Environ 2017

Putting the Eco in the Economy

10 - 12th April 2017, Athlone Institute of Technology

27th Irish Environmental Researchers Colloquium

AIT
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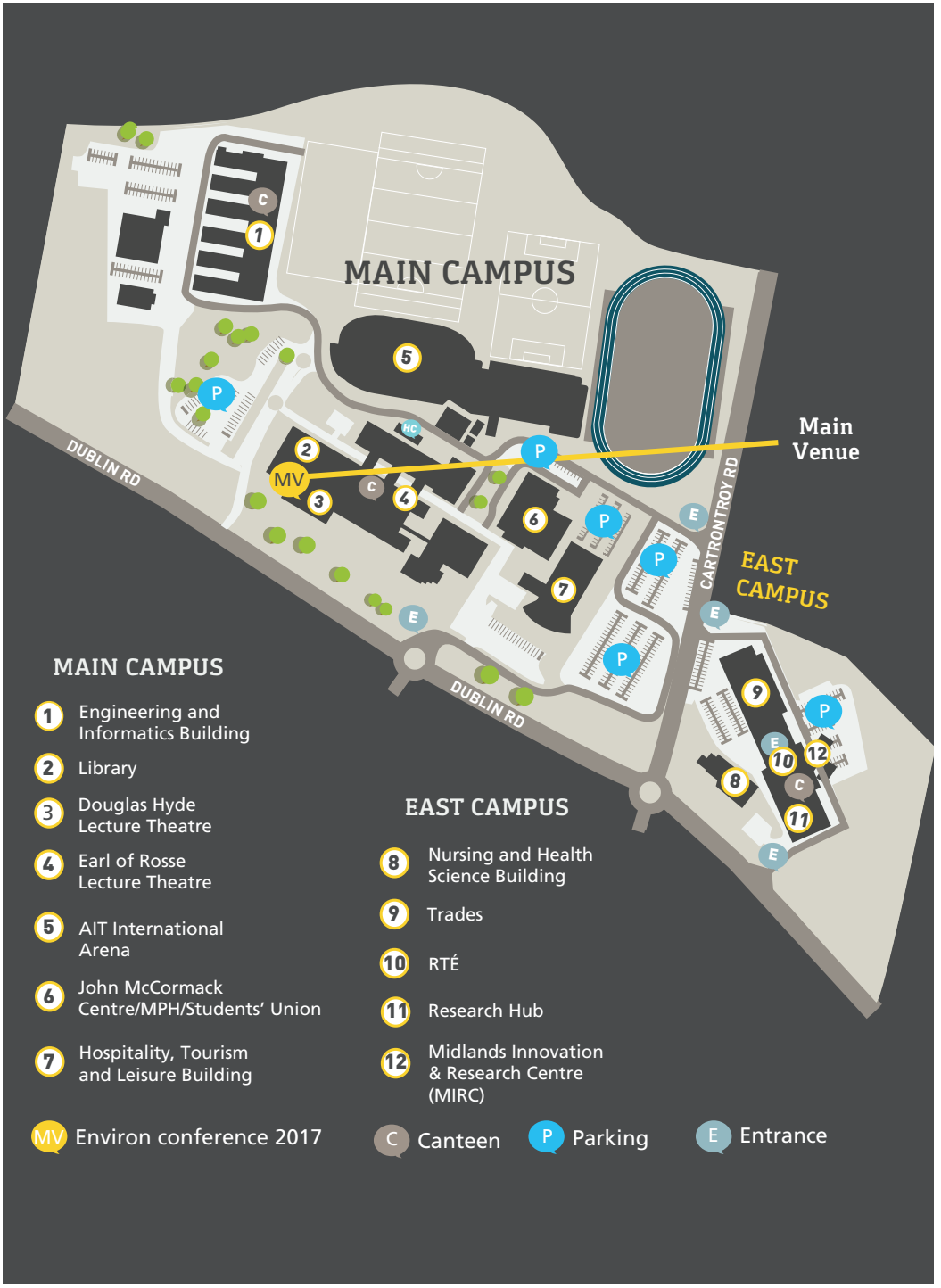
esai
Environmental Sciences Association of Ireland



MAIN CAMPUS

1. Engineering and Informatics Building
2. Library
3. Douglas Hyde Lecture Theatre
4. Earl of Rosse Lecture Theatre
5. AIT International Arena
6. John McCormack Centre/MPH/Students' Union
7. Hospitality, Tourism and Leisure Building

EAST CAMPUS

8. Nursing and Health Science Building
9. Trades
10. RTÉ
11. Research Hub
12. Midlands Innovation & Research Centre (MIRC)

MV Environ conference 2017

C Canteen

P Parking

E Entrance

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AIT Convenors Welcome to ENVIRON 2017

Dear Delegate,

The ENVIRON 2017 Organising Committee welcomes you to the 27th Irish Environmental Researchers' Colloquium (ENVIRON 2017) at Athlone Institute of Technology. The ENVIRON colloquium is the largest gathering of environmental researchers in Ireland with over 300 researchers attending this year. This event is a wonderful opportunity for environmental researchers both new and experienced to share their research with an audience drawn from academia, government bodies, industries and perhaps most importantly, the general public.

