UNIVERSITY OF BIRMINGHAM | Centre for Environmental Research & Justice

Centre for Environmental Research and Justice (CERJ)

Annual Report 2024

Photo Credits

Front page caption: Justitia surveys our polluted world

Photographs from CERJ Networking Day (not credited below) by Edward Moss Photography

Page	*Contributor*
Cover	Pavel Danilyuk, Pixabay, David Epps
4	Prof. Georgios Gkoutos
8	Dr Scott Glaberman
9	Dr Louis Dawson
10	Phenome Centre Birmingham, Creative Media
11	Hajime Watanabe, Creative Media, Eszter Voros
12	Frankie Lloyd
14	Frankie Lloyd
15	Unsplash
16	Prof. Iseult Lynch, Creative Media
17	Frankie Lloyd
18	Dr Katie Reilly, Dr Niamh Eastwood
20	Prof. Luisa Orsini / UPSTREAM
23-24	Agata Ormanin-Lewandowska / PrecisionTox
25	ONTOX
26	Pexels
28-29	David Epps
30	David Epps, Frankie Lloyd
32	Sergio Mendes, David Epps, Bayer Crop Science
36	Frankie Lloyd, David Epps
37	David Epps, Dr Xiaojing Li, Dr Niamh Eastwood
38	Juneau Projects

General information

Centre for Environmental Research and Justice (CERJ)
University of Birmingham
Edgbaston
B15 2TT
United Kingdom

birmingham.ac.uk/cerj

cerj@contacts.bham.ac.uk

cerj-uob

Contents

Foreword 1

Executive report 3

The CERJ Network

- The CERJ Network 6
- Dr Scott Glaberman 8
- Dr Louis Dawson 9
- Affiliated Facilities 10
- Committees 12

Research

- Research briefing 16
- Projects portfolio 19
- Update: PrecisionTox 23
- Update: PARC 25

Education

- Education briefing 29
- MSc Human and Environmental Toxicology with Law 31
- Placements 32

Events and engagement

- CERJ Networking Day 34
- Highlight events 36

Appendices

- Media, publications and impact 39
- Conferences, engagement, outputs 43
- Awarded research funding 47
- Contributions and acknowledgements 49

UNIVERSITY OF BIRMINGHAM

Centre for Environmental Research & Justice

Foreword

Professor John Colbourne

Director of CERJ

Environmental injustice refers to "the inequitable exposure of poor, minority, and disenfranchised populations to toxic chemicals, contaminated air and water, unsafe workplaces and other forms of pollution, and the consequent disproportionate burden among these populations of pollution-related disease, often in violation of their human rights"[1]. Environmental justice restores these rights by bringing fairness and equal treatment to affected communities through participation, due process and redress. Pollution kills three times more people than AIDS, malaria, and tuberculosis combined, accounting for one in four deaths in the poorest countries. Chemicals are also responsible for a decline in biodiversity that threatens ecosystem health and the services we derive from nature, such as pollination. Compounding the problem, traditional approaches to chemical risk assessment are slow, costly, unreliable and have proven unable to assign culpability and responsibility.

"We are raising the University's international profile through our **unique pathways to impact**"

Our Centre for Environmental Research and Justice (CERJ) offers a radical solution to this wicked problem – by focusing research and education on science-based governance interventions that will protect the environment, save lives and restore justice for those most harmed by pollution. We do this by working across multiple disciplines to fully embrace, combine, apply and extend the recent innovations in both science and governance. We work to inspire the next generation of environmental advocates in the same way that the discovery of genetic fingerprinting in 1984 has inspired civil rights advocates in criminal legal proceedings and tribunals involving people from minority populations, leading to a widespread acceptance of this new body of evidence by replacing uncertainty with greater scientific precision. CERJ is unique in its mission to bring science and governance experts together at the University of Birmingham to accelerate a new approach to establishing causal links – between chemicals in the environment and victims of pollution – by fingerprinting the harm caused by exposure in order to hold polluters accountable. The aim is to develop a working toolkit of environmental governance mechanisms into which precision toxicology is embedded to serve communities and our natural environments.

In pursuing our mission, we are raising the University's international profile through our unique pathways to impact. For example, the UK is poised to abandon the traditional and unethical use of animals for testing and regulating hazardous chemicals. By advancing new approach methodologies in regulatory toxicology, CERJ has a leading role in developing an alternative and profitable biomarker industry for testing chemical safety, diagnosing exposure-related diseases and providing mechanistic insights to support therapeutic interventions and treatments. CERJ faculty already advises the UK government through the Hazardous Substances Advisory Committee towards this future, and we're building our capacity

to lead a network of reference laboratories to validate these new approaches for their use in the UK and beyond. By expanding our scientific expertise to include engineers and computing scientists, CERJ has a leading role to play in implementing novel methods to remediate polluted environments using the same precision toxicology principles. CERJ contributes to the realisation of numerous UN Sustainable Development Goals (SDGs), most directly SDG 3, Good Health and Well-Being, by addressing dire public health issues connected to industrial pollution, and SDG 12, Responsible Consumption and Production, by targeting these toxic industrial outputs and developing processes for arriving at remedies or safer and more sustainable alternatives. In addition, we further SDG 16, Peace, Justice, and Strong Institutions, by building and strengthening environmental justice structures that can serve as models for multiple settings. Equally, these priorities correspond to the UK aid strategic objective of enhancing societal and ecosystem resilience by applying scientific and technological innovation to better support public and environmental health.

Last year, we welcomed our first cohort of MSc students who will obtain degrees in human and environmental toxicology with law. These graduates will fill a void within industry and government agencies for employees and leaders in transitioning to 21st cfentury regulatory toxicology. This and other course offerings will help to de-silo the pursuit of research and education to enable “action research” and grow this approach at our university to solve global challenges. The academic ambition of a university was rewarded in the past by recognition for its “schools of thought”. Ours, instead, will be recognised for our “schools of action”. This is our not-so-distant future.

Professor John Colbourne

[1] Landrigan, P.J. et al. (2018) ‘The Lancet Commission on pollution and health’, The Lancet, 391(10119), pp. 462–512.

Above: Photographs from CERJ Networking Day 2024

Top to bottom: Professor Mark Viant represents Michabo Health Sciences at a panel discussion; Dr Muhammad Abdullahi watches one of several key lectures; Ms Erin Jarvis and Ms Morven Pennie discuss a CERJ research poster; Dr Karin Slater recaps her presentation for several attendees.

Executive Report

from the Board of Directors

In 2024, the Centre for Environmental Research and Justice (CERJ) has grown, developed and adapted into a resilient community of researchers dedicated to effecting change through interdisciplinary action. Environmental injustice disproportionately affects poor, minority and disenfranchised populations, leaving them exposed to pollution from toxic chemicals in contaminated air, water and soil. Our centre is developing a portfolio of activities targeting this injustice; from cutting-edge research on effects and mitigation to educating and developing future environmental toxicologists and advocates.

Professor Iseult Lynch, CERJ Director of Research

We are delighted to report research successes including two new dedicated CERJ Fellowships and involvement in a new European Commission chemicals and pharmaceuticals project, and are constructing plans to harness significant impact from our involvement in the Partnership for the Assessment of Risks from Chemicals (PARC), which continues to provide substantial research time and opportunities for our newly recruited academics.

Most notably, our newly launched MSc in Human and Environmental Toxicology with Law has begun with an enthusiastic cohort of students joining the course to become the next generation of environmental risk assessors and advocators. We are proud to instil within them a fundamental understanding of the cross- and interdisciplinary "CERJ approach" our centre so boldly embodies. Plans are in motion to build and improve upon these achievements as we continue to make impactful strides towards securing a healthy environment for the future.

Professor Robert Lee, CERJ Director of Education

Our networks also continue to expand as we undertake new work with partners in industry, governmental, academic and non-governmental organisations (NGOs). Work towards an exciting placement programme with several of these is underway to develop year-in-industry pathways for our MSc students and outstanding final-year undergraduate students. The response from our partners to this has been very encouraging.

Professor Luisa Orsini, CERJ Deputy Director

Important to note is that 2024 has been a period of change and evolution for CERJ. Whilst the purpose of CERJ has never been in doubt, its membership,

remit and direction have formed ongoing constructive discussions: the original concept paper for the Centre described how pollution could not be solved in silo, and we have been working to forge and strengthen connections with a broad range of partners to pursue this approach. This resulted in creating membership policies and delivering workshops to encourage a wide range of researchers to join our cause to address pollution concerns through new multidisciplinary approaches.

Professor Georgios Gkoutos, CERJ Deputy Director

Capturing some of this growth and directional change, the Board is drafting an outline paper for CERJ – aimed at Lancet Planetary Health – which portrays the catastrophic effects of pollution and outlines the bold new directions our Centre brings in an attempt to influence a paradigm shift in addressing pollution.

Professor Aleksandra Cavoski, CERJ Deputy Director

This period of reflection also led to a highly productive November workshop, jointly organised by our Community Research Development Committee (CRDC) and Events Committee focused on the vision of the Centre to construct a unified and shared direction, understanding, and purpose. Early 2025 brings a follow-up event, hosted by new recruit Dr Scott Glaberman, which will build on event learnings and develop a new informed framework for centre-wide working and improved structure. This will – inevitably – lead to larger future successes, and we are excited to see how grassroots coordination and action has helped shape and develop centre activities in bold and tangible ways.

Professor John Colbourne, Director of CERJ

Our approach to planning research and education initiatives ensures continual horizon-scanning for identification and seizing of opportunities. With our newly acquired talent we hope to vastly expand our current portfolio to build CERJ into the preeminent resource for pioneering research, policy advocacy, community engagement, and tangible solutions to pollution.

The CERJ Board of Directors

The CERJ Network

CERJ 2024 Annual Report

UNIVERSITY OF BIRMINGHAM

Centre for Environmental Research & Justice

The CERJ Network

The driving force behind CERJ's success

CERJ was established through the shared vision of its founding academics, who recognized the need for mobilization to address global environmental issues. It is a grassroots centre formed to be greater than the sum of its parts; to collaborate, network and respond to some of the most critical issues of our time.

The centre emerged from a collaboration between colleagues across three University of Birmingham colleges: Life and Environmental Sciences, Medicine and Health, and Arts and Law. During the last year we were delighted to bring onboard participants from the College of Engineering and Physical Sciences and continue to seek further opportunities for collaboration with other colleges, schools, institutes and groups to further broaden our efforts torwards holistic resolution of pollution-based issues. In pursuit of this, the CERJ Board hosted several collaborative workshops in 2024 to identify potential internal partnerships and forge promising collaborations. We are committed to nurturing these relationships in 2025 and beyond as a means to generate innovative and impactful projects in line with the centre's mission.

Our researchers emphasize the importance of collaboration and multidisciplinary connection to address the global challenge of environmental pollution and its detrimental effects on human and environmental health. They leverage cutting-edge initiatives to drive impactful change, working with partners across academia, industry, government and non-profit organisations to generate novel responses to pressing concerns. They are passionate about providing top-tier education and training to the next generation of environmental experts and advocates, and believe in the cascading impact this approach brings.

The CERJ Network understands that large problems cannot be solved in isolation, and adopt transdisciplinary and revolutionary perspectives. Everyone in our network – academics, researchers, and professional services – brings CERJ to life. They are the driving force propelling us towards future change.

Attendees at the CERJ Networking Day 2024, 24th June 2024

CERJ Core Members are directly involved in our research, education, affiliated facilities or community development, and are listed A-Z (by surname) below.

College of Life and Environmental Sciences

Academic staff	*Postdoctoral researchers*	*Doctoral researchers*	*Other Staff & Students*
Prof. John Colbourne	Dr Muhammad Abdallahi	Jessica Chadwick	Marianne Barnard
Dr Scott Glaberman	Dr Sam Benkwitz-Bedford	Jacob-Joe Collins	Lauren Cruchley-Fuge
Dr Zhiling Guo	Dr Laura-Jayne Bradford	Grace Davies	David Epps
Prof. David Hannah	Dr Emilie Brun	Timothy Ezeorba	Raymond Huynh
Prof. Stuart Harrad	Dr Niamh Eastwood	Cristiana Gheorge	Erin Jarvis
Dr Scott Hayward	Dr Ossama Edbali	Shaleen Glasgow	Dr Lisa King
Prof. Iseult Lynch	Dr Martin Jones	Nooshin Barzegar Marvasti	Stephen Kissane
Prof. Luisa Orsini	Dr Eva Junque	Federica Merella	Frankie Lloyd
Dr Archana Sharma-Oates	Dr Xiaojing Li	Tia Soltanighias	Agata Ormanin-Lewandowska
Prof. Mark Viant	Dr Gavin Lloyd	Arron Watson	Caroline Sewell
Dr Ralf Weber	Dr Indrani Mahapatra	Lisi Wu	Eszter Voros
Dr Tim Williams	Dr Teng Meng	Ziheng Zou	
Dr Pu Xia	Dr Anastasios Papadiamantis		
Dr Jiarui (Albert) Zhou	Dr Oddný Ragnarsdóttir		
	Dr Katie Reilly		
	Dr Arthur de Carvalho e Silva		
	Dr Andrew Southam		
	Dr William Stubbings		
	Dr Tahmina Yasmin		

College of Arts and Law

Academic staff	*Postdoctoral researchers*	*Doctoral researchers*	*Other Staff & Students*
Dr Jyoti Ahuja	-	Ke Tang	Laura Holden
Prof. Aleksandra Cavoski			
Dr Louis Dawson			
Prof. Robert Lee			
Dr Synda Obaji			

College of Medicine and Health

Academic staff	*Postdoctoral researchers*	*Doctoral researchers*	*Other Staff & Students*
Prof. Georgios Gkoutos	Dr Yavor Hadzhiev	Nelson Alves	Niall Dunne
Dr Christian Ludwig		Qianhong Guan	
Prof. Ferenc Mueller			
Dr Karin Slater			

College of Engineering and Physical Sciences

Academic staff	*Postdoctoral researchers*	*Doctoral researchers*	*Other Staff & Students*
Dr Iestyn Stead	Dr Irwing Ramirez	Aaron Ainsworth	-
		Jacob Brown	
		Maninder Dayal	
		Morven Pennie	

Welcome to CERJ

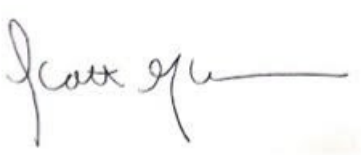
Dr Scott Glaberman

Scott joined the University of Birmingham at the beginning of 2024 as an Assistant Professor of Comparative Toxicology. He rapidly engaged with various activities: moving to the United Kingdom, applying for funding, starting CERJ research, and providing invaluable contributions to the MSc Human and Environmental Toxicology with Law programme. He is also taking leadership in the CERJ Placements programme and is pioneering the 2025 CERJ mission to craft themed work groups within the Centre. It has been a busy year!

