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Beyond Boundaries: An International Workshop on Global Policy for Pollutants in Environment including Forever Chemicals

Book of Abstracts

Wednesday, 3rd July 2024
Venue: University of Central Lancashire, Preston, UK

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Beyond Boundaries: An International Workshop on Global Policy for Pollutants in Environment including Forever Chemicals

Wednesday, 3rd July 2024
Time: 8:30 - 4:30 PM (British Summer Time)
Venue: University of Central Lancashir, Preston, UK

ORDER OF PROCEEDINGS

8:30 - 9:30 AM	**Registration and Coffee**
9:30 - 9:45 AM	**Professor StJohn Crean - Pro Vice Chancellor (Research & Enterprise) - Welcome & Opening Remarks**
9:45 - 10:00 AM	**Dr. Tapas Sen - An Overview of Capacity Building project for UNEP**
10:00 - 12:20 PM	**Technical Session**
10:00 - 10:20 AM	**Professor Guozhu Mao - Charting the Future: Global Policy for Forever Chemicals through Bibliometrics, Patent Analysis and Technology Forecasting**
10:20 - 10:40 AM	**Professor Asim Bhaumik - Advanced Nanocomposites for the Development of Potential Electrochemical Sensors involving Water**
10:40 - 11:00 AM	**Mr. Gary Hogben - Current test methods for culture of bacteria in water systems**
11:00 - 11:20 AM	**Dr. Somenath Roy - Miniaturised Sensors for Water Quality Monitoring**
11:20 - 11:40 AM	**Dr. Paul Mcdermott - UK Regulations of Waterborne Pathogens**
11:40 - 12:00 PM	**Dr. Divya Rathod - Current challenges of water and foodborne microorganisms around Mumbai region and potential remedy for the benefit of public health**
12:00 - 12:20 PM	**Professor Anita Verma - How Nano-Scientists can help to Resolve the Current Challenges of Aqua-Culture in the Eastern India**
12:20 - 2:00 PM	**Lunch and Poster/Industry Exhibition**
2:00 - 3:30 PM	**Panel Discussion on Policy and Governance**
3:30 - 4:00 PM	**Coffee Break**
4:00 - 4:30 PM	**Award announcement, Future Planning and Closing Remarks**

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Beyond Boundaries: An International Workshop on Global Policy for Pollutants in Environment including Forever Chemicals

Panel Discussion
Wednesday, 3rd July 2024
Time: 2:00 - 3:30 PM (British SummerTime)
Venue: University of Central Lancashire, Preston, UK

PANELISTS

Join us for a thought-provoking panel discussion and engage with leading policy experts from academia, industry and public health. In this session, we will discuss critical issues and potential solutions on policy, health and environment. Gain insights, network and contribute to the discussion for global policy and public health.

Dr. Tapas Sen
RSC Intergovernmental Science Policy panel member
University of Central Lancashire, UK

Prof. Guozhu Mao
Environmental Policy
Tianjin University
China

Prof. Anna A Stec
Fire Chemistry & Toxicity
University of Central Lancashire
UK

Prof. Vicki Stone
Lead, Nanomaterials for regulatory risk assessment and safe-by-design
Heriot Watt University
UK

Mr. Amitabh Verma
Policy Advisor
Ex-Indian Administrative Service
India

Ms. Stephanie Metzger
Policy Advisor
Royal Society of Chemistry

Dr. Divya Rathod
S4YE Youth Advisory Group, World Bank
CEO of Silvery Nanos
India

Dr. Yolla McCoy
Technical Director
Feedwater Ltd.
UK

Dr. Sakthi Karunanithi
Director of Public Health
Lancashire County Council, UK

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Topics for Discussion

- Current regulation of chemical pollution under the discussion by science policy panel-OEWG 3 (Royal Society of Chemistry-UK) for United Nations
- Current challenges on PFAS: Analytical methods for measuring, remediation, destruction, alternatives, and substitution to PFAS and their effect on human health
- Current regulation of chemical and microbial pollution in developing countries such as China and India compared to developed countries.
- Nanoparticles toxicity in environment