The world in 2017 is at a critical juncture regarding several issues including climate change, global access to clean water, the rise of antibiotic resistant microorganisms, the insidious ecotoxicity of micro plastics and endocrine disrupters to name but a few. Many of these issues have socio-economic aspects which are under pinned by economics thus the theme of this year's colloquium is **"Putting the Eco in the Economy"**. The word Eco is derived from the Latin word "Oeco" which means household so maybe if we view the environment and the economy as part of the same entity we might better understand our complex world.

The conference will begin on Monday 10th April with three afternoon workshops and a field trip to Clara bog nature reserve which is perhaps the best example of midland raised bog in Western Europe and is home to many protected wildlife species. The workshops are: "Maximising and Assessing Research Impacts" (Dr. Fintan Bracken, UL), "Early Stage Researcher Workshop – Where Next After Completing a PhD ?" (Dr. Yvonne Lang, IT Sligo) and "In the Eye of the Beholder: Nature Based Solutions for Health and Mental Health" (Dr. Tadhg MacIntyre, UL).

ENVIRON will open to the public on Monday 10th April with a keynote address entitled "Ireland's Climate Change Policy" by Minister Denis Naughten (Dept. of Communications, Climate Action and Environment) in the Douglas Hyde Lecture Theatre at 19.15. This will be followed by a questions and answers style public engagement debate entitled "Draining the Shannon – Flood Mitigation". This topic is of both national and local interest due to continual flooding of the Shannon and the record floods of 2015/2016. This debate will be chaired by Mr. Ciaran Mullooly (RTE) and the podium speakers are Minister Seán Canney (Minister of State, OPW and Flood Relief), Mr. Tom Browne (Asset Assurance and Engineering Manager, ESB), Dr. Ciaran Byrne (CEO, Inland Fisheries Ireland), Ms. Sinéad O Brien (Sustainable Water Network – SWAN), Mr. Éanna Rowe (Regional Manager, Waterways Ireland) and Mr. Michael Silke (IFA Spokesperson).

The academic proceedings of the colloquium will be formally opened on Tuesday 11th April by Professor Ciarán Ó Catháin (President AIT), Dr. Andy Fogarty (Conference Joint Convenor, AIT), Dr. Pat Gallagher (Chief Executive Westmeath County Council) and Dr. Frances Lucy (ESAI Chairperson). Four concurrent sessions will follow over the course of the next one and half days at which over one hundred papers and sixty posters will be presented under 16 topic areas which are:- Air Quality and Urban Development, Biodiversity

and Ecosystem Services, Climate Change, Ecotoxicology, Energy, Environment and Human Health, Environmental Management, Environmental Policy and Communications, Environmental Socioeconomics, Invasive Species, Marine and Coastal, Nanotechnology and the Environment, Sustainable Transport, Sustainable Land Use and Agriculture, Waste Management, and Water Quality and Resources. Given AIT's long association with Toxicology education, we are delighted to reintroduce Ecotoxicology as a session theme.

Another unique feature of Environ 2017 is the production of an edible art centrepiece. The sculpture, made entirely from chocolate, depicts a steel and concrete base, propping up a tree and entangled around a world globe to represent the intersection between ecology, the environment and the economy. This piece was specially commissioned for the Environ conference and produced by AIT's Department of Hospitality, Tourism and Leisure, Lecturer in Culinary Arts, Kevin Ward.

We hope that you will find ENVIRON 2017 stimulating for your own research and that you also enjoy the various social activities at our award winning AIT campus and Athlone on the banks of the majestic Shannon.

Fáilte roimh go léir go dtí Institiúid Teicneolaíochta Átha Luain agus tá súil againn go mbeidh comhdháil an-taitneamhach agaibh go léir.

Dr. Andy Fogarty and Dr. Síle Ó Flaherty

ENVIRON 2017 Joint Convenors

On behalf of the ENVIRON 2017 Organising Committee.

AIT Conference Convenors

Dr. Andy Fogarty

Dr. Andy Fogarty lectures Ecotoxicology and Microbiology in the Department of Life and Physical Science, Athlone Institute of Technology. He is a council member of ESAI and is a senior researcher in the Biosciences Research Institute, AIT. He is a Microbiology and Ecotoxicology graduate of University College Galway and The Ohio State University. His main research interests are multi-trophic ecotoxicity assessment of environmental toxicants; histopathological analyses of the effects of toxicants in fish and ecotoxicological assessment of novel wastewater treatment technologies. He serves as external examiner for several universities and is a Toxicology technical advisor to the Irish National Accreditation Board. Dr. Fogarty co-ordinates the ab initio BSc (Hons) in Microbiology at AIT and currently lectures at several European universities including Aalborg University, Denmark and University of Applied Sciences, Oestfriesland, Germany. He has published over 30 international peer reviewed papers and is a passionate science communicator having contributed to several TV and radio documentaries on environmental issues.

Dr Sile O'Flaherty

Dr Sile O'Flaherty has been a lecturer in the Faculty of Science and Health since 2007. She has been actively involved for the past ten years in education and development of educational programmes at AIT. She is the coordinator of the BSc (Hons) in Bioveterinary degree programme. Her expertise is in Terrestrial Ecology, Land Use and Land Management. She was instrumental in the development of the new four year ab initio BSc (Hons) degree programme in Microbiology which will be starting in September 2017.