Scott writes about his progression to date: "The diverse experiences in my career have greatly improved my teaching style. I started out as an evolutionary biologist, studying speciation in the Galapagos Islands – think giant tortoises! But I had an aching feeling that my work was too theoretical and wouldn't make a difference in the world. A fellowship in science policy at the American Association for the Advancement of Science redirected my career towards exciting new paths. This experience led me to spend many years as an applied scientist at the US Environmental Protection Agency, specialising in pesticides and water quality. There, I conducted numerous chemical risk assessments, collaborating with both domestic and European partners. The most exhilarating part was learning to perform science swiftly and under intense scrutiny.

In the classroom, I employ many real-world examples, stressing the application of science and communication skills, encouraging students to rely on observation and collaboration. For example, I regularly teach an environmental biology course in which I've integrated aspects of COVID-19, including the virus origins, mRNA vaccines, PCR testing, and the evolution of new genetic variants. For almost a decade, I've also taught environmental toxicology, equipping students with the latest tools for risk assessments pertinent to chemical regulation. My aim is to ensure each student is job-ready for various roles in environmental science and policy.

Joining the University of Birmingham is thrilling because of the impressive knowledge and passion for environmental health and justice among the students and researchers. The synergy within this community is remarkable. At both CERJ and the School of Biosciences, I plan to teach chemical regulation for the new MSc Human and Environmental Toxicology with Law and to help develop a dynamic internship programme, aiming to make Birmingham a pipeline for top environmental careers."



Dr Scott Glaberman

Welcome to CERJ

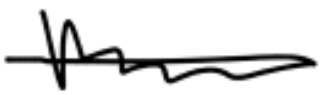
Dr Louis Dawson

Louis joined the Centre for Environmental Research and Justice in the summer of 2024 as an Assistant Professor of Law. He completed his PhD in environmental law at the University of Birmingham, having studied under an EPSRC Scholarship (pretty unusual for a lawyer!). This was due to his participation in the Faraday Institution, with his project focusing on lithium-ion battery recycling. During his doctoral studies, Louis was able to gain secondments to the House of Commons and the Welsh Senedd, so that he became well versed on policy development!

Louis previously held the post of Lecturer of Law at the University of South Wales, and completed his Postgraduate Certificate in Learning and Teaching in Higher Education (PGCLTHE). Louis acted as course leader for the USW's Master of Law programmes (LLM Laws and LLM Laws, International Commercial Law), and so is well versed in student recruitment, curriculum development and programme administration. He is passionate about ecology and the role of law in protecting the environment and is delighted to be back in Birmingham as a member of CERJ!

Louis conducts a beach clean to remove washed-up plastics, demonstrating first-hand the importance of circularity

Despite only joining towards the latter-end of 2024, Louis has provided valuable insights to our centre's education programme and vision planning, and we are excited to continue working together to drive focus on a portfolio of training, development, education and research in environmental law.



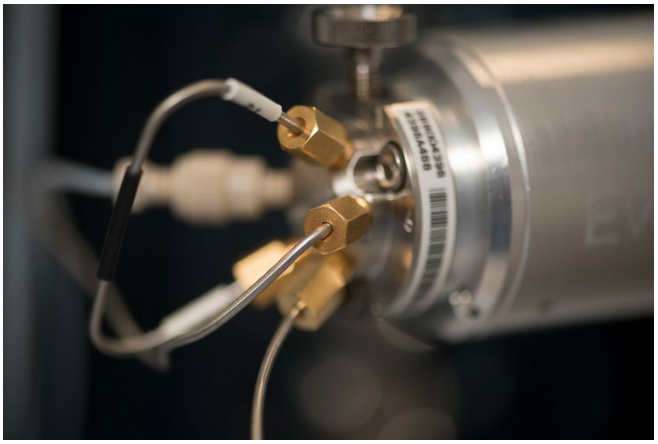
Dr Louis Dawson

Affiliated Facilities

CERJ is fortunate to collaborate with affiliated facilities that play a crucial role in underpinning our research activities. These partnerships enhance our ability to conduct groundbreaking research through providing access to exciting and cutting-edge approaches in tackling pollution.

Phenome Centre Birmingham

The Phenome Centre Birmingham (PCB) is an internationally recognised metabolomics facility, providing expertise and advice in metabolomics research, from conception and experimental design through data acquisition to analysis and biological interpretation.



Valves and capillary system of a liquid chromatography system coupled with a mass spectrometer

Using state-of-the-art ultra-high performance liquid chromatography-mass spectrometry (UHPLC-MS), PCB conducts analyses on model organisms, cells, and human samples to investigate toxicological effects. PCB is involved in many CERJ research projects, helping to ensure we remain at the forefront of scientific innovation.

PCB's team holds over 150 years of combined experience in the field of metabolomics, has forged networks and partnerships spanning academia, industry and government, and is involved in activities both pioneering and developing the future of metabolomics. The team is also championing the use of omics (primarily metabolomics and transcriptomics) for broader application in regulatory toxicology, working closely with worldwide regulators to better embed the approach in chemical safety assessment.

Phenome Centre Birmingham staff analysing samples on state-of-the-art analytical equipment

PCB is involved in several activities across the CERJ Network, including a pivotal role within the flagship PrecisionTox project, where the centre is processing 29,000 metabolomics assays on model organisms exposed to a variety of chemicals. The overarching project aim is to identify pathways of toxicity shared by common ancestry, and PCB's core participation demonstrates how this CERJ affiliated centre is helping to drive the future of modern chemical safety assessment.

Find out more: birmingham.ac.uk/PCB

Daphnia Facility

The Daphnia Facility offers light- and temperature-controlled laboratory spaces for *Daphnia magna* eco(toxicology) and exposure biology experiments. The water flea, *Daphnia magna*, has a remarkable ability to remain in "suspended animation" for centuries, allowing scientists to revive dormant populations that endured varying historical pollution pressures. This makes them a fantastic model for studying responses to environmental stressors throughout time, and a critical affiliated facility underpinning CERJ's research.

Daphnia magna under the microscope

The Daphnia Facility plays a vital role in several large-scale CERJ European Projects such as PrecisionTox and PARC, which focus on establishing New Approach Methodologies (NAMs) to safeguard both human health and the environment. The facility also supports CERJ PhD students, postdoctoral researchers and fellows undertaking projects in a variety of fields, including evolutionary biology, (eco)toxicology, bioremediation, and genomics.

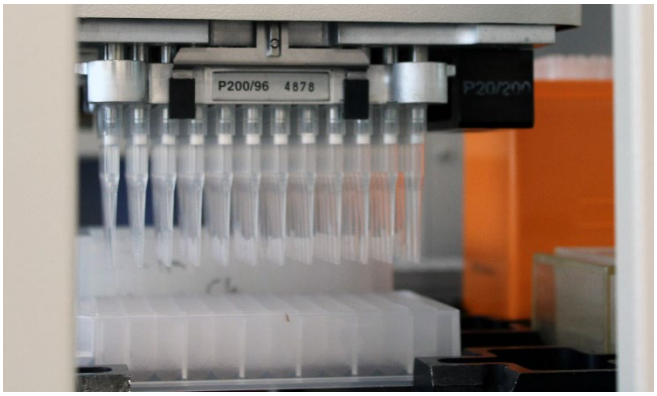
Marianne Barnard (Daphnia Facility Manager) conducts an experiment in the laboratory

Find out more: birmingham.ac.uk/daphnia

EnviSion

EnviSion provides comprehensive environmental omics services, guiding projects from initial design to data acquisition. Collaborating with scientists, industry partners, and commercial businesses, EnviSion offers tailored solutions to meet diverse research needs. Founded in 2019, EnviSion has grown steadily, advancing innovative methodologies and toolkits, offering specialized training for students and researchers, and successfully delivering collaborative projects with industry and regulatory bodies.

In 2024, EnviSion has contributed to 17 European-funded projects, 14 UK-funded projects, and 4 industry collaborations, establishing itself as a vital research service at the University of Birmingham. EnviSion supports groundbreaking research, providing cutting-edge expertise and facilities.



96-well head on a Beckman Coulter enables support for high-throughput screening (HTS)

EnviSion has played a pivotal role in CERJ, contributing to the Horizon 2020 project PrecisionTox, where they provided expert guidance to institutions across the EU and generated samples leading to significant scientific discoveries. Committed to innovation, EnviSion is developing novel tools poised to revolutionize exposure biology, ecotoxicology, and conservation biology. In 2024, EnviSion spearheaded the development of spatial transcriptomics in non-model species, offering transformative insights into tissue and cell-specific toxicity.

Looking ahead, EnviSion is also pioneering in-field biodiversity monitoring solutions, leveraging high-throughput approaches to enhance monitoring and conservation efforts. With a strong track record in supporting research excellence, EnviSion continues to drive impactful discoveries and practical applications in environmental science and exposure biology.

Find out more: birmingham.ac.uk/envision

CERJ Committees

At CERJ, our core activities, interests, and initiatives are powered by a network of dedicated committees. These committees are not only essential to our operations but also embody the grassroots collaboration that inspired CERJ's founding.

Events Committee

- **Co-Chairs**: Marianne Barnard, Dr Niamh Eastwood
- **Members**: David Epps, Dr Martin Jones, Frankie Lloyd, Agata Ormanin-Lewandowska, Dr Katie Reilly, Eszter Voros

The Events Committee is a fundamental component of CERJ, planning, coordinating and delivering a diverse programme of events to nurture and grow our centre community. These events bring together our network, disseminate research, enhance knowledge and skills, and shape the future of CERJ.

2024 event highlights included the Grant Writing Workshop led by guest expert Elisabeth Andrews to equip early career researchers with new skills, and the annual CERJ Christmas Social which provided a chance for the CERJ Network to come together and celebrate our collective successes.

Elisabeth Andrews hosts a Grant Writing Workshop for CERJ

In response to community feedback, the Committee also jointly organised a November 'Shaping the CERJ Vision' workshop with the Community Research Development Committee, aiming to integrate the diversity of expertise, interests, and voices within the centre's future structure and goals.

CERJ Events Committee members, 2024

The major annual occasion in the CERJ calendar, Networking Day, was the most successful yet with over 70 attendees. The event assembles the entire CERJ Network – academics, researchers, and professional services across all five colleges and varied career levels – to celebrate the centre's activities and mobilise around future opportunities. Crucially, this year's event welcomed the participation of stakeholders from our vast CERJ Partner Network, spanning industry, government agencies and non-governmental organisations.

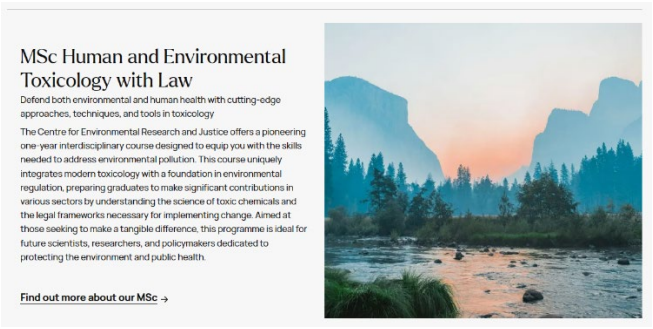
> "CERJ Networking Day [was] a good example of **interdisciplinary collaborations**, and especially of the **inclusion** of staff in various roles and careers levels in research and impact development […]."
>
> **Networking Day attendee feedback**

In 2025, the Events Committee plans to build on their successes and establish further events that cater to the needs of the CERJ community, create opportunities, and foster new collaborations.

Education Committee

- **Chair**: Professor Robert Lee
- **Members**: Professor John Colbourne, Dr Louis Dawson, Dr Scott Glaberman, Frankie Lloyd, Dr Pu Xia, Dr Albert Zhou

2024 saw the launch of CERJ's first major deliverable, our new MSc Human and Environmental Toxicology with Law. This milestone would not have been possible without the outstanding efforts of the Education Committee, who developed a high-quality program aimed at equipping students with the necessary knowledge and skills to tackle pollution-based issues. Our new MSc is both inter- and cross-disciplinary, instilling students with "the CERJ perspective" that pollution-based issues require a holistic approach. More information on the MSc can be found later in the report.