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Capacity building with China and India, funded by British Council China and India in collaboration with Royal Society of Chemistry, UK

Dr Tapas Sen, Reader in Nanomaterials Chemistry & Fellow of Royal Society of Chemistry

University of Central Lancashire UCLan

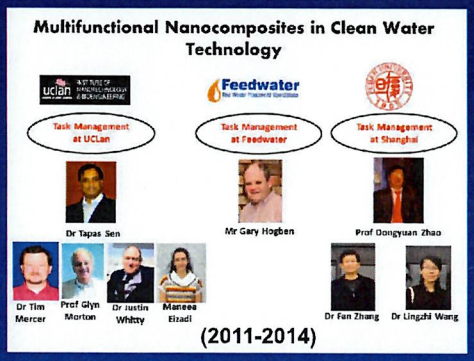
Email: tsen@uclan.ac.uk; Phone: +441772894371

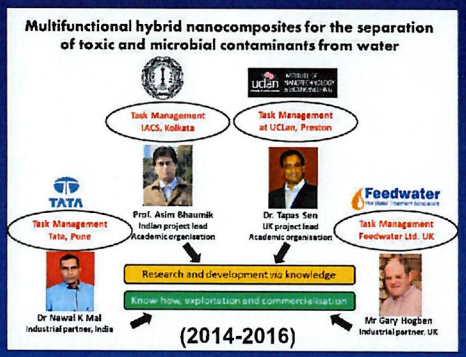
Dr Sen's research group has been actively working with several Indian and Chinese academic and industrial organisations since 2011 on public health related research involving water quality and cancer Theranostics using nanotechnology. 2 major projects with India and 2 major projects with China have already been completed with more than 10 bilateral academic visits from UK to China, UK to India and vice versa along with a large number of PhD students exchange, 4 joint PhD supervisions, 2 international workshops and 2 international conferences with 5 high impact journal special issues.

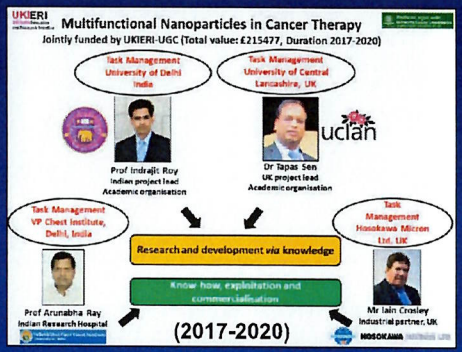
Currently, one project "Functional Nanomaterials in wastewater treatment" is running (2022-2024) in collaboration with East China University of Science & Technology which has been selected for a case study by British Council China as a most successful and well managed projects.

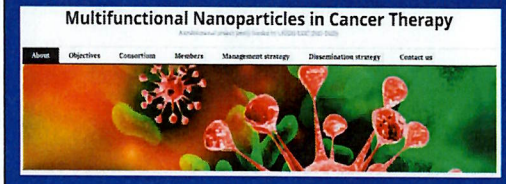
A brand new project "Development of nanobiosensors for the detection of waterborne pathogens in the interest of public health and education" has just been funded by British Council India Going Global programme, 2024-2025 and another project, first of its' kind "Implementation of Translational Research (TNR) into Transnational Education (TNE) involving environmental water ecosystem" has also been funded by British Council, China Going Global Institutional Partnership Fund for 2 years (March 2024- February 2026)

Past and recently completed projects









Ongoing and recently funded projects

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FNM Society for Functional NanoMaterials

BRITISH COUNCIL | India

Beyond Boundaries: An International Workshop on Global Policy for Pollutants in Environment including Forever Chemicals, 3rd July 2024, UCLan, Preston, UK

Title: Charting the Future: Global Policy for Forever Chemicals through Bibliometrics, Patent Analysis, and Technology Forecasting