Previously she was a senior researcher in the area of Microbial Molecular Ecology at Rothamsted Research (UK), previously known as the Rothamsted Experimental Station which is one of the oldest agricultural research institutions in the world.

ESAI Welcome to ENVIRON 2017 Delegates

ESAI Welcome to ENVIRON 2017 Delegates

On behalf of the Environmental Sciences Association of Ireland (ESAI), the ESAI Council extends to you a warm welcome to the 27th Irish Environmental Researchers colloquium (ENVIRON) at Athlone Institute of Technology [AIT]. We are delighted that the ENVIRON Colloquium is in Athlone, which has a long established and excellent reputation in environmental research. This year's theme for Environ is 'Putting the Eco in the Economy'.

ENVIRON provides a platform for researchers to present to a wide audience and also gives an opportunity to engage with the general public. Environmental issues, both national and global, feature increasingly on a range of social media and traditional media platforms. Society's relationship with the environment is evolving and although largely positive is sometimes provocative; we now see ourselves as environmental stakeholders often 'paying' the price for the impacts of climate change and environmental policies. Irish environmental research provides opportunities to explore the complexity of environmental systems and issues, and moreover develop solutions for both environmental and societal gain.

For the last number of years, the colloquium has been open to the public on the first evening of the event in the form of a Questions & Answers debate. This year, the Q&A is on 'Draining the Shannon –Flood Mitigation'. I would like to highlight some other initiatives that we have developed in ESAI for the benefit of our members. Each Higher Education Institute has an ESAI Liaison to promote Environ and our other activities. We offer free membership to all undergraduates in relevant courses in each college. On the back page of this book, please read details of the ESAI Postgraduate Researcher of the Year competition.

The ESAI wishes to sincerely thank Dr. Andy Fogarty, Dr. Sile O Flaherty, Ms Marese Ward Shine and the AIT committee for hosting ENVIRON and for assembling a very comprehensive programme. We also wish to thank Ms Sinead Macken for providing excellent administrative support to the event as always.

We look forward to meeting you over the course of the colloquium and hope you enjoy your visit to Athlone.

Dr Frances Lucy

ESAI Chairperson

ESAI Chairperson: Dr. Frances Lucy

Dr. Frances Lucy is Chairperson of the Environmental Sciences Association of Ireland and Head of Department of Environmental Science at the Institute of Technology, Sligo. As a researcher, she is Director of CERIS, the Centre for Environmental Research Innovation and Sustainability at IT Sligo. Her main research interests are aquatic invasive species, fisheries science and human waterborne pathogens. She is involved in a range of international invasive species forums in both Europe and North America. Frances is a Board member of Inland Fisheries Ireland.

President of AIT – Welcome Address

On behalf of the Athlone Institute of Technology I wish to welcome you all to our Institute for the 27th Irish Environmental Researchers colloquium (ENVIRON).

Our research strategy in AIT is to focus our efforts in a small number of strategic platforms areas based on core competencies built up over the years within the Institute, aligned with regional needs and national research priorities, namely materials, bioscience and software. They outwardly support industry in the region and inwardly support our teaching faculties.

Our campus offers a modern state-of-the-art Postgraduate Research Hub which provides for hosting of young researchers and distinguished scientists from national and international universities.

We have many innovative degree programmes including Toxicology, Bioveterinary Science, Mechanical & Polymer Engineering and a new ab inito BSc (Hons) in Microbiology which is the first of its kind in Ireland.

The theme of this year's colloquium is **"Putting the Eco in the Economy"** and I am delighted that Minister Denis Naughten is delivering a keynotes address, followed by a much anticipated public engagement debate on "Draining the Shannon – Flood Mitigation" which is bringing together all of the stakeholders involved in this complex and relevant issue for our region. As the only HEI in the region, providing support to the economic, social, cultural and environmental development of the region is a priority for AIT.

I congratulate the team involved in organising this conference, of which include our very own Dr. Andy Fogarty, Dr. Sile O Flaherty, Ms Marese Ward Shine and all of the organising committee.

Professor Ciarán Ó Catháin

President of Athlone Institute of Technology

Thanks to the ENVIRON 2017 Sponsors and Exhibitors

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CIWM

CIEEM Chartered Institute of Ecology and Environmental Management

CIWEM Chartered Institution of Water and Environmental Management
Republic of Ireland Branch

AQUATT Science. Communication. Knowledge. Innovation.

Athlone Institute of Technology

April 10th-12th 2017

Putting the Eco in the Economy
27th Irish Environmental Research Colloquium

DELEGATE INFORMATION

Registration

The Environ 2017 registration desk will be open in the main reception area (Building 4 on the map) at the following times:

Monday April 10th 13.00 - 20.00

Tuesday April 11th 8.00 - 18.00

Wednesday April 12th 9.00 - 11.00

Delegate Badges

Delegates are asked to wear their badges at all times during the colloquium.