MSc advertisement on the CERJ website

The committee is investigating part-time and distance learning variants to expand the course's scope and reach, but the launch of the MSc also served as a springboard for other activities. We are in discussions with our CERJ Partner Network regarding additional contributions, such as MSc final project work and placement opportunities. Developing placements is high on the priority list: in 2024, CERJ partnered with Bayer Crop Science to offer several year-in-industry placements. In the new year, Committee-member Dr Scott Glaberman will lead the charge to secure additional opportunities which augment the university's course offerings and enhance impact for students and placement hosts alike.


Professor Robert Lee responding to questions about CERJ Education deliverables at CERJ 2024 Networking Day

Looking ahead, the Education Committee is focusing on Continuous Professional Development (CPD), aiming to create and deliver several CPD programs in rapid succession. We are evaluating synergies with some of our academic partners, for example the University of Illinois which runs a highly successful programme combining regulatory toxicology and regulatory science, including 'Genomics for Judges'. This is a useful link to have!


Dr Pu Xia introducing his new module at the CERJ 2024 Networking Day

The Education Committee continues to develop exciting and dynamic contributions to this mission, with new activities, perspectives and opportunities

lining the horizon which educate and inspire the next generation of environmental researchers, policy-makers and advocators. Our Education deliverables will equip students with the skills and knowledge necessary to address complex environmental challenges and drive sustainable impact and long-term change.

Community Research Development Committee

- **Chair**: Dr Iestyn Stead
- **Members**: Marianne Barnard, Dr Niamh Eastwood, Laura Holden, Raymond Huynh

The CERJ Community Research Development Committee (CRDC) is the newest of our committees, started in 2024 with the remit of developing, coordinating and joining researchers across community-driven research applications in line with overall CERJ research strategy. The committee focuses on new interdisciplinary grass-roots research opportunities that are vital for maintaining, developing and undertaking community action.

Dr Iestyn Stead presents on best practice in interdisciplinarity at the CERJ 2024 Networking Day

The CRDC conducts horizon-scanning and dissemination for grants and recently published a community resource spreadsheet of recurring small grants (£1k-£300k) relevant to CERJ's research areas, focusing on interdisciplinary opportunities. It is hoped that this resource will enable early career researchers to find and apply for appropriate funding to continue to grow as a researcher, support their future development, and provide new prospects for portfolio and career advancement.

Professor John Colbourne presenting the old CERJ themes at the 'Shaping the CERJ Vision' workshop

Perhaps the most important output to date of the CRDC was the 'Shaping the CERJ Vision' workshop, jointly organised with the Events Committee. Since its founding, CERJ had been segmented into five themes: Measurement, Monitoring, Effects, Prediction and Demonstration. However, upon review and discussion with the CERJ Network, it became apparent these were ill-defined and did not accurately represent the breadth and diversity of CERJ expertise. The vision workshop therefore sought to initiate conversations on a new framework for CERJ that better reflected centre operations, and community involvement has been paramount to laying the groundwork for a new structure. We look forward to a further workshop in early 2025 to push discussions further and begin mapping a framework the entire CERJ Network can identify with.

Though important, this is not the only item on the horizon; the CRDC is developing a series of workshops and seminars on topics in line with its research-advancing aims, including grant development, demystifying university application procedures, and communicating with policymakers.

Research

CERJ 2024 Annual Report

UNIVERSITY OF BIRMINGHAM

Centre for Environmental Research & Justice

Research briefing

Professor Iseult Lynch

CERJ Director of Research

In just a couple of generations we have lost our connection to the natural world, and with it the implicit understanding that the planet's resources are finite and that our relentless consumerism is polluting and poisoning ourselves and our planet. This disconnect can be linked to increased urbanisation, reduced awareness of the cycles of growth and decay, and to the disposable culture embodied by fast fashion and the relentless offers to "upgrade our phone". This connection to the land was inherent in older generations. My mother, for example, was one of the first environmentalists I knew – she walked everywhere, she recycled religiously (and gave instructions for recycling and gifting her treasured sewing materials and books in her final days), she repaired and mended clothes to prolong their life, planned meals carefully to avoid food-waste and ate seasonal food sourced from Ireland as far as possible, long before these actions became fashionable or part of a *movement*. She deeply resented the accusation from Gen Z activists that it was her generation who had caused the climate crises, and cited the fact that (at least in Ireland) fresh mangoes, avocados and other exotic fruit were unknown until at least the 1990s, and that having a coffee for her meant sitting down in one place and drinking from a cup that someone then washed rather than having it "on the go" and throwing away the disposable cup (to join the 7 million cups that are discarded every single day in the UK alone).

Integrating cross-generational knowledge and perspectives, as well as indigenous approaches to living in harmony with the planet, interweaving it with advanced technological approaches and mechanistic understanding of how ecosystems function and interact, underpinned by post-consumerism business models and stronger governance and legal regulatory frameworks that are empowered by scientific evidence to enforce "polluter pays" principles, for example, will provide the necessary step-change to "restore our environment and ensure a thriving planet for all". CERJ embodies this vision and brings together our greatest minds from across environmental science, medicine, engineering, law, business and the humanities, enabling action research and translation of the research into societal change. CERJ's research plays a critical role in achieving the University of Birmingham's strategic vision 2030 to become a world top-50 university, leveraging internationally recognised strengths in environmental sciences and law.

Professor Luisa Orsini and Daphnia Facility Research Technician Erin Jarvis examine Daphnia magna specimens which may unlock our understanding of comparative toxicology

2024 has been a transformative year for CERJ from the ***research capability*** perspective – five of our newly hired academic staff are now in place, across Biosciences, Medicine and Law, who are bringing their energy, enthusiasm and vision to CERJ. Their expertise spans evolutionary biology and

ecotoxicology (Dr Scott Glaberman), systems toxicology for next generation risk assessment (Dr Pu Xia), linked data and biomedical semantics (Dr Karin Slater), environmental bioinformatics (Dr Jiarui Zhou, known to all as Albert), and environmental law (Dr Louis Dawson), with another post in the area of environmental health data to be filled shortly. In addition, the CERJ Board of Directors have been defining the scope for participation and membership in CERJ and working actively to expand our basis into Engineering, Computer Sciences, Human Geography, Humanities and beyond. Workshops were held with colleagues from across the university during the Spring to present CERJ and its vision, and to identify areas for collaboration and growth, with a number of follow-up activities planned.

Early career researchers attend a CERJ research proposal workshop in March 2024

Another key focus area for 2024 has been ***building the collaborative, inclusive and supportive ethos*** of CERJ's research community. The CERJ Board of Directors are committed to ensuring that all CERJ academics and researchers thrive and achieve their full potential, and thus a strong focus has been placed on mentoring new staff in grant writing and leadership, and ensuring succession planning for CERJ leadership roles. Specific examples of ongoing activities to support our research portfolio and research income generation include:

- Development of a research funding pipeline that identifies key opportunities, matches these to CERJ academics with the capability, career-level and desire to lead bids, and identifies a CERJ Founding member to provide mentoring in the bid development;
- A dedicated CERJ administrative post to support research bid development and research project management and to liaise with the school and college level research support teams to support CERJ academics and researchers;
- Empowering our growing and evolving CERJ research community to help shape the medium and longer-term vision for CERJ, through ongoing engagement and the all-hands workshop in November 2024 (which also considered education and networking).

"The scale of the challenge "**to restore our environment and ensure a thriving planet for all**" requires our greatest minds from across science, medicine, engineering, law, business and the humanities to come together in innovative ways to create solutions and empower collective action. CERJ embodies this vision."

These approaches are already paying off, with several of the grant successes in 2024 being from early career researchers securing fellowships, including Dr Laura Bradford securing a Daphne Jackson fellowship for return to science, Dr Xiaojing Li beginning a NERC Knowledge Exchange Fellowship in Precision Environmental Health, and Dr Swaroop Chakraborty securing a prestigious NERC Independent Research Fellowship to explore the environmental transformations of metal-organic frameworks (MOFs) and their consequences for the safe and sustainable use of

MOFs. Swaroop will join CERJ in 2025; for the full list of funding secured and begun in 2024, see the Appendix.

CERJ's leading role in the Partnership for Assessment of the Risks of Chemicals (PARC) and its role as the largest (funding and overall participation) UK partner were further consolidated by hosting the 2-day in-person UK PARC Science days at The Exchange on 21st and 22nd May 2024, which was attended by over 100 researchers. CERJ academics and researchers continue to find their way into existing PARC projects and propose UoB-led PARC projects.

Dearbhla the Daphnia (Dr Katie Reilly!) visits Draycote reservoir for some rest and relaxation before a busy Autumn of activities including the British Science Festival in London, and the Cladocera conference in October 2024

CERJ researchers are also highly active in ***public engagement in research***, with just a couple of examples including:

- Living Lakes in Motion – a hands-on one-off evening workshop (19th September 2024) using animation to explore the relationship between technology and the natural world, led by Juneau Projects and inspired by CERJ research, to create a visual story about biodiversity, lake species, and artificial intelligence;
- Dr Katie Reilly (School of Geography, Earth and Environmental Sciences) and a team of researchers are delivering a session entitled 'Nature's agony aunts' featuring Dearbhla the Daphnia (pictured to the left) to highlight some of the key challenges facing freshwater environments – a refreshingly amusing and engaging activity likely to be repeated several times in 2025.

Attendees of the Living Lakes in Motion event construct the storyboard for the animation

This report can only ever be a snapshot of CERJ's research activities, but the appendix provides more details including the list of publications, some press coverage of our research, the geographical breadth of our research collaborations and more.

Iseult Lynch

Professor Iseult Lynch

Projects portfolio

CERJ continues to demonstrate its strength as an outstanding academic research center. Our projects are interdisciplinary, multi-partner, and often multi-sector, aimed at driving change and generating insights that contribute to our mission.

Dr Xiaojing Li

NERC Knowledge Exchange Fellow

Xiaojing began her fellowship for developing and improving Precision Environmental Health (PEH) in February 2024 and has made significant strides in both knowledge exchange and research activities.

In the past year, Xiaojing had the pleasure of contributing to the Workshop of the European Cooperation in Science and Technology (COST) Action CA21111, "Omics Technologies as a New Tool in Ecotoxicology" and the CERJ Networking Day, where she received encouraging positive feedback. Another highlight of the year was an invitation to participate in a workshop on "Next Generation Environmental Risk Assessment of Chemicals" in Tianjin. There, Xiaojing shared her expertise on developing New Approach Methodologies (NAMs) for chemical risk assessments and advocated for the creation of a benchmark database to support both regulatory and research needs. A major milestone was joining the NAMs Validation Working Group of the European Partnership for Alternative Approaches to Animal Testing (EPAA). Through this platform, Xiaojing contributed to advancing paradigm shifts in NAMs validation by helping to align regulatory standards with cutting-edge methodologies.

Xiaojing's Fellowship also offers research opportunities deeply connected with ongoing CERJ activities. In the Partnership for the Assessment of Risks from Chemicals project, Xiaojing co-leads a case study (MONAMMIX) within work package 6, focusing on addressing the limitations of current EU and UK regulatory frameworks (e.g. Water Framework Directive) in evaluating the risks of complex chemical mixtures in freshwater ecosystems by developing PEH next generation risk assessment (PEH-NGRA) approaches. Last year she also published papers in *Trends in Genetics*[2] and *Environmental Science & Technology* (ES&T)[3], with notable attention; the latter being featured in both EurekaAlert and CHEMIE.DE, a leading German scientific platform.

Xiaojing discussing her experiences as a Knowledge Exchange Fellow at the CERJ 2024 Networking Day

Looking ahead to 2025, Xiaojing aims to continue driving progress in the PARC case study, deepen her involvement with the EPAA, and further contribute to workshops and collaborative initiatives that bridge the gaps between NAMs and regulatory practice.

[2] Li X, Colbourne JK. A molecular mechanism for environmental sex determination. Trends in Genetics. 2024

[3] Li X, Zhou J, Bai Y, Qiao M, Xiong W, Schulze T, et al. Bioactivity Profiling of Chemical Mixtures for Hazard Characterization. Environ Sci Technol. 2025 Jan 14;59(1):291–301.

Project funded by

UKRI Natural Environment Research Council

Dr Laura-Jayne Bradford

Daphne Jackson Research Fellow

Laura began a Daphne Jackson Fellowship (underwritten by NERC) in May 2024, which is specifically for those who have taken a break of at least two years from their career in research for family, caring or health reasons. Returning to academia, Laura was eager to dive back into the fascinating yet under-regulated world of nanomaterials — tiny particles with big implications for our environment and health.

Her project tackles the challenges of assessing the environmental and biological risks of nanomaterials, which are increasingly used in consumer products but remain poorly regulated. By combining acute and chronic toxicity studies on *Daphnia magna* – a model organism – Laura's research will generate data on how nanomaterials transform in realistic environmental conditions and how these changes affect biological systems over multiple generations.

Much of 2024 was spent generating data; Laura conducted (i) acute toxicity studies to establish the toxicity of her four nanomaterials, and (ii) chronic (28-day) studies using the pristine nanomaterials. Data for each of these has been obtained across 6 generations (F0-F5) of exposed *Daphnia* in both natural water replicate and OECD standard test media, collecting an array of data for genomic investigation.