G.Mao[1*], X.Zhang[2], Y.Yang[3]

[1,2,3]*Tianjin University, School Of Environmental Science & Engineering, Tianjin 300354, Peoples R China*
[*] *Email: maoguozhu@tju.edu.cn; Tel No. +86 022 27892622*

ABSTRACT

'Forever chemicals' pose a serious threat to the global environment and health due to their persistence and inability to degrade.This paper systematically analyzes the research status and future trends in this field, and analyzes the relevant global policies through bibliometrics, patent analysis and technology prediction. Bibliometrics reveals research hotspots and development trajectories, and patent analysis uses Derwent Innovations Index Database[1] makes subsequent technology forecasts, which use ARIMA big Data analytics to predict possible future technology breakthroughs and policy needs.

Keywords: forever chemicals, bibliometrics, patent analysis, technology prediction

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Beyond Boundaries: An International Workshop on Global Policy for Pollutants in Environment including Forever Chemicals, 3rd July 2024, UCLan, Preston, UK

Advanced Nanocomposites for the Development of Potential Electrochemical Sensors Involving Water

A. Bhaumik[1*], A. Ghosh[1], and T. Sen[2]

[1]*Indian Association for the Cultivation of Science, Kolkata, India;* [2]*University of Central Lancashire, Preston, UK*
[*]*Presenting author's details: Email: msab@iacs.res.in; Tel No. +913324734971*

ABSTRACT

Contamination of inorganic pollutants in water like mercury (Hg), arsenic (As), etc. is one of the major environmental and health issues that has been affecting our lives for several decades.[1] Porous organic and organic-inorganic hybrid materials by virtue of excellent porosity and high specific surface areas have emerged as ideal adsorbent materials for the sensing and removal of these heavy metal ions from contaminated water.[2] These porous nanomaterials are generally synthesized via bottom-up chemical reactions, which offer ample opportunities for modifying their structure through the incorporation of various functional sites, thereby, rendering them as an essential platform for designing flexible materials with numerous applications. Scalable synthetic approaches, together with high specific surface area and robustness of framework distinguishes the porous organic polymers (POPs) and covalent organic frameworks (COFs),[3] as versatile and indispensable nanoscale adsorbent materials along with other advanced porous materials including porous carbons, metal–organic frameworks (MOFs), functionalized mesoporous silica, and periodic mesoporous organosilicas (PMOs)[4] for the detection and removal of these toxic metal ions.

Thus, to address this matter a rational design for the robust porous adsorbent nanomaterials bearing chelating sites for binding with the metal ions is highly desirable. We have designed several high surface area adsorbent materials based on purely organic[5] or inorganic nanostructured materials[6] by employing the bottom-up chemistry approach and they displayed high affinity for sensing and/or binding with these heavy metal ions present in the contaminated water. High surface area and the presence of surface bound chelating donor sites in these nanoporous adsorbents provide high robustness and recyclability for sustainable operations.

Keywords: sensing of heavy metal ions; adsorptive removal, porous nanomaterials; porous organic polymers, covalent organic frameworks

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Current test methods for culture of bacteria in water systems

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Feedwater Ltd., UK

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ABSTRACT

In the 21st century access to clean potable water remains elusive for billions of people worldwide. The United Nations has made access to clean water and sanitation the subject of UN sustainable development goal 6 that addresses both this issue and those of salutation, pollution reduction, protection of ecosystems and improving international cooperation. Much of the end result of this work will depend upon the development of real-time sensing and on online monitoring, enabling intervention to protect the quality of water. My presentation will look at some of these challenges with a specific focus on current situation regarding microbiological testing for two key developed world pathogens. This analysis remains stuck in a that past era, dependent upon fixed laboratory facilities and extended incubation. Similar problems apply to other organisms of concern in less developed nations. We will set some key challenges for the future development of active surfaces that prevent or restrict growth of microbes.