Locations

Registration	Reception Area (Building 4)
Keynote Presentation	Douglas Hyde Lecture Theatre
Public Engagement Debate	Douglas Hyde Lecture Theatre
Conference Sessions	B08, B09, B10, B11
Poster Sessions and Exhibitors	B54 - B58
Tea/Coffee	B54 - B58
Lunch	Food Court
ESAI AGM	B57
Dr. Fintan Bracken Workshop: Maximising and Assessing Research Impact	IT 4
Dr. Yvonne Lang : Where Next? Career Opportunities after Completing a PhD	B59
Dr. Tadhg E. MacIntryre: Nature Based Solutions for Health and Mental Health	D02

Delegates giving oral presentations

After registering for the colloquium, delegates giving oral presentations should upload their presentation at the content management desk (located beside Registration desk). All presentations for oral sessions should be uploaded well in advance of the session in which the presentation is being given (no later than 2 hours before the session begins). Presentation titles should include the submitting author' s surname for easy identification. Presenters are asked to introduce themselves to the session chairs in the assigned session room at least 5 -10 minutes before the session begins.

Posters

The poster presentation area is upstairs in rooms B54 – B58. When you arrive at the registration desk please indicate that you have a poster for presentation and the registrars will guide you to the poster presentation area. Posters can be erected on Monday April 10th (13.00 - 17.00) or on Tuesday morning April 11th (8.00 - 11.00). **All posters must be in place by 10.00 on Tuesday April 11th**. Please do not remove posters until the end of the final poster session on Wednesday morning. There will be three poster sessions throughout the colloquium. To ensure that colloquium delegates can meet poster presenters we would strongly encourage poster presenters to be by their posters for these sessions to answer any questions. Each presenter is assigned a unique poster ID number (check ID in poster abstract section in the Delegate Handbook). You poster should be mounted on the poster board assigned to your ID. You are welcome to bring some A4 handouts of your poster to give away.

WIFI

AIT has Eduroam for those from other colleges. There will also be a temporary log- on available during Environ. This will be provided for you on signs in the conference zones.

Tea/ Coffee/ Lunch

Teas and coffees will be served in the poster presentation area on Tuesday and Wednesday during colloquium conference breaks. A hot lunch will be served on Tuesday and Wednesday in the Food Court. There will be take away options available also.

ATM

There is a Bank of Ireland ATM on campus situated just off the main reception area.

Parking

Free parking is available in the main carparks on campus. There is also an underground pay carpark on campus.

Local Transport

There is a bus service in to Atlhlone every 15 minutes from outside the college.

Taxi services include

A One Cabs	090 647 3000
Athlone Cab Company	090 647 4400
AD Cabs	090 642 0902
Athlone City Taxis	090 647 4888
Athlone Cosy Cabs	090 647 2233
Athlone Express Cabs	090 647 9888
Castle Cabs	090 647 9777
Dial – A – Cab	090 649 3030

ENVIRON 2017 ORGANISING COMMITTEE

Joint Conference Convenors

Dr. Andy Fogarty and Dr. Síle O' Flaherty

Conference Coordinator

Marese Ward Shine

Athlone Institute of Technology Planning Committee

Dr. Don Faller
Dr. Mike Mullen
Dr. Mary Booth
Prof. Clem Higginbotham
Mr. Cormac Cloonan
Dr. Brian Murphy
Dr. Gary Stack
Dr. Anne Friel
Mr. Iain Murray

Environmental Sciences Association of Ireland (ESAI)

Ms Sinead Macken ESAI Administrator
Dr Frances Lucy ESAI Chairperson ESAI Council

On the ground assistance at Athlone Institute of Technology

Mr. John McKenna
Dr. Niall Seery
Dr. Donal Eardly
Dr. Sinead Devery
Mr. Rossa Coleman
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Dr. Declan Devine
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Ms. Sarah Naughton
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Mr. Michael Hopkins (JNR)
Ms. Emer O'Neill
Ms. Caoimhe O'Connell
Ms. Felicia Cezar
Ms. Aishling Gath
Ms. Shannon Costin

ENVIRON 2017 CONFERENCE PROGRAMME

	Conference Programme Monday April 10th 2017
13.00 -20.00	**Registration AIT Reception Area**
14.00 - 17.00	**A: Clara Bog Fiield Trip** Facilitator: Dr. Sile O'Flaherty, AIT
14.00 -17.00	**B: Maximising and Assessing Research Impact** Facilitator: Dr.Fintan Bracken, University of Limerick
14.00 -17.00	**C: Where Next? Career Opportunities after Completing a PhD** Facilitator: Dr. Yvonne Lang, IT Sligo
14.00 -17.00	**D: Nature Based Solutions for Health and Mental Health** Facilitator: Dr. Tadhg E. MacIntryre, University of Limerick
18.30 -19.15	**Drinks Reception AIT**
19.15 - 19.45	**Keynote Presentation by Minister Denis Naughten,** Minister for Communications, Climate Action and the Environment **Douglas Hyde Lecture Theatre** **"Putting the Eco in the Economy"**
20.00 - 21.30	**Public Engagement Debate: Douglas Hyde Lecture Theatre** **"Draining the Shannon – Flood Mitigation"** **Followed by Q&A Session** **Panel:** Minister Seán Canney,OPW and Flood Relief Mr. Tom Browne, ESB Dr. Ciaran Byrne, CEO Inland Fisheries Ireland Ms. Sinead O'Brien, Sustainable Water Network (SWAN) Mr. Éanna Rowe, Waterways Ireland Mr. Michael Silke, IFA Spokesperson. Chairman: Mr. Ciaran Mullooly

