investigations suggest that natural fibers may potentially induce comparable or even greater ecotoxicological effects than plastic fibers (Détrée et al 2023). Yet, the full scope of natural fibers' fate and their impacts in freshwater ecosystems remains inadequately understood.

The role of riverbed sediments in serving as a repository for these natural fibers is expected, but their interactions with these fibers depend on a multitude of physical, biological, and chemical factors. This research project aims to investigate the complex interplay and feedback loops between riverbed dynamics and natural fibers in freshwater environments. The primary objective is to

identify the key variables that influence the entrapment and resuspension of natural fibers within this critical ecological zone. Various types of natural fibers with differing characteristics will be considered and analysed in comparison to plastic fibers using advanced technology and innovative methods.

Understanding the release rates and sources of natural fibers is vital for a comprehensive assessment of their environmental impact. The insights gained from this project have the potential to inform the development of new policies related to water management and environmental conservation, contributing to more effective strategies for monitoring and mitigating the presence of natural fibers in freshwater ecosystems.



Schematic figure to illustrate custom-built recirculating flume experimental system, comprising of 3 separate units each containing 3 flumes. Each flume is 1.98 m, long, 0.1m wide and 0.2 m deep.

Methodology:

This project will conduct laboratory experiments simulating river and lake conditions to investigate the influence of biofilm colonization on the settling velocity and distribution of natural textile fibers, alongside the potential to investigate resuspension from bioturbation. It will also involve characterizing the biological communities within biofilms formed on various fiber types and comparing them to those found on natural substrates. To further enhance the real-world applicability of the experiments, the natural fibers will be inoculated with real river water. The research will explore how environmental parameters, including UV degradation, pH, and temperature, impact the behaviour of fibers associated with biofilms. To validate the laboratory findings, spatial sampling of textile fiber populations in rivers and lakes will be conducted.

Training and skills:

Students will be awarded CENTA2 Training Credits (CTCs) for participation in CENTA2-provided and 'free choice' external training. One CTC equates to 1⁄2 day session and students must accrue 100 CTCs across the three years of their PhD.

This research project provides comprehensive training in various environmental science disciplines, covering topics such as environmental river processes, molecular techniques, ecological analysis, and metagenomic sequencing. Participants will gain practical experience by conducting hands-on

laboratory experiments that simulate river and lake conditions, allowing them to explore the effects of biofilm colonization on natural textile fibers. They will also have the opportunity to study biological communities within biofilms on different fiber types, using real river water for a more practical approach. Additionally, fieldwork includes spatial sampling of textile fiber populations in rivers and lakes.

Partners and collaboration (including CASE):
Further information on partners and collaboration (including CASE):

Possible timeline:

Year 1 will concentrate on setting up laboratory experiments simulating river and lake conditions. This encompasses equipment preparation, securing natural textile fiber samples, and launching biofilm colonization experiments, with initial data collection and analysis commencing.

Year 2, the project will progress to more advanced experimentation, investigating the influence of environmental parameters on fiber behaviour. Additionally, it will delve into characterizing biological communities within biofilms formed on various fiber types.

Year 3, the project's focus will shift towards the analysis and interpretation of the accumulated data. The primary objective will be to synthesize findings and draw conclusions about the entrapment and resuspension of natural fibers in freshwater environments.

Further reading:

Cook, S., Price, O., King, A., Finnegan, C., van Egmond, R., Schäfer, H., Pearson, JM., Abolfathi, S., Bending, GD. Bedform characteristics and biofilm community development interact to modify hyporheic exchange. Sci Total Environ. 2020 Dec 20;749:141397. doi: 10.1016/j.scitotenv.2020.141397.

Détrée, C., Labbé, C., Paul-Pont, I., Prado, E., El Rakwe, M., Thomas, L., Delorme, N., Le Goïc, N. and Huvet, A., 2023. On the horns of a dilemma: Evaluation of synthetic and natural textile microfibre effects on the physiology of the pacific oyster Crassostrea gigas. Environmental Pollution, 331, p.121861.

Hazlehurst, A., Tiffin, L., Sumner, M. and Taylor, M., 2023. Quantification of microfibre release from textiles during domestic laundering. Environmental Science and Pollution Research, 30(15), pp.43932-43949. doi: https://doi.org/10.1007/s11356-023-25246-8

Stanton, T., Johnson, M., Nathanail, P., MacNaughtan, W. and Gomes, R. (2019). Freshwater and airborne textile fibre populations are dominated by ‘natural’, not microplastic, fibres. Science of The Total Environment, 666, 377-389. doi: https://doi.org/10.1016/j.scitotenv.2019.02.278

Further details:

Please add project/institutional contact details including a link to the application website if applicable