Beyond Boundaries: An International Workshop on Global Policy for Pollutants in Environment including Forever Chemicals, 3rd July 2024, UCLan, Preston, UK

Miniaturised Sensors for Water Quality Monitoring

Somenath Roy* and Ankita Dutta Chowdhury

Functional Materials and Devices Division, CSIR-Central Glass and Ceramic Research Institute, 196 Raja S.C. Mullick Road, Kolkata 700032, India

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ABSTRACT

The assessment and continuous surveillance of water quality are essential for the preservation and responsible utilization of aquatic ecosystems, safeguarding public health, and supporting various industries and communities that rely on clean water sources. To this end, the deployment of robust and efficient water quality monitoring systems has become a crucial endeavor, with the development of advanced sensor technologies playing a pivotal role [1]. Conventional water quality monitoring practices have typically involved manual sample collection and laboratory analysis, which can be time-consuming, labor-intensive, and unable to capture the dynamic and spatiotemporal complexities of water supply systems [2,3]. However, in recent years, the integration of *in-situ* sensors, remote sensing, and predictive modeling has revolutionized the field of water quality monitoring, enabling more comprehensive, real-time, and cost-effective assessments.

In this direction, miniaturized point-of-analysis sensors offer a promising approach for the rapid, *in-situ* detection of heavy metals and pathogenic contamination in water. While heavy metals are responsible for a gamut of health issues including liver and kidney failure, gastric and skin cancer as well as neurological disorders [4]; the presence of coliform bacteria, in particular *Escherichia coli (E. Coli)* in drinking water can cause gastrointestinal disorders, fever, fatigue, and even death [5].

We adopt a two-pronged approach for water quality monitoring using miniaturized sensors. On one side, electrochemical sensors, modified with specific sensing materials, are deployed for detection of heavy metal ions (Hg^{2+} and As^{3+}) in water. On the other hand, electrical sensors having specific bio-recognition elements, are explored to detect DNA of the target pathogens (*E. Coli* in this case) that might potentially be present in drinking water. In literature, for example, carbon dots derived from green precursors have demonstrated excellent heavy metal ion detection capabilities, with the ability to selectively bind and report on the presence of ions such as iron, mercury, copper, and lead [6]. In this work, covalent organic polymers (COPs) are explored as promising materials for detection of mercury contamination in drinking water. Owing to the presence of free lone-pair electrons on N atoms that are suitably placed to coordinate with Hg^{2+}, these porous polymers offer high degree of adsorption for Hg^{2+} that entails a sensitive detection [7]. For recognition of DNA fragments, derived from the genome sequence of *Escherichia coli* O157:H7, we deploy micro-fabricated electronic chips, bearing oligo sequence complementary to the target DNA, along with a customized signaling probe for sensitive and specific detection of the pathogen. The PCR-free technology for instant detection of pathogenic DNA could be a game changer in water quality monitoring, especially in resource-limited areas.

Keywords: *water quality, heavy metals, pathogenic DNA, miniaturized sensors, point-of-analysis detection*

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Title: UK regulation of waterborne pathogens

P.J. McDermott[1]

[1]*PJM-HS Consulting Ltd*
Email: info@pjm-hs.co.uk Tel No. +44(0)7518528885

ABSTRACT

This short paper describes the regulatory requirements for safe water in the workplace. It covers the laws that apply in all workplaces and those that apply specifically in the healthcare setting, where patients receiving care there may be at increased risk of infection from opportunistic waterborne pathogens. To help employers and healthcare service providers comply with their legal obligations, a range of guidance material is available and will be discussed briefly, alongside the enforcing authorities responsible for these sectors.