	Conference Programme Tuesday April 11th 2017			
8:00	**Registration – AIT Reception Area**			
9.15 - 9.30	Opening of Environ 2017; Douglas Hyde Lecture Theatre AIT President Professor Ciarán Ó Catháin, Environ 2017 Conference Convenors: Dr. Andy Fogarty and Dr. Síle O'Flaherty Dr. Frances Lucy, ESAI Chairperson Dr. Pat Gallagher, Chief Executive Westmeath County Council			
09.45 -10.45	Biodiversity and Ecosystems Services **Room B08**	Nanotechnology and the Environment **Room B09**	Environmental Socioeconomics **Room B10**	Air Quality and Urban Development **Room B11**
10.45 - 11.30	**Coffee Poster Session 1 & Meet the Exhibitors: Rooms B54 - B58**			
11:30 - 13:00	Water Quality & Resources 1 (RIA) **Room B08**	Invasive Species **Room B09**	Ecotoxicology **Room B10**	Sustainable Land Use & Agriculture 1 **Room B11**
13.00 - 14.30	**Lunch Food Court**			
14.30 - 15.30	Water Quality and Resources 2 **Room B08**	Waste Management 1 **Room B09**	Environmental Management **Room B10**	Sustainable Land Use and Agriculture 2 **Room B11**
15.30 - 16.15	**ESAI College Liaisons Meeting: Room B57**			
15.30 - 16.15	**Coffee Poster Session 2 & Meet the Exhibitors Rooms B54-B58**			
16.15 - 17.15	Water Quality and Resources 3 **Room B08**	Waste Management 2 **Room B09**	Environmental Policy and Communications **Room B10**	Marine and Coastal 1 **Room B11**
17.30 - 18.00	ESAI AGM & Presentation by Postgrad Researcher of the Year Award Winner – Christopher Finnegan , IT Carlow: **Room B57**			

19.00 - 20.00	Drinks Reception: The Siege Suite , Sheraton Hotel Athlone Entertainment; Clem Higginbotham & Áine O'Regan
20.00	Conference Dinner: The Hoey Suite, Sheraton Hotel Athlone Entertainment: The Small Deal Band

	Conference Programme Wednesday April 12th 2017			
9.00 - 11:00	**Registration – AIT Reception Area**			
10.00 - 11.00	Environment and Human Health 1 **Room B08**	Climate Change 1 **Room B09**	Marine and Coastal 2 **Room B10**	
11.00 - 11.45	**Coffee Poster Session 3 & Meet the Exhibitors: Rooms B54 - B58**			
11.45 - 12.45	Environment and Human Health 2 **Room B08**	Climate Change 2 **Room B09**	Energy **Room B10**	Waste Management 3 **Room B11**
12.45 - 13.30	**Lunch Food Court**			
13.30 - 14.15	**Prize Giving & Close of Environ 2017**			

Environ 2017

Athlone Institute of Technology

April 10th-12th 2017

Putting the Eco in the Economy
27th Irish Environmental Research Colloquium

ORAL AND POSTER PRESENTATION SCHEDULE

Oral Presentations Sessions (1-4): Tuesday April 11th 9.45 - 10.45

	Session 1 **Biodiversity and Ecosystems** **B08**	**Session 2** **Nanotechnology and the Environment** **B09**	**Session 3** **Environmental Socioeconomics** **B10**	**Session 4** **Air Quality and Urban Development** **B11**
9.45 - 10.00	Chair **Dr Michael Mullen** AIT Sustainable development of Greenways: Application of Morphological Spatial Pattern Analysis to determine ecological connectivity of Greenways. **Julien Carlier** IT Sligo	Chair **Dr Yvonne Lang** IT Sligo The role of state of the art 2D materials in water treatment applications **Saoirse Dervin**, IT Sligo	Chair **Dr Dorothy Stewart** EPA Estimating Individual Willingness to Pay for Community Flood Defences **Finbarr Brereton** UCD	Chair Address **Mr. David Dodd** (Dept Communications , Climate Action and Environment)
10.00-10.15	Under the hedge; soil invertebrate communities are influenced by hedgerow tree species and condition **Florentine Spaans** QUB	Anatase to rutile transition in TiO_2 nanomaterials for environmental applications **Ciara Byrne** IT Sligo	Gender and the Sustainable Energy Transition **Christine Gaffney** UCC	Quantifying the influence of ambient environmental quality on the effectiveness of green exercise **A.A. Donnelly** UL
10.15 - 10.30	Valuable biodiversity: Examining the values and impacts of biodiversity offsetting initiatives in Colombia **Jane Feeney** TCD	Silver nanoparticles in the environment: an overview **Eoin McGillicuddy** NUIG	Sustainability accounting and reporting for origin green: A national sustainability programme for the Irish food and drink industry **Rebecca Maughan** UCD	Characterization of primary organic aerosols of domestic wood, peat, and coal burning in Ireland **Chunshui Lin** NUIG
10.30 - 10.45	Functional vegetation dynamics, substrate and eco-morphological relations in the mediation of fluvial erosion and transport in a coastal dune-fen system **Ray Tighe** DIT	Standardized Non-invasive Toxicological analysis of Nano-carriers within Freshwater Aquatic Environments **Andrew Reynolds** DIT FOCAS	Educating designers on multi-sensory acknowledgement within the built environment **Aoife Hayes** CIT	Sources and abundance of black carbon in atmospheric particles around Ireland **Paul Buckley** UCC