The outcomes of Laura's work include advancing environmental toxicology, enhancing regulatory strategies for nanomaterials, and fostering machine-learning applications to predict long-term health risks in human populations. These efforts aim to collectively safeguard aquatic ecosystems, which are critical for overall environmental and human health.

Project funded by
Daphne Jackson TRUST

UPSTREAM (Circular and Bio-Based Solutions for the Ultimate Prevention of Plastics in Rivers Integrated with Elimination And Monitoring Technologies)

Upstream
FOR WASTE-FREE EUROPEAN RIVERS

UPSTREAM is a Horizon Europe Innovation Action project focused on improving the cleanliness and water quality of European rivers, particularly those flowing through major capitals and into five sea basins. The project addresses pollution from litter, plastics, and microplastics in seven key rivers using 15 advanced solutions.

The UPSTREAM team pioneering the use of *Daphnia magna* to treat wastewater in partnership with Severn Trent Water

The University of Birmingham – with academics from CERJ – plays a crucial role in two areas:

Water bioremediation: Collaborating with Daphne Water Solutions (DWS), the University supports a nature-based technology for treating wastewater. This solution removes pharmaceuticals, pesticides, and industrial chemicals, making the water safe for reuse. In partnership with Severn Trent Water, the technology is being optimized to also remove microplastics.

Circular reuse of biomass: The team is developing a system to reuse *Daphnia* (water flea) biomass, which is a byproduct of DWS water treatment, as fertilizer. This includes treating residual chemicals with a photocatalysis process enhanced by sustainable nanoparticles.

In 2024, the water bioremediation technology was successfully validated at a prototype scale, highlighting its immense potential. Preparations are underway for its first commercial-scale application at a Severn Trent wastewater plant in 2025. Additionally, a feasibility study on sludge treatment was completed in 2024, demonstrating the feasibility of photocatalytic processes to destroy microplastics and enable biomass reuse, in line with sustainability goals. In 2025, a benchtop reactor will be developed to scale up this process towards commercial applications.

Find out more: upstream-project.eu

Project funded by

UKRI Innovate UK

Co-funded by the European Union

RECREATE (Recycling Critical Elements in Advanced Technologies for the Environment)

RECREATE aims to develop a circular economy for technology-critical materials (TCMs), keeping the materials or components in the highest value form with the lowest environmental footprint. CERJ academics are embedded examining critical materials policy and world trade law, building upon previous work in the Met4Tech project, which was designed to accelerate transition towards a circular economy.

Although launched in April 2024, RECREATE is already off to a flying start with a recent publication in *Global Energy Law and Sustainability*[4], and attendance by colleague Dr Jyoti Ahuja at an International Organisation for Standardisation (ISO) workshop on Sustainable Critical Mineral Supply Chains.

[4] Ahuja J, Lee R, Cavoski A. Geopolitics of Access to Critical Minerals Necessary to Support Energy Transition. Global Energy Law and Sustainability. 2025;163–81.

Project funded by

UKRI Engineering and Physical Sciences Research Council

PINK (Provision of Integrated Computational Approaches for Addressing New Market Goals for the Introduction of Safe-and-Sustainable-by-Design Chemicals and Materials)

The PINK project, which started in January 2024 is developing an open innovation platform to support the transition to safe and sustainable by design (SSbD) materials and chemicals, by enabling industry to solve the multi-objective optimisation problem of improving and balancing the four requirement categories i.e., functionality, cost-efficiency, safety and sustainability, at each stage of the development of new materials or chemicals and the products utilising them. Core to this is enabling access to data and data mining tools: PINK is developing a workflow to support researchers in making their data Findable, Accessible, Interoperable, and Reusable (FAIR), enriched with the relevant metadata to enable its use in multi-objective modelling, and providing the tooling and modelling approaches needed for the multi-objective modelling as a one-stop solution to operationalisation of the EU's Framework for SSdB chemicals and materials.

CERJ are leading the activities around the development of the semantic framework – the process by which we describe and make sense of data coming from disparate sources – i.e., from different labs, publications, models etc. Semantic artefacts are machine-readable models of knowledge that describe the meaning of data and the relationships between data items, such as a vocabulary or ontology, and are used to represent and annotate data in a standardized way. Within PINK, we are extending existing and developing new ontologies to integrate Life Cycle Assessment (LCA), SSbD and classical exposure, hazard and risk assessment of chemicals and materials to enable simultaneous optimisation of the functionality, safety and sustainability of new chemicals and materials, and products utilising

them. The CERJ team are also developing new machine learning models to interrogate the compiled and annotated datasets to enable read-across from data-rich to data-poor chemicals and materials, and to facilitate mapping of the entire chemical space for identification of new materials.

One of the tools that we are using to "map" the currently available tools and approaches, and to identify if and how they can be made interoperable, is the FAIR Implementation Profile – this tool systematically compiles how each FAIR Enabling Resource (e.g., ontology, database, registry etc.) currently complies with the FAIR principles and allows us to generate a convergence matrix that shows commonalities across tools and platforms and gaps where we will need to develop additional solutions to allow tools to communicate and inter-operate.

Find out more: pink-project.eu

Project funded by

UKRI Innovate UK

Co-funded by the European Union

MACRAMÉ (Advanced Characterisation Methodologies to assess and predict the Health and Environmental Risks of Advanced Materials)

MACRAMÉ started in December 2022 and is focused on evaluating where and how existing approaches, previously optimised for nanoscale materials in their simplest forms, might need to be further adjusted for risk assessment of advanced materials (AdMas) and especially for assessment of these materials in complex formulations or at different stages of the product life cycle (e.g., following disposal whereby much of Europe's waste is incinerated). The UoB/CERJ teams are involved in several aspects of the project, including supporting the ecotoxicology assessment of the MACRAMÉ AdMas and their formations (e.g., graphene sprays for cars which is often self-applied as a coating to protect the paint), the development of a regulatory roadmap for ecotoxicity testing of AdMas including considerations around New Approach (or non-animal) methods (so-called NAMs), and supporting the data management aspects including co-developing the approach to capture materials and data provenance in parallel using instance mapping.

Some really interesting scientific challenges have emerged in this work, which explain why researchers have shied away from testing product formulations previously. With the graphene sprays for example, we expected to encounter issues with the graphene itself being challenging to disperse so that it remains in the water column and is thus exposed to the daphnids, we were surprised to discover that the formulation components including mineral oil are themselves toxic to the daphnids as the oil coats their appendages thereby impairing their swimming behaviour. This suggests we require a complete re-think of the current acute toxicity test for daphnids, which uses lack of swimming (impaired mobility) as a proxy for mortality, meaning that even through the daphnids exposed to mineral oil are alive but "stuck" they would be categorised as dead using the current test. Our inputs to the regulatory ecotoxicology roadmap discuss this and other AdMa-related challenges to current approaches, and makes a number of recommendations for alternative approaches and adjustments to the test method to overcome these challenges. As part of the project dissemination activities, these challenges have also been discussed with regulators and other relevant stakeholders.

Find out more: macrame-project.eu

Project funded by

UKRI Innovate UK

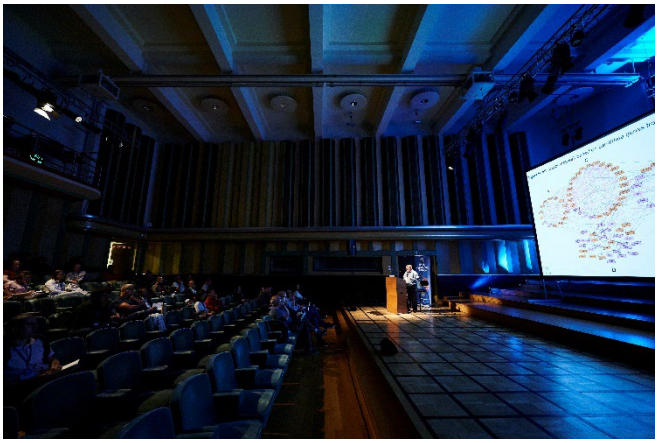
Co-funded by the European Union

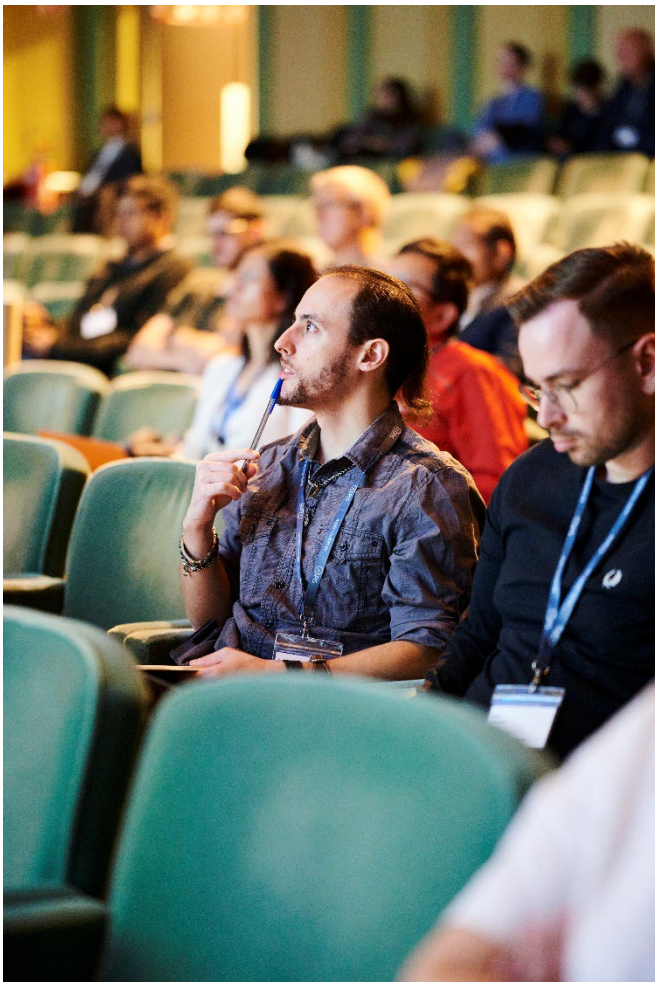
PrecisionTox

Interdisciplinary investigations towards 21st century toxicology

PrecisionTox is funded by the European Union's Horizon 2020 research and innovation programme and is led by the University of Birmingham, with all its UoB researchers being CERJ academics, staff, and students. This 5-year project gathers 15 partners from Europe, the UK and North America with the aim of better protecting the health of people and the environment by establishing New Approach Methodologies (NAMs) for chemical safety testing. The consortium uses cutting-edge approaches such as genomics, metabolomics, evolutionary theory, quantitative genetics, data science, toxicology and law. The results of this unique interdisciplinary initiative provide a new regulatory paradigm with greater certainty at predicting which chemicals cause harm to humans and all other animals while avoiding doing safety testing using mammals.

PrecisionTox is not alone in seeking paths to NAMs acceptance. Recently, the European Commission began developing a roadmap to phase-out animal testing, for which they are including elements of collaboration, such as workshops and targeted working groups. The PrecisionTox teams are strongly involved in this process. In October 2024, PrecisionTox participated in the second European Commission roadmap workshop towards phasing out animal testing for chemical safety assessments. The development of this roadmap is part of the Commission's response to the European Citizens' Initiative (ECI) "Save Cruelty-Free Cosmetics – Commit to a Europe Without Animal Testing'. The workshop presented a valuable opportunity for our research consortium to engage with Member States and key stakeholders across different sectors, discussing the development of





PrecisionTox members attend the 2024 annual consortium meeting in Brussels.

Top to bottom: Dr Robert Anholt (Clemson University) presents on findings so far; Dr Ruben Martinez listens to updates and scientific findings so far

NAMs for chemical legislation. The final roadmap is expected to be published in 2026. The expertise of PrecisionTox on the subject can be expected to be continuously recognised by the Commission and our stakeholder community.

CERJ's expertise in precision toxicology has also been acknowledged at the national level. In November 2024, the UK Department for Environment, Food & Rural Affairs (DEFRA) published the HSAC's (Hazardous Substances Advisory Committee) recommendations for the UK's early adoption of advanced alternative methods to animal testing (e.g., NAMs). The committee's opinion is that science has now sufficiently progressed that DEFRA could set criteria to begin integrating NAMs that deliver key biological information about responses to potentially toxic chemicals. Additionally, HSAC recommends that UK centres of excellence and a UK national reference laboratory for NAM development and validation are established – this is of real importance now that the UK has left the European Union. PrecisionTox was named a key contributor to the recommendations, a great example of Embedded Translation in practice – one of the three pillars of the project.

Events wise, the PrecisionTox team organised two successful events in 2024. The consortium held its third annual meeting in Brussels in June, gathering scientists dedicated to improving human health and environmental safety from chemicals. In two science-packed days, the teams presented their recent findings and discussed ongoing and upcoming research aimed at transforming chemical safety testing whilst addressing ethical concerns, making a significant advancement in protecting human and environmental health. This year, the project coordinating team also concluded an incredibly successful 2-year period of chairing the ASPIS Cluster, a groundbreaking collaboration of three EU-funded research projects responding to a common need. The chairmanship concluded at an Open Symposium in Copenhagen in September, showcasing significant strides in developing and implementing NAMs for chemical safety assessment and fostering collaboration among researchers, regulators and industry stakeholders. ASPIS continues to be at the forefront of revolutionising chemical safety testing through the development of the ASPIS-initiated alternative Safety Profiling Algorithm (ASPA), a well-guided Next Generation Risk Assessment (NGRA) workflow. ASPA offers a promising approach for streamlining safety profiling. This aligns with the cluster's goal to operationalize NGRA by developing a well-guided workflow for chemical safety assessment (ASPA) and providing guidance on data generation and interpretation.