Keywords: opportunistic waterborne pathogen, legislative requirements, enforcing authority

Beyond Boundaries: An International Workshop on Global Policy for Pollutants in Environment including Forever Chemicals, 3rd July 2024, UCLan, Preston, UK

Title: Current challenges of water and foodborne microorganisms around Mumbai region and potential remedy for the benefit of public health

Author: Dr. Divya Rathod
[1]*Silveyrnanos Innovations LLP*
[*]*Presenting author's details: Email silverynanos@gmail.com., founder@hapito.in; Tel No. +91 7208009995*

ABSTRACT

Mumbai being densely populated with 210 million population and with one of the biggest slums in world is facing huge water and sanitation (UNDP SDG 6) problems. According to TOI about 83% of diseases in Mumbai are due to unclean and unhygienic water supply used in food, toilets, drinking water, cleaning., etc. According to recent January 2024 reports and Brihanmumbai municipal corporation's recent environment status report (ESR), 2019-20, states that *Escherichia coli*, which can cause anything from dysentery to meningitis if ingested, continues to have a high count along the city's coastline. *E. coli* with increasing multidrug resistance properties has caused a nuisance in antibiotic treatment due to which mortality rates increased drastically in recent years, especially in children which is of major concern. *E. coli* detection takes ample of time and effort, hence urgent application of technologies like nanotechnology combined with artificial Intelligence is required in the field of microbiology. Nanotechnology revolution is required for combating world challenges like Climate change due to chemical pollutants used majorly by facility management industry which will also result in decrease in chemical resistance of micro-organisms including *E. coli*. Nanotechnology combined with AI has wide applications which can combat problems in MDR, climate change, cleaning industry leading to prevention of infections causing pandemics, sustainability, green synthesis, detection of micro-organisms in less time and effort, accessibility, ease of manufacturing, advantage in export and import and many other making a better planet for future.

Keywords: water and sanitation, sdg6, *E. coli, nanotechnology, artificial intelligence, climate change, detection*

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How Nano-Scientists can help to Resolve the Current Challenges of Aqua-Culture in the Eastern India?

Anita Kamra Verma[1,2*]

[1]*Nano-Biotech Lab, Kirori Mal College, University of Delhi, Delhi-110007, India*
[2]*Fellow, Delhi School of Public Health, Institution of Eminence, University of Delhi, Delhi, India*
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ABSTRACT

Keywords: Nanotechnology, Aquaculture sustainability, fish farms, Pathogen control, nanoregulation.

Aquaculture is considered one of the most important food production systems both in terms of economic impact and food security, and the ongoing development of this industry is a key factor in the strategy to guarantee nutritional safety in Eastern India. Novel approaches have paved innovative technologies to deal effectively with such challenges. Among these, nanotechnology has shown tremendous potential in aquaculture preservation by increasing its production, efficiency and sustainability. Recent efforts have been made in the fields of health management, enhancement of fish and shellfish development by dietary supplementation with nutraceuticals, but also in the processing and preservation of seafood and water treatment, among others. Therefore, nanotechnology has a significant role to play in the improvement of the efficiency and the environmental impact of this industry. Given this perspective, we propose using nanotechnology in the field of aquaculture and fisheries, emphasizing not only in current applications, and future prospects, but also in the ethical and governance aspects associated with this topic. The talk will briefly shed light on its potential as a novel tool which may possibly enhance the management and the control of disease prevalence. Therefore, the importance of this technology to promote sustainable aquaculture has also been highlighted.

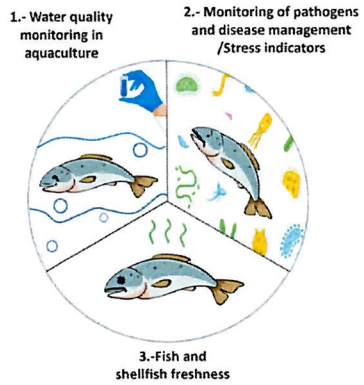

Fig.1: Nanosensors for monitoring fish health

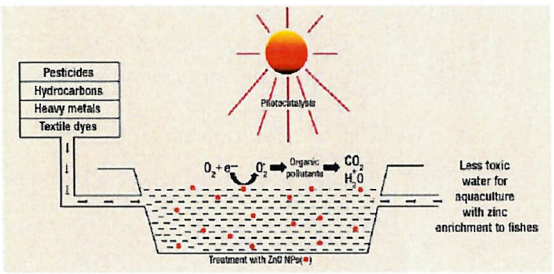

Fig 2: Nanoremediation by zinc oxide nanparticles

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Title: Decomposition study of "Forever Chemicals" using multifunctional magnetic nanocomposites