Continue onto next page

	Session 1 **Biodiversity and Ecosystems** **B08**	**Session 2** **Nanotechnology and the Environment** **B09**	**Session 3** **Environmental Socioeconomics** **B10**	**Session 4** **Air Quality and Urban Development** **B11**
10.45	Poster 1 Minute Oral Presentation **M Larkin BES Poster 3**	The capture of silver nanoparticles from solution using activated charcoal **Eoin McGillicuddy** NUIG	Chair **Dr Dorothy Stewart** EPA Estimating Individual Willingness to Pay for Community Flood Defences **Finbarr Brereton** UCD	Chair Address **Mr. David Dodd** (Dept Communications , Climate Action and Environment)

Oral Presentations Sessions (5-8): Tuesday April 11th 11.30 -13.00

	Session 5 **Water Quality & Resources 1** **B08**	**Session 6** **Invasive Species** **B09**	**Session 7** **Ecotoxicology** **B10**	**Session 8** **Sustainable Land Use & Agriculture 1** **B11**
11.30 - 11.45	Chair Address **Prof. Catherine Coxon** TCD	Chair Address **Dr. Jaimie Dick** QUB Predicting invasive species impacts under context-dependencies QUB **Jaimie T.A. Dick** QUB	Chair **Dr. Andy Fogarty** AIT Designing an ecotoxicological toolbox for silver nanoparticles in the freshwater environment **Iain Murray** AIT	Chair **Dr. Síle O'Flaherty** AIT Irish potato rhizobacterial isolates show promise as biocidal alternatives and plant growth-promoters **Darren Heenan Daly** UCC
11.45 - 12.00	Lake ecological assessment metrics in Ireland: relationships with phosphorus and typology parameters and the implications for setting nutrient standards **Gary Free** EPA	First record of the Asian clam Corbicula fluminea (Müller, 1774) (Bivalvia, Cyrenidae) in Northern Ireland. **Joe Caffrey**INVAS Biosecurity	Nematodes and environmental change **Thomae Kakouli-Duarte** IT Carlow	Using Geographical Information Systems (GIS) to build a risk assessment model for the potential impact of atmospheric ammonia **David Kelleghan** UCD
12.00 - 12.15	Fish in tidal freshwater transitional waters in Ireland: recommendations for assessment, policy and management of ecological quality under the Water Framework Directive (WFD) **Michelle Giltrap** DIT	Invasion history of Dreissena polymorpha, the zebra mussel in a Shannon Lake, Lough Key **Frances Lucy** IT Sligo	Endocrine Disruptors & the Environment - Current State of Play in Europe (pesticides) **Aisling Redmond** Dept. Agriculture, Food & the Marine	Hill farmers: under-valued custodians of hill ecosystems **Brian Dunne** Wicklow Uplands Council
12.15 - 12.30	Integrating observed, inferred and simulated data to illuminate environmental change: a limnological case study **Eleanor Jennings** DKIT	EU Regulation on Invasive Alien Species - Will It Make A Difference in Ireland? **Joe Caffrey** INVAS Biosecurity	Evaluating the success of different rehabilitation strategies of bauxite residues: a risk assessment of trace elements along the food chain **Elisa Di Carlo** UL	Socio-cultural valuation of ecosystem services - a tool for effective stakeholder engagement to inform land use planning and management: case study **Deirdre Joyce** UCD

Continue onto next page

	Session 5 **Water Quality & Resources 1** **B08**	**Session 6** **Invasive Species** **B09**	**Session 7** **Ecotoxicology** **B10**	**Session 8** **Sustainable Land Use & Agriculture 1** **B11**
12.30 - 12.45	What have we learnt from over two decades of monitoring riverine nutrient inputs to Ireland's marine environment? **Shane O'Boyle** EPA	Parasite-mediated effects of an invasive fish on native brown trout **Paula A.Tierney** TCD	An Ecotoxicological investigation on the effects of pulsed ultraviolet light on selected aquatic chemical disinfectants **Sarah Naughton** AIT	The potential of gaseous nitrogen (Ng) mitigation and offsetting in agricultural systems **M. Ibrahim Khalil** UCD
12.45 - 13.00	Understanding pathways transferring nutrients from source to sea: from study catchments to national modelling **Eva Mockler** UCD	Underpinning Invasive Species Outreach with an Effective Communications Plan **Eithne Davis** IT Sligo	Genomic Insights into the Virulence Capacity of Soil-Adapted E. coli **Nicholas Waters** NUIG	An Evaluation of the GrassVESS technique for Soil Structural Quality **Eileen Jeuken** IT Sligo