Find out more: precisiontox.org

Project funded by

Funded by the European Union

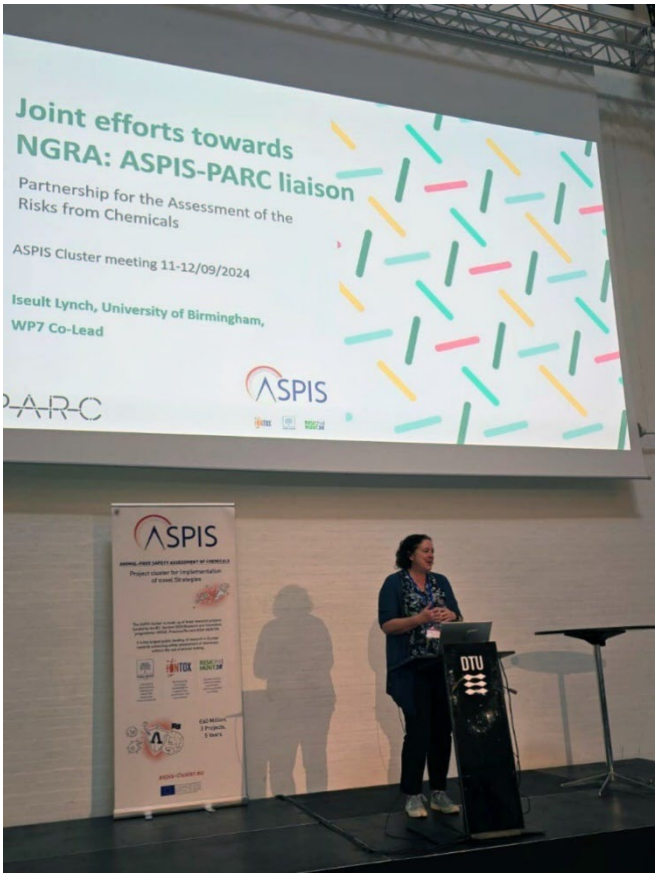
Below: Attendees at the PrecisionTox 2024 consortium meeting

The Partnership for the Assessment of Risks from Chemicals (PARC)

Next generation risk assessment at scale

The total number of industrial chemicals in commerce globally is conservatively estimated at between 40,000-60,000 substances. More than 60% of the volume of chemicals in the EU are classified as hazardous to human health, while around 35% are hazardous to the environment. Our knowledge about exposure to, and toxicology of, chemicals is relatively limited. Moreover, the methods to obtain data and to manage data storage and sharing are not well harmonised which complicates data exchange. To address these challenges, PARC's mission is to address current, emerging and novel chemical safety challenges and enable the transition to the Next Generation Risk Assessment (NGRA), in line with the European Green Deal's zero-pollution ambition for a toxic free environment and in particular with the Chemicals Strategy for Sustainability Towards a Toxic-Free Environment. PARC is described in detail in the publication "A walk in the PARC: developing and implementing 21st century chemical risk assessment in Europe".

UOB's participation as the largest UK partner of PARC is possible because of CERJ, with representation and leadership roles across all 9 work packages as well as playing an important role in the UK National Hub for PARC. Highlights of our PARC and UK-PARC activities in 2024 included hosting the UK-PARC science meeting at the Exchange in June 2024, (**Prof. John Colbourne**) facilitating a joint meeting of PARC and the ASPIS cluster of toxicology projects (which was coordinated by CERJ during 2024 as described also in the PrecisionTox report) in September 2024, providing FAIR Awareness training both as a 2-day a hands-on session in Ljubljana, Slovenia from 22nd – 24th May 2024 and online organised on request by the PARC National Hubs on 14th November 2024 where almost 80 participants took part (**Prof. Iseult Lynch** and **Dr Anastasios Papadiamantis**), and major contributions from **Dr Ralf Weber** to PARCopedia and from our legal experts (**Prof. Aleks Cavoski**, **Prof. Bob Lee**, **Dr Laura Holden** and **Dr Louis Dawson**) to PARCRoute which is developing roadmaps for NGRA.



Prof. Iseult Lynch presents collaborative efforts towards NGRA between PARC and the ASPIS consortium at the cluster's Open Symposium

Research highlights from the last year include:

- The acute toxicity and behavioural effects of *Daphnia* exposed to natural toxins have been evaluated. Transcriptomics and metabolomics analysis is being conducted to identify potential biomarkers of *Daphnia* chronically

exposed to natural toxins. Contributions include the development of alternative *in vivo* non-sentient models for testing systemic toxicity and omics approaches useful in human toxicology and ecotoxicology (**Dr Pu Xia**).

- CERJ is working on the development of single-cell approaches to assay developmental neurotoxicity using zebrafish larvae as a model organism – including the optimisation of suspension preparations and comparison of the whole single cell versus single nuclei. Two pilot single cell experiments have been carried out so far comparing two technologies 10X Genomics (microfluidics based) and Parse Bioscience (SplitSeq based) (**Prof. Ferenc Mueller** and **Dr Yavor Hadzhiev**).
- CERJ is contributing to the efforts on modelling of aggregate exposure from multiple routes and sources, including children's exposome to metals, PFAS, emerging chemicals, flame retardants, etc. CERJ have provided data on PFAS concentrations in many soft furnishing and childcare articles, which provide essential source term data for exposure assessment models. CERJ also provided empirical data on the dermal bio-accessibility and bioavailability of PFAS that facilitate assessment of human exposure to PFAS via the dermal pathway (**Prof. Stuart Harrad**).
- The CERJ team is contributing to a landscaping survey for both human health and the environment including contributions to the use of artificial intelligence and machine learning for integrating an environmental focus, and to risk assessment to support and promote efficient overall protection of biodiversity. CERJ is also leading on the establishment of the BioAI approach for holistic biodiversity monitoring and AI-aided forecasting which involved using empirical data collection and interpretation as a training set to build forecast models (**Prof. Luisa Orsini** and **Dr Albert Zhou**).
- CERJ has also contributed to a review paper "Chemical mixtures: a roadmap to future risk

Above: In 2024 CERJ researchers led and contributed to a variety of projects examining exposure to chemicals and metals, employing machine learning for efficient risk assesment, and investigating ways to incorporate next generation risk assessment within regulatory frameworks

assessment and management" which is expected to be submitted to Environment International.

Upcoming activities of note, led by the CERJ team, include:

- a special session at SETAC 2025 (11 – 15 May 202, Vienna, Austria) on Bridging Science and Risk Assessment to Protect Biodiversity from Chemical Pollution (B-SAFE) and an accompanying special issue led by **Prof. Luisa Orsini** to be published by Environment International in 2025;
- sessions on Unravelling the Complexities of PFAS From Environmental Toxicology to Human Health and Flame Retardants – Regulatory and Circular Economy Challenges also at SETAC 2025 with **Prof. Iseult Lynch** and **Prof. Stuart Harrad** as Co-Chairs, respectively.
- two major deliverables from WP7 are currently being finalised – one on all our activities related to tools and approaches for FAIR data (D7.3: Data Infrastructures Tool and Services) with contributions from **Dr Indrani Mahapatra**, **Dr Anastasios Papadiamantis**, **Dr Karin Slater** and **Prof. Iseult Lynch**), and another on machine learning approaches in chemical risk assessment (D7.4: Evaluation of innovative analytical and uncertainty) with contributions from **Prof. Georgios Gkoutos**, **Dr Karin Slater** and **Prof. Iseult Lynch** which are due to be submitted to the European Commission by end of April 2025 (end of year 3).
- CERJ is leading a case study on improvements to omics-based NAMs approaches for regulatory use. The project will review the current Water Framework Directive (WFD) to develop a next generation risk assessment (NGRA) framework, enhancing European water quality from both scientific and regulatory perspectives. If matching funds are secured in time, it may also include experiments and data collection on water samples from rivers in the UK or Europe (**Prof. Luisa Orsini**).
- CERJ is leading a case study on integrating hydrological data into chemicals monitoring in freshwaters to develop more sophisticated early warning systems for chemical pollution – the approach will be demonstrated using the Seine river, as well as integrating data on sediment particles as transport vectors for pollutants and hospital data on water exposures to *E. coli* (sewage-related emissions) and *Cyanobacteria* (linked to excess nitrogen-associated algal blooms) and other natural toxins as proxies for broader chemical exposures related to deteriorating water quality (**Prof. Iseult Lynch**, **Prof. David Hannah** and **Dr Tahmina Yasmin**).
- case studies on data-driven NGRA (**Dr Scott Glaberman**), omics integration and quantitative adverse outcome pathway (AOP) development (**Dr Pu Xia**) are planned to commence in 2025.

CERJ also plays an important role in defining PARC strategy, with **Prof. Iseult Lynch** as Co-Lead for WP7 on FAIR Data, sitting on the PARC Management Board (the strategic management group for PARC), and on the PARC Ethics and Data Boards. She is the Chemicals lead for Nanomaterials in PARC, and was recently asked to lead an evaluation of the use of Artificial Intelligence (AI) in PARC to support development of a PARC Strategy for safe use of AI in Chemical Risk Assessment in collaboration with the European Commission.

All CERJ founding members and CERJ-appointed academic staff are increasingly involved in PARC with major contributions over the last year to work package, task and project leadership from **Prof. Iseult Lynch**, **Prof. John Colbourne**, **Prof. Luisa Orsini**, **Prof. George Gkoutos**, **Prof. Aleks Cavoski**, **Prof. Robert Lee**, **Dr Karin Slater**, **Dr Ralf Weber** and many others (as noted in the summary above).

Find out more: eu-parc.eu

Project funded by
UK Research and Innovation
Co-funded by the European Union

Education

CERJ 2024 Annual Report

UNIVERSITY OF BIRMINGHAM

Centre for Environmental Research & Justice

Education briefing

Professor Robert Lee
CERJ Director of Education

A major initiative pursued by CERJ during 2024 was the preparation of the groundbreaking MSc in Human and Environmental Toxicology with Law, an interdisciplinary programme of study which aims to equip students with the knowledge and skills to tackle chemical pollution. The course is running for the first time on campus 2024 – 25. There has already been some demand for a part-time variant of the course from potential students already working within toxicology. However, it is clear that the market is global in nature so we have discussed the possibility of a distance learning variant of the course with the Dean of Birmingham Online and market research is underway.

The MSc is well supported by a range of partners from both industry and regulatory agencies, many of whom will make an active contribution to the delivery of the course. We are discussing with these partners the possibility of generating both project work (the project being a significant element of the M.Sc. award) and placements. We are also working on placement opportunities for undergraduate students on programmes such as the B.Sc. in Human Biology. Longer term, we would like to develop this network by exploring opportunities for master's level apprenticeships.

There is a clear market for continuing professional development (CPD) in this specialty. We are committed to running the first CPD programmes in 2024/25.

> "We are facing a **dual environmental crisis of climate change and biodiversity loss**, both of which will lead to greater environmental pollution and considerable harm to human health and the environment"

To this end we are holding discussions with the Business Development Manager for Short Courses & Professional Education. We have also spoken with our partner the University of Illinois that already runs a highly successful programme which mixes regulatory theory and regulatory science, including 'Genomics for Judges'. This has proved a most useful link in terms of drawing upon their experience. CERJ is exploring the possibility of EMBO support for short courses run by the Centre.

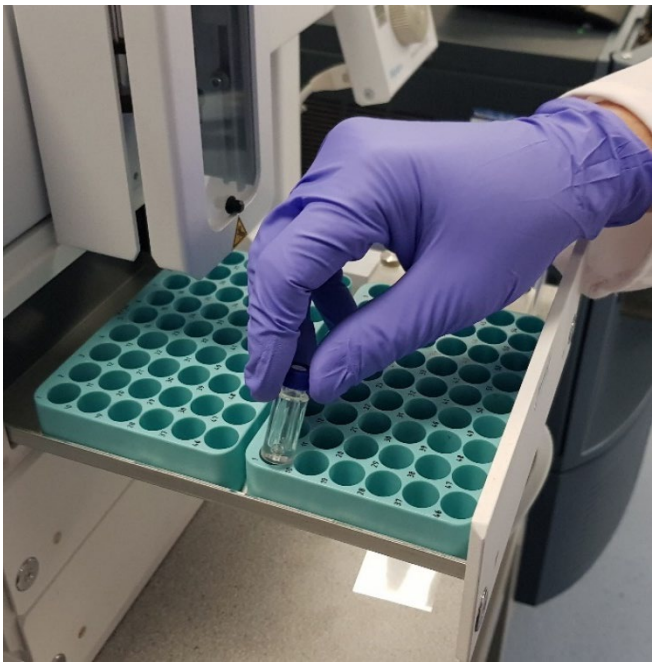
Delegates attend a CERJ-hosted workshop for BioFAIR, to learn about the £34m UKRI investment in FAIR research data management & analysis capabilities in the UK (24th June 2024)

Research lies at the heart of CERJ and we are already contributing to educational initiatives related to our research work, particularly within the ASPIS cluster of EU funded research programmes

on new approach methodologies for chemical testing. CERJ has an ambition to build on its already vibrant postgraduate research community and we are actively exploring an application to the EU Funded Marie Sklodowska-Curie Actions programme to support a (European) doctoral network. We believe also that the M.Sc. programme (above) will provide a route for graduates from this programme to feed into our research work at doctoral level connected to our funded research programme including PrecisionTox, PARC, UPSTREAM and ReCREATE.