Author: Mohammed Faris Haroon
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ABSTRACT

This study synthesized magnetic titanium IONPs for PFOA catalytic degradation under UV light, varying Titanium concentrations and activated Charcoal were also incorporated. The nanocomposites showed promise for PFAS treatment, confirmed by XRD and FT-IR for synthesis accuracy. EDX confirmed titanium concentration variations. Despite limited data, qualitative interpretations supported findings. Multifunctional magnetic titanium IONPs offer potential for PFAS degradation with eco friendly synthesis and mild reaction conditions.

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BRITISH COUNCIL

Beyond Boundaries: An International Workshop on Global Policy for Pollutants in Environment including Forever Chemicals, 3rd July 2024, UCLan, Preston, UK

Title: Removal of fluoride ions from ground water using nanotechnology tools and methodologies

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ABSTRACT

Fluorine contamination of ground water has become a major problem as it can cause several health issues. This poster discusses a fluoride removal technique using Zr and Magnetite nanoparticles. FT-IR, SEM/EDX, XRD are used determine the characteristics and the fluoride removal efficiency is measured by using a fluoro-meter.

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Beyond Boundaries: An International Workshop on Global Policy for Pollutants in Environment including Forever Chemicals, 3rd July 2024, UCLan, Preston, UK

Title: A future study validating a GCMS method for the concentration determination of PFAS from UK drinking water after one step enzymatic degradation and separation via horseradish peroxidase/Fe magnetized nanocomposites

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ABSTRACT

Per – and polyfluoroalkyl substances (PFAS) originally gained widespread attention from the industrial sector for their revolutionary properties, particularly their chemical robustness and outstanding amphiphilic nature. This chemical robustness however has led to them being dubbed 'forever chemicals', and subsequently a major problem to the environment and human health[1]. Degradation and capture of PFAS is no longer just research, but policy. With over 4,700 individual PFAS compounds, the concentration limit of 100 ng/L in water is often easily exceeded in UK waters, hence the substantial research on capture and degradation of PFAS[2]. Technologies such as enzymatic, photocatalytic, electrochemical, sonification and nanotechnology are common trends for removal of PFAS, with some degrading parent compounds by 100%[3]. Our proposed research aims to capture and degrade PFAS, particularly perfluorooctanoic acid (PFOA) and trifluoroacetic acid (TFA), by breaking the carbon-fluorine bonds. The C-F bond requires 526 j mol^{-1}[4] of energy to break, hence the challenging chemistry at hand. While our primary aim is to separate and degrade PFAS, it is vital that a valid and reproduceable method is established for monitoring the degradation of PFAS. Our goal is to develop an analytical method using GC-MS to monitor the capture of PFAS and the concentration of fluoride in water samples. Due to the non-volatile nature of PFOA and TFA, samples will be chemically transformed via esterification prior to GC-MS analysis and spiked with an internal standard. SPE extraction via a commercial syringe will be performed to concentrate PFAS samples while analysing the efficiency of the commercial SPE material, which we will modify with magnetic Fe_3O_4 to reduce the steps in sample preparation. We expect a calibration curve with linear results for quantification, validation and limit of detection (LOD). Previous use of Ti IONP's combined with activated charcoal was explored by our team for degradation of PFAS which led to further developments such as utilizing zinc and magnetite composites. Our current study focuses on enzymatic degradation of PFAS with naturally abundant horseradish peroxidase (HRP), combined with magnetic separation via Fe_3O_4 nanoparticles (NP). HRP mediated degradation has been reported in previous literature with substantiated results [5]. Our aim is to immobilize HRP onto magnetized Fe_3O_4 NP's for a one step breakdown and separation of PFAS in a cost effective and green manner.