Oral Presentations Sessions (9 – 12): Tuesday April 11th 14.30 -15.30

	Session 9 Water Quality & Resources 2 **B08**	**Session 10 Waste Management 1** **B09**	**Session 11 Environmental Management** **B10**	**Session 12 Sustainable Land Use & Agriculture 2** **B11**
14.30 - 14.45	Chair **Dr Caroline Wynne** TCD Fast Analysis of Polar Pesticides in Water by IC-MS/MS **Gemma Ellison** Thermo Fisher Scientific	Chair **Dr. Niamh Power** CIT Death by digesters: eliminating pathogens in agricultural waste products **Agathe Auer** UCD	Chair Address **David Tobin**	Chair **Dr Brian Murphy** AIT White clover for pasture production systems: does ploidy affect clover proportion? **Clare Guy** Teagasc Moorepark
14.45 - 15.00	An investigation of the hydrology, ecology, and ecosystem function of groundwater dependent wetlands **Victor Perelló** DKIT	Phosphorus (P) removal, recovery and reuse in wastewater using Bauxite Residue **Patricia B. Cusack** UL	**1**NUI Galway's journey towards sustainability LEARN LIVE LEAD **Michelle O'Dowd** NUIG	Effects of planting density on the physiological and growth responses of three potential short-rotation forestry species in Ireland **Susan Foreman** UCD
15.00 - 15.15	The value of a desk study in building a river obstacle inventory **Siobhán Atkinson** UCD	Pathogen survival in agriculture-based anaerobic co-digestion with FOG **Stephen Nolan** NUIG	Sustainable development (SD) in higher education (HE) – Learning from global best practice to inform meaningful action in Ireland. **Maria Kirrane** UL	Pasture based livestock systems: can white clover successfully over-winter? **Clare Guy** Teagasc Moorepark
15.15 - 15.30	Sediment transport on the river Bandon, Ireland **Laurence Lomasney CIT** Poster 1 Minute Oral Presentation **L Hall WQR Poster 50** **D Mooney WQR Poster 53**	Screening of Polystyrene Insulation Foams from Construction and Demolition Waste for Flame-Retardant Persistent Organic Pollutants using X-Ray Fluorescence **Martin Sharkey** NUIG	Assessment of environmental conditions affecting the performance of eelgrass Zostera marina meadows in western Ireland **Pedro Beca-Carretero** NUIG	Nutrient cycling in an agricultural setting **Andrew C. Fowler** UL

Oral Presentations Sessions (13 – 16): Tuesday April 11th 16.15 -17.15

	Session 13 **Water Quality and Resources 3** **B08**	**Session 14** **Waste Management 2** **B09**	**Session 15** **Environmental Policy & Communication** **B10**	**Session 16** **Marine and Coastal 1** **B11**
16.15 -16.30	Chair **Prof. Catherine Coxon** TCD The ecological impacts of cattle access on freshwater ecosystems **Matt O'Sullivan** UCD	Chair **Dr Tom Curran** UCD Backcasting: a means to deliver sustainable health-care priorities **Yvonne Ryan-Fogarty** UL	Chair **Prof. Neil Rowan** AIT Mobilising Finance for Conservation: A National Biodiversity Expenditure Review for Ireland **Rachel Morrison** UCD	Chair Address **Dr. Ciaran Kelly** Marine Institute
16.30-16.45	Candidate method identification for arsenite detection and quantification in water using optochemical strategies **Annija Lace** IT Carlow	Assessing the potential for industrial symbiosis in Ireland **Rosemarie D. Mac Sweeney** UCC	Sustainable Voluntary Urban Communities: Supports for Sustainable Development Actions **Anne Bennett** UL	Monitoring internal moisture and salinity changes in Irish coastal sand dunes **Ciaran Nash** TCD
16.45-17.00	How do river channels and their floodplains adjust to changes in flood flows? **Patrick Belmont** Utah State University	Evaluation of a reuse technology for bauxite residue – Extraction of critical raw materials **Éva Ujaczki** UL	Catchments.ie – communicating the story of water from source to sea **Paddy Morris** EPA	Re-inventing the wheel: an alternative fisheries management system. **Debbi Pedreschi** Marine Institute
17.00 -17.15	Pumps as turbines technology for energy recovery from water supply systems **Daniele Novara** TCD	Preliminary investigations on the utilisation of vermitea as an alternative nutrient source for plant growth **Mary Fitzpatrick IT** Carlow	Particulate matter from diesel vehicles: Emission & exposure in Dublin **Meabh Gallagher** TCD	DiscardLess: Assessment of some impacts of the landing obligation and the development of tools and strategies to achieve its goals within the Irish fishing fleet **Julia Calderwood** Marine Institute

Oral Presentations Sessions (17 – 19) : Wednesday April 12th 10.00 -11.00

	Session 17 **Environment and Human Health 1** **B08**	**Session 18** **Climate Change 1** **B09**	**Session 19** **Marine and Coastal 2** **B11**
10.00 - 10.15	Chair Address **Prof. Martin Cormican** NUIG	Chair Address **Prof. Jenny McElwain** UCD	Chair **Dr. Ciaran Kelly** Stress in aquaculture: The use of a biomarker to measure stress levels in farmed fish **Sandra Bohan** IT Carlow
10.15 - 10.30	Engagement with Nature: An exploratory study of nature savouring among college Students **Tadhg MacIntyre** UL	The Relationship between Fluorescent Particles and Ice Nuclei Measured at Two Contrasting Sites. **David O'Connor** DIT	The Point System for Fishing Vessels- Dead in the Water? **Laurie O'Keeffe** Sea-Fisheries Protection Authority
10.30 - 10.45	Influence of ambient temperature on biosand filter performance for domestic drinking water treatment. **Greg Beechinor UCC**	Integrating GIS and modelling approaches for precise estimation of SOC stocks and their historical changes for different agricultural land uses in Ireland **M. Ibrahim Khalil UCD**	Developing Real-time PCR assays for the rapid identification of marine Actinomycetes. **Ciara McDonnell** AIT
10.45 - 11.00	Using Geographic Information Systems to map human cases, and risk of shiga toxigenic Escherichia coli in the west of Ireland **Carina Brehony** NUIG	Ensemble of Regional Climate Model Projections for Ireland **Paul Nolan** ICHEC	The application of 3D geometric morphometric techniques to detect differences in shell morphology between populations of Littorina littorea **Darragh Doyle** GMIT
11.00	Poster 1 Minute Oral Presentation **B Reddy EHH Poster 18**		Co-ReSyF: Opening a gateway for coastal research to capitalise on increasing Earth Observation data availability **Rory Scarrott** UCC