It should be noted that much activity to date has been generated from the work that underpinned and led to a successful award in the PrecisonTox programme. Our ambitions do not end there. We are facing a dual environmental crisis of climate change and biodiversity loss, both of which will lead to greater environmental pollution and considerable harm to human health and the environment. Thus far, legal and policy interventions in the face of these threats have shown limited success and at times seem to demonstrate outright failure. As CERJ moves more deeply into this agenda, we will be able to serve the pressing necessity for educational offerings that both address and respond to the environmental crisis.

Professor Robert Lee



Trainees attend a continuing professional development course with the Birmingham Metabolomics Training Centre (BMTC), supported by CERJ through Phenome Centre Birmingham (PCB) personnel and the CERJ Centre Management Team (CMT). The BMTC aims to train the next generation of researchers using toxicological metabolomics.

CERJ MSc Human and Environmental Toxicology with Law

CERJ kicks off its Education portfolio with a new programme designed to train the next generation of risk assessors

In September 2024, CERJ formally launched its educational programme, welcoming a cohort of students to the brand new MSc in Human and Environmental Toxicology with Law. This course brings together teams from the Colleges of Life and Environmental Sciences and Arts and Law to develop the next generation of environmental toxicologists instilled with the unique CERJ multidisciplinary mindset.

Our new postgraduate course uniquely integrates modern toxicology with a foundation in environmental regulation, preparing graduates to make significant contributions in various sectors by understanding the science of toxic chemicals and the legal frameworks necessary for implementing change. Aimed at those seeking to make a tangible difference, our new MSc is ideal for future scientists, researchers, and policymakers dedicated to protecting the environment and public health.

CERJ faculty Dr Jiarui Zhou led course development, and coordinated development of new modules for MSc participants, including "New Approach Methodologies for Regulatory Toxicology" (lead: Dr Pu Xia) and "Environmental and Energy Regulation" (leads: Professor Robert Lee, Dr Louis Dawson). The remaining modules were carefully selected from existing materials to ensure a high-quality curriculum.

Dr Jiarui (Albert) Zhou provides an introduction to the new CERJ MSc at the CERJ Networking Day 2024

The MSc is also reflective of CERJ's interdisciplinary approaches, with guest lecturers spanning across the University, such as Dr Zhiling Guo from the School of Geography, Earth and Environmental Sciences and Dr Angela Taylor from the Steroid Metabolome Analysis Core. External lecturers come from our CERJ Partner Network, and include contributions from Unilever, the UK Health and Safety Executive, and Bayer Crop Science.

But the work isn't stopping here: the team aims to further develop and enhance this MSc program through new modules, lectures, and workshops. As part of our CERJ placement drive within our Partner Network, we are also identifying options for short-term placements (3 months) where students could build their final semester Interdisciplinary Individual Project through gaining hands-on, real-world experience, with a subsequent year-in-industry opportunities for graduates.

Placements

Sergio Mendes

Placement student in industry

Sergio Mendes, a BSc Biochemistry student at the University of Birmingham, embarked on a Year in Industry in 2024, a collaboration facilitated by CERJ and Bayer Crop Science, part of the CERJ Partner Network. He is currently engaged in the Environmental Safety: Ecotoxicology and Risk Assessment placement in Monheim, Germany, and shares an exciting update from his first six months on placement:

"Hello everyone, my name is Sergio, and I am currently undertaking my year in industry with Bayer Crop Science, focusing on ecotoxicology. My main focus is developing tools for environmental risk assessments using *in vitro* methods.

Currently, I am working on expanding our knowledge in bird metabolism in hepatic cell fractions (microsome and S9 functions). This project aims to increase the availability of high-quality data for researchers using data collected using techniques like mass spectrometry, aiding them in making informed decisions regarding risk assessments without the need for *in vivo* testing. My initial steps include conducting a literature review, followed by developing a project proposal and final report on my findings and data collected. This work is aimed at improving our current assay and creating a tool for data analysis, ultimately establishing a methodology for fast-tracking *in vitro* testing as a screening method for bird toxicity, with potential future applications in other species.

Mass spectrometers such as the Thermo Fisher Q Exactive Plus pictured have qualitative and quantative uses including identifying compounds and their structures, and determing their isotopic composition of elements

I am especially excited to be part of CERJ to enable this collaboration with a significant stakeholder industry towards a holistic approach to integrating research into policy change. My strong connection with experts in the field provides invaluable guidance and support, enhancing the impact and reach of my work. This partnership promises to be a significant step forward in advancing ecotoxicological research and its application in environmental risk assessment."

Sergio is based in Bayer's Monheim campus, which is currently being expanded; the company is investing €220m in expanding the crop protection research and development facility to develop the next generation of chemicals for a sustainable future

Events and engagement

CERJ 2024 Annual Report

UNIVERSITY OF BIRMINGHAM

Centre for Environmental Research & Justice

CERJ Networking Day

21st June 2024

Networking Day is now an established time-honoured CERJ tradition, held mid-year to bring CERJ academics, researchers, and professional services together. The event serves to provide a point of reflection with opportunities to mingle and integrate centre-wide, but – increasingly – the day is about celebration of efforts towards achieving the centre's mission. The 2024 Networking Day leaned more into this theme than ever before.

Professor John Colbourne opens the annual CERJ Networking Day 2024

For 2024 it was decided that we should widen participation to members of the CERJ Partner Network. We were delighted to have external representation from organisations such as AstraZeneca, Syngenta, NC3Rs, Michabo Health Science, Bayer Crop Science, Kings College London and Unilever. The CERJ Events Committee did a fantastic job weaving our partners into the day's events, with each contributing to various activities and workshops held throughout the day.

The involvement of these external partners helped to create a rich and diverse agenda. Sessions included newly appointed faculty providing their inaugural address to the CERJ Network, a panel discussion on how to achieve environmental impact, short presentations on best practice in subjects such as interdisciplinarity, research impact, and moving from animal models to *in vitro*, and the poster session dedicated to promoting the work of early career researchers was very well received.

Professor Mark Viant (Michabo Health Sciences), Dr Geoff Hodges (Unilever), Dr Fiona Sewell (NC3Rs), and Dr Stewart Owen (AstraZeneca) participating in the CERJ environmental impact panel

The keynote address, delivered by Dr Gavin Maxwell (Head of Regulatory Science Strategy & Advocacy at Unilever, Co-Chair of the European Partnership for Alternative Approaches to Animal Testing (EPAA)), was a highlight of the agenda. Gavin offered valuable insights into bridging the gap between advanced safety science and regulatory requirements and sparked lively discussion and questions from audience members on the topic.

Dr Gavin Maxwell (Unilever) delivers the keynote address

Networking breaks strategically scheduled throughout the day, which brought forth productive conversations about past, present and future collaborations. As mentioned above, we are liaising with members of the CERJ Partner Network to expand contributions to our new MSc, establish short and medium-term placement opportunities for our students, and begin new research projects and investigations together.

Dr Synda Obaji chats with a fellow networking day attendee

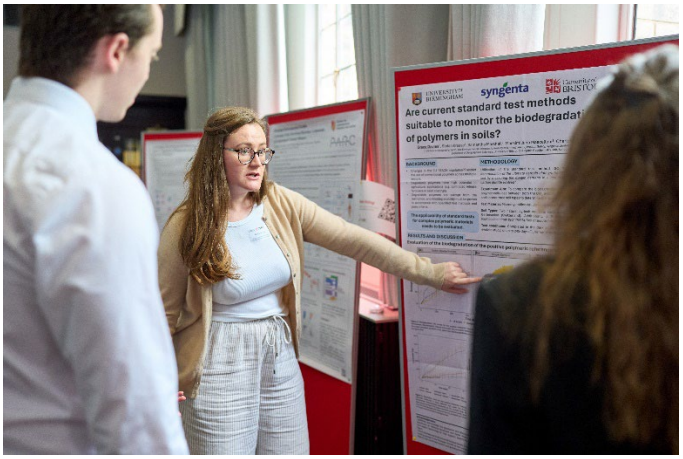
The carefully structured and highly varied agenda ensured the day was exceptionally engaging and full of diverse experiences and left a pathway legacy for future iterations to follow and adapt. Undoubtedly, the entire centre is looking forward to CERJ Networking Day 2025 as the peak of their annual agenda!

Special thanks to the members of the CERJ Events Committee for their hard work in planning and executing a highly successful and productive event, with particular contributions by members Marianne Barnard and Dr Niamh Eastwood recognised and appreciated.

"Our networking day continues to bring together and mobilise leading researchers across numerous disciplines to participate in CERJ's mission of solving pollution-based issues.

We are extremely proud to work with a strong and diverse **community network** that is dedicated to **bringing about change** to protect human and environmental health."

David Epps, CERJ Centre Manager



Above: Photographs from CERJ Networking Day 2024

Top to bottom: Dr Xiaojing Li delivers a spotlight talk on her research fellowship; Grace Davies presents her most recent work at the poster session; David Epps delivers a closing presentation on the route ahead and strategy for CERJ

Other highlights: CERJ events

CERJ hosted a record number of events in 2024, showcasing a broader range of themes and activities than ever before. More participants engaged in our events than previous years, and the impact of these events was significant, leaving a lasting impression on our community and beyond.

Grant writing workshop

21st March 2024

Attendees enjoy the workshop: Dr Niamh Eastwood (left) and Dr Fozia Shaheen (right)

CERJ's research portfolio is a foundational base for the centre to grow and expand. To maintain our edge in the highly competitive application process, the Events Committee organised a workshop for early career researchers with an innovative angle: how to develop research proposals through a reviewer's mindset. Approaching research proposals in this way focuses on (a) understanding evaluation criteria to tailor applications, but more significantly (b) how to interest and excite a panel who are not necessarily experts in your particular field of research.

We were delighted to welcome grants consultant Elisabeth Andrews to run the session, who supported the PrecisionTox application and various publications for the project. Elisabeth briefed participants on communicating impact through linking to UN Sustainable Development Goals, the importance of creating a production schedule for the application, and most importantly how to write in a way that excites and interests the reviewer, even within a predefined funder framework.

Left to right: Dr Anna Gardner, Dr Xiaojing Li, Dr Muhammad Tahir

The response from attendees was fantastic. 25 staff and doctoral students from colleges, schools and research groups across the university attended, with the feedback received overwhelmingly positive. Given the success, it is likely that we will re-run this session at least once in 2025, liaising with research support colleagues to further reach across the university.

BioFAIR Roadshow

24th June 2024

CERJ and BioFAIR banners

BioFAIR is a UKRI-funded digital research infrastructure that will invest £34m in life sciences

research data management and analysis capabilities across the next 5 years. The BioFAIR Roadshow team approached CERJ to request help hosting a "roadshow" event to gather stakeholder input, and we were thrilled to support. Partnering with the Birmingham Institute for Sustainability and Climate Action (BISCA), we hosted a workshop session at their fantastic Elm House location.

Dr Karin Slater presenting on managing metadata in biomedical and life sciences applications

The workshop-style event focused on incorporating best practices of the participants into BioFAIR plans to support future development of world-class and critical life-sciences data infrastructure. We hosted stakeholders from partners across the West Midlands who, through interactive and engaging sessions, contributed feedback and input into future development needs.

Dr Ralf Weber lecturing on approaches to data management in the PrecisionTox project

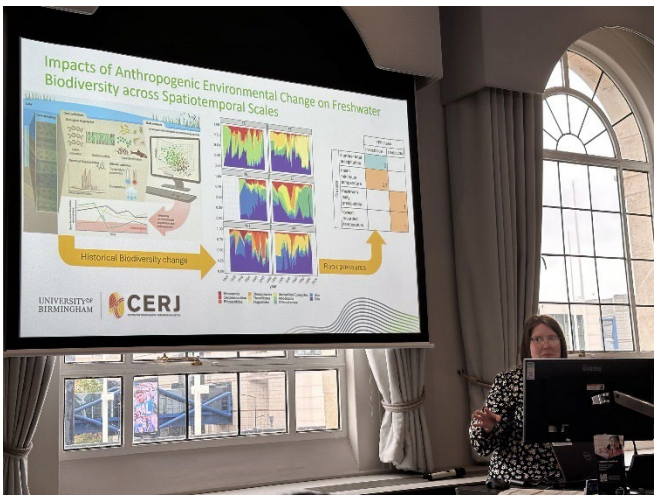
CERJ researchers also took the stage to present their own work, with Dr Ralf Weber and Dr Karin Slater delivering insightful presentations related to their experience with and use of life sciences data, and Dr Stephanie Thompson presenting on the University of Birmingham infrastructure Birmingham Environment for Academic Research (BEAR). These presentations were both thought provoking and well received, prompting further discussions and input into future infrastructure plans.

The organising team would like to thank all attendees for their helpful contributions to BioFAIR, the presenters for their rich and engaging sessions, and CERJ CMT staff member Eszter Voros for orchestrating and managing the event.