Keywords: Enzyme, PFAS, graphene oxide, nano particle, magnetic

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Beyond Boundaries: An International Workshop on Global Policy for Pollutants in Environment including Forever Chemicals, 3rd July 2024, UCLan, Preston, UK

Cigarette butt pollution causes abnormal behaviour in *Gammarus pulex*

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ABSTRACT

Discarded cigarette butts are one of the world's most common pollutants and consist of over 4000 chemicals and compressed microplastics. The ubiquity of cigarette butts presents a significant challenge to our natural environment. While human health concerns predominate this area of study, strong lethal and sublethal impacts of cigarette butts on aquatic life have been found. This study focused on the potential behavioural impact of cigarette butt pollution on aquatic biota using the amphipod crustacean species, *Gammarus pulex*. A laboratory experiment was conducted in which individual *G. pulex* were subjected to one of four conditions: smoked non-menthol cigarette butt leachate, unsmoked non-menthol cigarette butt leachate, almond leaf leachate and 48-hour aged water. Each single blind observation was conducted for 10 minutes. Active, resting and circling behaviours, which were established in an ethogram during a pilot experiment, were observed and collected in the behavioural recording software BORIS. A Kruskal-Wallis test showed that circling behaviour was significant. Further analysis using a pairwise Wilcoxon rank sum test showed that the smoked and unsmoked cigarette filters were significant in comparison to almond leaves and aged water. These results showed that cigarette butt pollution caused *Gammarus pulex* to circle more, irrespective of whether the filters had been smoked or not. This potentially inhibits *G. pulex* ability to escape predation, causing detriment to their survival rates. Active and resting levels were not influenced by cigarette butt pollution. These findings shed light on the ecological consequences of these hazardous contaminants and contribute knowledge to the behavioural impact of cigarette butt pollution on aquatic invertebrates.

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Beyond Boundaries: An International Workshop on Global Policy for Pollutants in Environment including Forever Chemicals, 3rd July 2024, UCLan, Preston, UK

Dynamic Modelling of Nitrogen Flux in River Systems: Impact of Land Use Pattern on River Quality

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ABSTRACT

Excess nitrate in water can lead to eutrophication, algal blooms, and biodiversity loss. In Pakistan, a developing country struggling with poor water quality and sanitation, providing clean drinking water and preserving river systems are critical challenges. A 2013 study found nitrate contamination responsible for 13% of waterborne diseases. This study used the Integrated Catchment Model of Nitrogen (INCA-N) to simulate daily nitrogen concentrations in the Kabul River System for 2017. The river was divided into seventeen reaches, with six key reaches selected for detailed analysis. GIS software ARC INFO determined sub-catchment boundaries and land use patterns. INCA-N modeled nitrogen processes like nitrification and denitrification. Results indicated that dominant scrub forests and unplanned livestock grazing in the upper reaches are major nitrogen sources. Three scenarios were tested: converting scrub forest to irrigated agriculture, reducing fertilizer application by 20%, and changing nitrogen deposition by 50%. The first scenario reduced nitrate levels by 20%. The model's performance was validated with a Nash-Sutcliffe efficiency of 0.65 for nitrate-N and 0.75 for ammonium-N.

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Beyond Boundaries: An International Workshop on Global Policy for Pollutants in Environment including Forever Chemicals, 3rd July 2024, UCLan, Preston, UK
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Beyond Boundaries: An International Workshop on Global Policy for Pollutants in Environment including Forever Chemicals, 3rd July 2024, UCLan, Preston, UK
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Beyond Boundaries: An International Workshop on Global Policy for Pollutants in Environment including Forever Chemicals, 3rd July 2024, UCLan, Preston, UK
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