PARC 2024 Science Days

21st – 22nd May 2024

The University of Birmingham is the recipient of the largest portion of UK funding for the Partnership for the Assessment of Risks from Chemicals (PARC). CERJ researchers play pioneering roles in this crucial investment in the development of future risk assessment and given this important role we were delighted this year to be able to host the UK-Hub PARC Science Days at The Exchange in central Birmingham this year.



Dr Niamh Eastwood presenting her fascinating work on the relationship between environmental change and freshwater diversity

The agenda was packed full of PARC goodies: project updates, poster sessions, and panel discussions revealed insight into new science, the

UK government's approach to replacing animals in science, and emerging chemical issues from leading UK regulators. This was all accompanied, of course, by numerous presentations of CERJ's ongoing efforts in PARC to develop and transform chemical risk assessment.

Despite being members of the same UK-Hub for PARC, work package areas are vast (there are 9 of them), and it is unlikely that UK researchers have substantial overlap between activities. While CERJ has representation and leadership roles across all PARC work packages – and so is aware of numerous ongoing activities – for many attendees the event was a primary reveal into the broader approaches and impact of the PARC project. Whether their research was human or environmentally focused – or in the case of CERJ, adopts the One Health approach – the days held engaging sessions for all, revealing intriguing insights into project partner activities.

One of the key aspects of PARC is the interplay between researchers and regulators; key partners such as the UK Health Security Agency (UKHSA), Department for Environment Food and Rural Affairs (DEFRA), Department for Science, Innovation and Technology (DSIT), UK Environment Agency, UK Food Standards Agency (FSA) and Health and Safety Executive (HSE) joined the sessions to hold discussions and provide input to shape the future of PARC UK-Hub priorities. This was particularly useful for CERJ researchers with a focus on developing and influencing regulatory frameworks to accommodate new approaches to chemical risk assessment.

The CERJ team was delighted by the outcomes and progress of the day, and hopes to host the event again before PARC funding ends in 2029.

Living Lakes in Motion

19th September 2024

As part of the AI Futures at The Exchange programme, CERJ researchers partnered with artists Juneau projects to create a stop motion animation inspired by their work using AI to extrapolate DNA data from soil samples taken from lakes. This is then used to construct a 'digital twin' model to investigate how different external factors (pollution, invasive species, etc) affect the biodiversity of a lake over time.

Attendees work together to take still frames for the stop motion film

The Juneau Projects team then worked with the researchers and external attendees to create a stop motion animation featuring some of the microscopic creatures that the team analyse (e.g., *Daphnia magna*), and used AI to generate a fitting soundtrack using the prompt "toxic lake of death" – sort of a screaming metal vibe that provides some edge to the otherwise cutesy animation!

Still frame from the final animation

Want to see the final result? Search online for "Birmingham Living Lakes Juneau Projects" and follow the link to Juneau Project's Instagram post.

Appendix I: Media, publications and impact

CERJ 2024 Annual Report

UNIVERSITY OF BIRMINGHAM

Centre for Environmental Research & Justice

Media

Our academic team participates in regular media appearances to enhance the visibility and reputation of CERJ and the wider university through both internal and external channels. For many of the below, the press piece was published in multiple outlets (but one example has been provided).

Ajasa, A. (2024) 'Scientists found another way we're exposed to "forever chemicals": Through our skin', Washington Post, 26 June. Available at: https://www.washingtonpost.com/climate-environment/2024/06/26/toxic-forever-chemicals-beauty-products-study.

BBC One (2024) The One Show (The Impact of Forever Chemicals), BBC. Available at: https://www.bbc.co.uk/programmes/m00225xn.

BBC Radio 4 (2024) Rare Earth, How do we get our healthy rivers back? (Tiny fleas called daphnia could be the future of water purification), BBC. Available at: https://www.bbc.co.uk/programmes/m001wrhm.

Capel, M. (2024) Innovation would help find more chemicals in water, Water Magazine. Available at: https://www.watermagazine.co.uk/2024/03/14/innovation-would-help-find-more-chemicals-in-water.

e.V, F.B. (2024) A chemical cocktail of micropollutants amplified effect of algal toxins in 2022 mass fish mortality event: Study. Available at: https://phys.org/news/2024-09-chemical-cocktail-micropollutants-amplified-effect.html.

NCUB (2024) Drops of innovation: Navigating the waters of collaboration, National Centre for Universities & Business. Available at: https://www.ncub.co.uk/insight/drops-of-innovation-navigating-the-waters-of-collaboration.

Pugsley, C. (2024) Study raises questions about media used for in vitro tests on nanomaterials, Chemistry World. Available at: https://www.chemistryworld.com/news/study-raises-questions-about-media-used-for-in-vitro-tests-on-nanomaterials/4019400.article.

ScienceDaily (2024) Using metabolomics for assessing safety of chemicals may reduce the use of lab rats, ScienceDaily. Available at: https://www.sciencedaily.com/releases/2024/02/240220144548.htm.

Service, E.N. (2024) 3-day int'l conference on comparative law at VIT-AP University begins, The New Indian Express. Available at: https://www.newindianexpress.com/states/andhra-pradesh/2024/Feb/17/3-day-intl-conference-on-comparative-law-at-vit-ap-university-begins.

Thriving Planet (2024). Available at: https://www.youtube.com/watch?v=I7QGjsrjfTk.

University of Birmingham (2024) Biodiversity Conservation and our Thriving Planet, University of Birmingham. Available at: https://www.birmingham.ac.uk/news/2024/biodiversity-conservation-and-our-thriving-planet.

Vizzuality (2024) 'OpenNature Initiative: It's time for accessible, actionable nature data.', Vizzuality Blog, 22 August. Available at: https://medium.com/vizzuality-blog/opennature-initiative-its-time-for-accessible-actionable-nature-data-f1ee63864ce3.

Publications

Our research teams have published 35 academic papers between 1 January 2024 and date of report, many in journals with high impact factors such as *Nature Communications* (14.7), *Journal of Hazardous Materials* (14.2), *Trends in Genetics* (13.6), *Environment International* (13.3), *Nano Today* (13.2), *Nature Protocols* (13.1), *Environmental Science & Technology* (10.8), and *Science of The Total Environment* (10.7).

Abdolahpur Monikh, F. et al. (2024) 'Biotransformation of nanoplastics in human plasma and their permeation through a model in vitro blood-brain barrier: An in-depth quantitative analysis', Nano Today, 59, p. 102466.

Au Yeung, V.P.W. et al. (2024) 'Computational approaches identify a transcriptomic fingerprint of drug-induced structural cardiotoxicity', Cell Biology and Toxicology, 40(1), p. 50.

Cavoski, A. et al. (2024) 'Precision toxicology: new approach methodologies for chemical safety', Bio-Science Law Review, 19(3), pp. 101–107.

Cavoski, A., Ahuja, J. and Lee, R. (2024) 'Just Energy Transition and the planning and Permitting of Critical Mineral Extraction', Journal of Planning & Environment Law, 2024(1), pp. 3–19.

Cavoski, A., Lee, R. and Holden, L. (2024) 'The Role of Epistemic Communities in Formulating EU Policy – the Case of PrecisionTox Project', Transnational Environmental Law, 1-26

Di Ianni, E. et al. (2024) 'Pro-inflammatory and genotoxic responses by metal oxide nanomaterials in alveolar epithelial cells and macrophages in submerged condition and air-liquid interface: An in vitro-in vivo correlation study', Toxicology in Vitro, 100, p. 105897.

Dickmeis, T. et al. (2024) 'Evaluating Toxicity of Chemicals using a Zebrafish Vibration Startle Response Screening System', JoVE, (203), p. e66153.

Eastwood, N. et al. (2024) 'Single metabarcoding multiplex captures community-level freshwater biodiversity and beyond', Environmental DNA, 6(1), p. e515.

Escher, B.I. et al. (2024) 'Mixtures of organic micropollutants exacerbated in vitro neurotoxicity of prymnesins and contributed to aquatic toxicity during a toxic algal bloom', Nature Water, pp. 1–10.

Gigl, F. et al. (2024) 'Interactions between phenanthrene exposure and historical chemical stress: Implications for fitness and ecological resilience of the sentinel species Daphnia magna', Science of The Total Environment, 949, p. 174963.

Gruszczynska, H. et al. (2024) 'Multi-omics bioactivity profile-based chemical grouping and read-across: a case study with Daphnia magna and azo dyes', Archives of Toxicology, 98(8), pp. 2577–2588.

Holden, L. et al. (2024) 'Biodiversity management challenges: A policy brief', Environmental Law Review, 26(2), pp. 141–150.

Holden, L., Cavoski, A. and Lee, R. (2024) 'Legal Barriers to new methods of chemical testing', elaw [Preprint].

Holden, L., Lee, R. and Cavoski, A. (2024) Report on Socio-technical Barriers to the Uptake of NAMs.

Jimenez-Gonzalez, A. et al. (2024) 'Paternal starvation affects metabolic gene expression during zebrafish offspring development and lifelong fitness', Molecular Ecology, 33(6), p. e17296.

Kukkola, A. et al. (2024) 'Beyond microbeads: Examining the role of cosmetics in microplastic pollution and spotlighting unanswered questions', Journal of Hazardous Materials, 476, p. 135053.

Li, X. and Colbourne, J.K. (2024) 'A molecular mechanism for environmental sex determination', Trends in Genetics, 40(10), pp. 817-818

Li, X et al. (2024) "Bioactivity Profiling of Chemical Mixtures for Hazard Characterization" Environmental Science & Technology, 59(1), pp. 291–301.

Mathisen, G.H. et al. (2024) 'Time for CHANGE: system-level interventions for bringing forward the date of effective use of NAMs in regulatory toxicology', Archives of Toxicology, 98(8), pp. 2299–2308.

Perry, W.B. et al. (2024) 'An integrated spatio-temporal view of riverine biodiversity using environmental DNA metabarcoding', Nature Communications, 15(1), p. 4372.

Ratier, A. et al. (2024) 'Estimating the dynamic early life exposure to PFOA and PFOS of the HELIX children: Emerging profiles via prenatal exposure, breastfeeding, and diet', Environment International, 186, p. 108621.

Reilly, K. et al. (2023) 'Daphnia as a model organism to probe biological responses to nanomaterials—from individual to population effects via adverse outcome pathways', Frontiers in Toxicology, 5.

Rosa, A.H. et al. (2024) 'Neural network for evaluation of the impact of the UK COVID-19 national lockdown on atmospheric concentrations of PAHs and PBDEs', Environmental Pollution, 341, p. 122794.

Serrano, B.A. et al. (2024) 'The role of FAIR nanosafety data and nanoinformatics in achieving the UN sustainable development goals: the NanoCommons experience', RSC Sustainability, 2(5), pp. 1378–1399.

Shad, S., Bashir, N. and Lynch, I. (2024) 'Low-cost iron nanoparticles for remediation of agricultural pollution: adsorption of herbicides bromoxynil and paraquat', Environmental Science: Nano, 11(4), .

Silva, A. de C. e et al. (2024) 'A novel method to derive a human safety limit for PFOA by gene expression profiling and modelling', Frontiers in Toxicology, 6.

Soltanighias, T; Umar, A et al. (2024) "Combined toxicity of perfluoroalkyl substances and microplastics on the sentinel species Daphnia magna: Implications for freshwater ecosystems" Environmental Pollution, 363, p125133.

Song, Z. et al. (2024) 'Influence of soil properties and aging on exogenous antimony toxicity to Caenorhabditis elegans in agricultural soil', Environmental Science and Pollution Research, 31(8), pp. 12499–12510.

Sostare, E. et al. (2024) 'Metabolomics Simultaneously Derives Benchmark Dose Estimates and Discovers Metabolic Biotransformations in a Rat Bioassay', Chemical Research in Toxicology, 37(6), pp. 923–934.

Tal, T. et al. (2024) 'New approach methods to assess developmental and adult neurotoxicity for regulatory use: a PARC work package 5 project', Frontiers in Toxicology, 6.

Varsou, D.-D. et al. (2024) 'In silico assessment of nanoparticle toxicity powered by the Enalos Cloud Platform: Integrating automated machine learning and synthetic data for enhanced nanosafety evaluation', Computational and Structural Biotechnology Journal, 25, pp. 47–60.

Viant, M.R. et al. (2024) 'Demonstrating the reliability of in vivo metabolomics based chemical grouping: towards best practice', Archives of Toxicology, 98(4), pp. 1111–1123.

Viant, M.R. et al. (2024) 'Utilizing Omics Data for Chemical Grouping', Environmental Toxicology and Chemistry, 43(10), pp. 2094-2104.

Zhang, P. et al. (2024) 'Analysis of nanomaterial biocoronas in biological and environmental surroundings', Nature Protocols, pp. 1–48.

Zhou, Y. et al. (2024) 'Application of Machine Learning in Nanotoxicology: A Critical Review and Perspective', Environmental Science & Technology, 58(34), pp. 14973–14993.

Research Excellence Framework 2029 (REF2029) impact case studies (ICS) in progress

We are developing and supporting the below REF2029 case studies, all directly tied to our core purpose and demonstrating the excellence of research within both CERJ and the wider university.

Name	*Team*
Biomolecular (omics) approaches for chemical safety regulation	Prof. Mark Viant, Prof. John Colbourne
PrecisionTox - Addressing Socio-technical Barriers to Uptake of New Approach Methodologies in Assessing Chemical Safety for Human Health and the Environment	Prof. Robert Lee, Prof. Aleksandra Cavoski, Laura Holden
Pioneering the application of insect physiology in beneficial insect provision to enhance food security	Dr Scott Hayward
One Health	Prof. Luisa Orsini, Prof. Karl Dearn, Prof. Robert Lee, Dr Iestyn Stead, Dr Mohamed Abdallah

Appendix II: Conferences, engagement and outputs

CERJ 2024 Annual Report

UNIVERSITY OF BIRMINGHAM

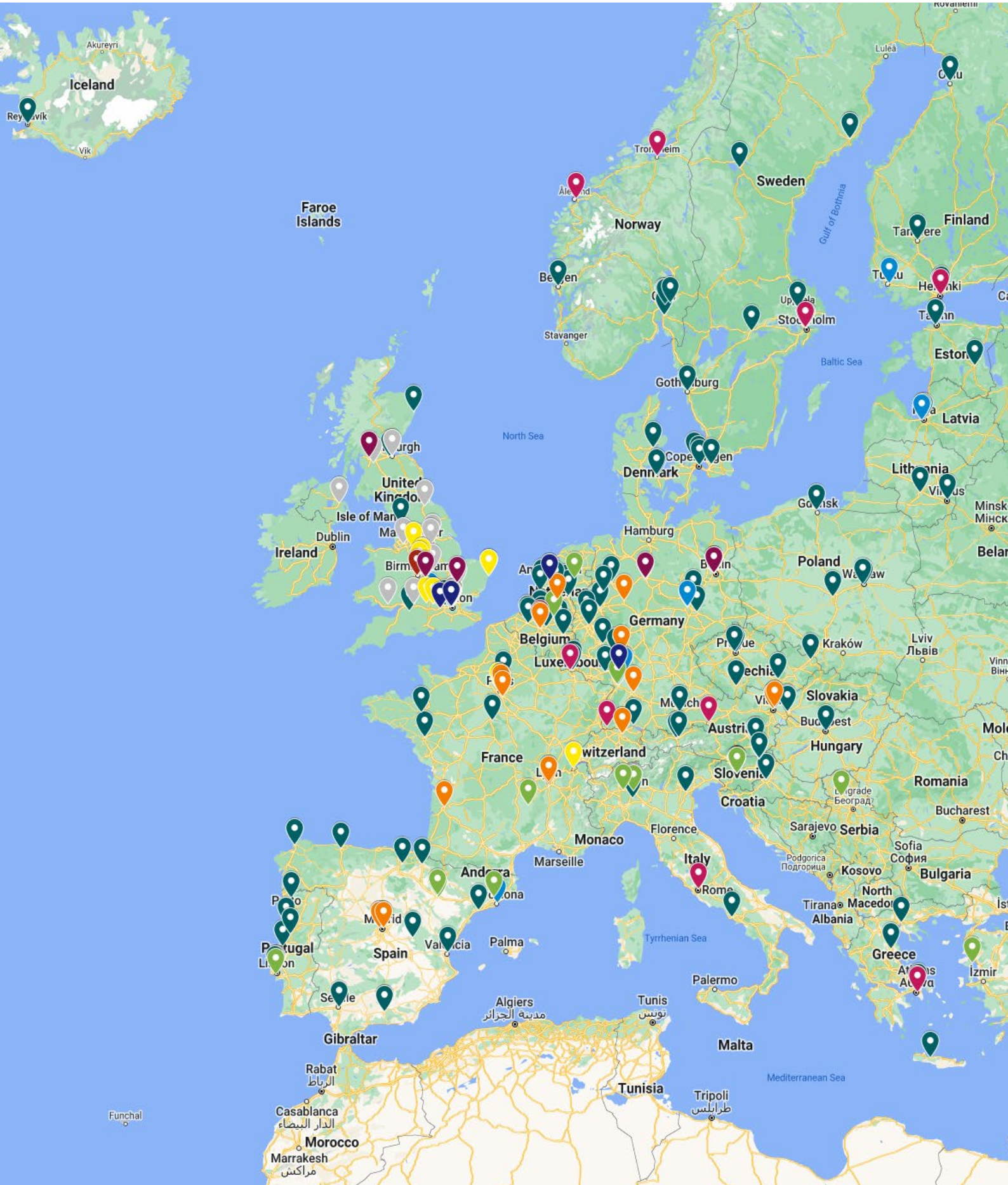
Centre for Environmental Research & Justice

Conferences

Date(s)	*Event*	*Attendee*	*Contribution*
24-25 January	Festival of Genomics and Biodata, London, UK	Dr Xiaojing Li	Participant
15-16 February	Sustainable Critical Minerals Supply Chains, Australia	Dr Jyoti Ahuja	Participant
21 February	Women with Impact (Parliament visit), London, UK	Dr Katie Reilly	Participant
13-15 March	9th German Pharm-Tox Summit, Munich, Germany	Prof. John Colbourne	Keynote
22-24 April	PARC WP6 Meeting, Stockholm, Sweden	Prof. John Colbourne, Dr Xiaojing Li	Presenter
23 April	Environment Agency PhD Knowledge Exchange Event, Bristol, UK	Arron Watson	Presenter
5-9 May	SETAC Europe 34th Annual Meeting, Seville, Spain	Prof. Iseult Lynch	Presenter
21-22 May	PARC UK Hub Science Days, Birmingham, UK	UoB PARC Network	Host, Presenter
22-23 May	Open Nature Data, Cambridge, UK	Dr Niamh Eastwood	Participant
3-6 June	ESTIV 22nd International Congress, Prague, Czech Republic	Shaleen Glasgow	Presenter
13-14 June	PrecisionTox Consortium Meeting, Brussels, Belgium	UoB PrecisionTox Network	Consortia lead, Presenter
16-20 June	Metabolomics 2024, Osaka, Japan	Dr Martin Jones	Presenter
17-21 June	MaterialsWeek, Limassol, Cyprus	Prof. Iseult Lynch, Laura Cristiana Gheorghe	Presenter, Participant
21 June	CERJ Annual Meeting, Birmingham, UK	UoB CERJ Network	Host, Presenter
24 June	BioFAIR Roadshow, Birmingham, UK	Dr Ralf Weber, Dr Karin Slater	Host, Presenter
5 July	Hazardous Substances Advisory Committee, London, UK	Prof. Iseult Lynch, Prof. John Colbourne, Prof. Stuart Harrad	Chair of Committee, Committee Member
23-27 July	22nd Annual European Conference on Computational Biology, Lyon, France	Prof. Georgios Gkoutos	Presenter
26-30 July	Evolution Conference, Montreal, Canada	Prof. Luisa Orsini	Participant
27-28 August	International Network of Environmental Forensics (INEF), Galways, Ireland	Prof. Stuart Harrad	Presenter
11-12 September	ASPIS Open Symposium, Copenhagen, Denmark	UoB PrecisionTox Network, Prof. Iseult Lynch	Host, Presenter
12 September	British Science Festival, London, UK	Dr Katie Reilly	Presenter
19 September	Living Lakes in Motion, part of AI Futures at The Exchange, Birmingham, UK	Prof. Luisa Orsini, Dr Jiarui (Albert) Zhou	Host, Presenter
6-12 October	Cladocera XII Conference, Verbania, Italy	Dr Katie Reilly	Presenter
25 October	2nd workshop on Roadmap towards phasing out animal testing for chemical safety assessments, Brussels, Belgium	Prof. Aleksandra Cavoski, Prof. John Colbourne, Laura Holden	Participant
5 November	A Roadmap for Non-Animal Science in the UK, London, UK	Laura Holden	Participant
26-28 November	Metabomeeting 2024, Liverpool, UK	Prof. Mark Viant, Dr Ralf Weber, Dr Andrew Southam, Dr Martin Jones, Dr Ossama Edbali, Dr Teng Meng, Lauren Cruchley-Fuge	Presenter

Partnerships

CERJ has over 290 etablished global partnerships through funded projects and placement partners, mainly focussed across Europe.



Continuing Professional Development (CPD)

In addition to developing new CPD programmes, CERJ supports the Birmingham Metabolomics Training Centre (BMTC) to deliver advanced training courses to the metabolomics community, with a particular focus on those working in toxicological metabolomics.

Course	*Delegates*	*Trainers*
LC-MS Metabolomics and Metabolite Identification with the Q Exactive Plus and the Orbitrap ID-X Tribrid 13 – 16 May 2024	8	Prof. Mark Viant, Dr Ralf Weber, Dr Martin Jones, Dr Andrew Southam, Dr Gavin Lloyd
Metabolomics in Toxicology 7 - 9 October 2024	4	Dr Ralf Weber, Dr Martin Jones, Dr Andrew Southam, Dr Gavin Lloyd

Appendix III: Awarded research funding

CERJ 2024 Annual Report

UNIVERSITY OF BIRMINGHAM

Centre for Environmental Research & Justice

Awarded grants

The following grants were awarded between 1 January 2024 and date of report.

Title	*Lead*	*Principle Investigator*	*Funder*	*Total Value*	*Value to UoB*
Advancing Biodiversity Monitoring in the Water Industry	University of Birmingham	Prof. Luisa Orsini	BBSRC IAA & Severn Trent Water	£50,282	£50,282
Precision Environmental Health	University of Birmingham	Dr Xiaojing Li	NERC	£233,157	£233,157
Deeply Annotating the Drosophila Metabolome to Advance Brain Studies (internal pump priming)	University of Birmingham	Dr Ralf Weber	Internal funds	£4,500	£4,500
Development of High-throughput Behavioural Screening in Daphnia (internal pump priming)	University of Birmingham	Dr Pu Xia	Internal funds	£4,500	£4,500
Photocatalytic treatment of biowaste to prevent environmental pollution by persistent chemicals	University of Birmingham	Dr Iestyn Stead	BBSRC IAA	£19,440	£19,440
Social Barriers to Non-animal Testing	University of Birmingham	Prof. Aleksandra Cavoski	AHRC IAA	£9,445	£9,445
Developing A Nematode High-Throughput Toxicity System	University of Birmingham	Dr Scott Glaberman	Industry partner	£8,297 ($10,621)	£8,297 ($10,621)
Establishment of Nanomaterial-induced adverse outcome pathways	University of Birmingham	Dr Laura-Jayne Bradford	Daphne Jackson Memorial Fellowship Trust	£60,107	£60,107
NAMs within integrated safety & efficacy evaluation of chemicals and pharmaceuticals (NAMWISE)	Institut national de l'environnement industriel et des risques (INERIS)	Prof. Aleksandra Cavoski	EC HORIZON Europe	€1.97m	£66,696
Expanding cell-based services for environmental risk assessment of chemicals as alternatives to long-term animal tests using fish (ExCell)	Michabo Health Science	Dr Ralf Weber	Innovate UK	£327,218	£86,265
Unravelling Structural And Biogeochemical Transformation Of Nano-Metal Organic Framework: Impact On Ecotoxicity & Environmental Applications	University of Birmingham	Dr Swaroop Chakraborty	NERC	£654,815	£654,815
EMBRACE: Exploring Microplastic Behavior and Risks in the Placenta and During Early Development	University of Birmingham	Dr Zhiling Guo	Innovate UK	£206,085	£206,085
				Total	**£1,403,589**

Appendix IV: Contributions and acknowledgements

CERJ 2024 Annual Report

UNIVERSITY OF BIRMINGHAM

Centre for Environmental Research & Justice

The CERJ Board of Directors and Centre Management Team would like thank our entire CERJ community, both our internal cohort and external partner organisations, for their continuing efforts in advancing, enhancing and developing the centre.

The below individuals contributed towards specific sections of this report, and we thank them for their dedication and support in preparing a document which we believe reflects the high standards and quality of the centre.

Contribution	*Person(s)*
Conceptionalisation, design, drafting, copy	Frankie Lloyd, David Epps
Proofing, content suggestion, and copy editing	Agata Ormanin-Lewandowska, Prof. Iseult Lynch, Prof. John Colbourne, Marianne Barnard, Prof. Aleksandra Cavoski, Prof. Robert Lee
Data gathering (conferences, publications)	David Epps, Eszter Voros, Frankie Lloyd, Marianne Barnard, Dr Martin Jones, Dr Niamh Eastwood, Raymond Huynh
Partnership mapping	Raymond Huynh
Editing	David Epps

Section	*Person(s)*
Front-page visuals and captions	David Epps
Foreword	Prof. John Colbourne
Executive Report	The CERJ Board of Directors: Prof. Aleksandra Cavoski, Prof. Georgios Gkoutos, Prof. Iseult Lynch, Prof. John Colbourne, Prof. Luisa Orsini, Prof. Robert Lee
Welcome to CERJ	Dr Scott Glaberman, Dr Louis Dawson
Affiliated facilities	Prof. Mark Viant, Prof. Luisa Orsini
Committees	Dr Niamh Eastwood, Marianne Barnard, Dr Iestyn Stead
Research briefing	Prof. Iseult Lynch
Projects portfolio	Dr Xiaojing Li, Dr Laura-Jayne Bradford, Prof. Luisa Orsini, Prof. Aleksandra Cavoski, Prof. Iseult Lynch
PrecisionTox	Agata Ormanin-Lewandowska
PARC	Prof. Iseult Lynch
Education briefing	Prof. Robert Lee
CERJ Placements	Sergio Mendes
CERJ-hosted events	Eszter Voros, Dr Niamh Eastwood