Oral Presentations Sessions (20 – 23): Wednesday April 12th 11.45 -12.45

	Session 20 Environment and Human Health 2 **B08**	**Session 21 Climate Change 2** **B09**	**Session 22 Energy 3** **B10**	**Session 23 Waste Management 3** **B11**
11.45 - 12.00	Chair **Prof. Martin Cormican** Antibiotic resistance in Irish waters: Genetic analysis of the prevalence of antimicrobial resistance species in the aquatic environment **Karen Harney** DIT	Chair **Prof. Jenny McElwain** Storminess in the Irish Climate: what can we expect in the future? **Ray Mc Grath** ICHEC	Chair **Prof. Niall Brown** nZEB-RETROFIT: The influence of human behavior on the energy consumption and internal environment of Irish residential buildings **P. Moran** NUIG	Chair **Dr Niamh Power** CIT Examination of the economic content of waste LCD-TVs **Paul Moroney** UL
12.00 - 12.15	Contamination of Irish bathing waters with shiga toxigenic Escherichia coli **Carina Brehony** NUIG	Assessment and application of carbon footprint methods at a higher education institution **William Horan** UL	Energy behaviour change approaches in Ireland: a review of existing policy instruments **Alexandra Revez** UCC	Anaerobic digestion for biogas production and its future in Ireland **Navodita Bhanagar** IT Carlow
12.15 - 12.30	The agri-food chain as a reservoir for antimicrobial resistant Escherichia coli. **Bláthnaid Mahon** NUIG	Dissolved carbon and nitrogen losses from decomposing woody forest debris **Brian Tobin** UCD	Experience, dialogue and negotiation: Identifying sustainable energy transition pathways **Breffní Lennon** UCC	Biological phosphorus recovery during low-temperature anaerobic digestion wastewater treatment **Jasmine Connolly** NUIG
12.30 - 12.45		Exploring the prospects of community led sustainability transformation in Ireland **Rosemary Byrne** UL	Store surplus electricity as renewable gaseous or liquid fuels **Truc .T.Q.** UCC	On-line fluorescence sensing of airborne fungal spores released from a green-waste/composting site in Ireland **Patrick Feeney** UCC

Environ 2017

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27th Irish Environmental Research Colloquium

Oral Presentation Abstracts

Biodiversity and Ecosystem Services

Sustainable development of Greenways: Application of Morphological Spatial Pattern Analysis to determine ecological connectivity of Greenways

Julien Carlier[1], James Moran[1]

[1]Centre for Environmental Research Innovation and Sustainability, IT Sligo, Ash Lane Co. Sligo, Ireland.

Corresponding Author Email Address: julien_carlier18@hotmail.com

European Greenway developments typically 'upcycle' disused transport corridors for multi-use, non-motorised public infrastructure. The linear and relatively undisturbed nature of these disused infrastructures means many are functioning as high quality ecological corridors. The sustainable integration of public infrastructure and ecological corridor roles requires consideration during design, development and maintenance stages of Greenways, taking into account the surrounding landscape composition and condition. In this research, morphological spatial pattern analysis (MSPA) is used to determine ecological connectivity of the ecosystems occurring along a 70 km^2 study area following a proposed Greenway route in the North West of Ireland. MSPA can produce pixel-based characterisation of landscapes, identifying habitat core and various connectivity features of raster images. For the proposed route, desk-based MSPA is used to analyse individual ecosystem connectivity features within the study area. The output data from MPSA analysis is then combined with corresponding spatial habitat data from a combination of ground truthing and remote sensing. The combined output is further interpreted using principal components analysis (PCA), resulting in six distinctive landscape characterisations based on land cover and ecosystem connectivity. Using the landscape types, additional interpretation using MSPA classifies the ecosystem status in terms of habitat fragmentation, core, links and potential linkages. This research provides a method to characterise the existing ecosystems connectivity within the particular landscape contexts of Greenways. Using such data, Greenways can be developed to optimise habitat linkages along and through their routes, contributing towards their realisation as true sustainable projects.

Keywords: greenway, landscape characterisation, morphological spatial pattern analysis, ecological corridors, sustainable development

Biodiversity and Ecosystem Services

Under the hedge; soil invertebrate communities are influenced by hedgerow tree species and condition

Florentine Spaans[1], Ian Montgomery[1], Tancredi Caruso[1]

[1]School of Biological Sciences and Inst. of Global Food Security, Queen's University, Belfast, Northern Ireland.

Corresponding Author Email Address: fspaans01@qub.ac.uk

A large proportion of the land area throughout Ireland consists of enclosed farmland, with an extensive hedgerow network which extends to ca. 113,648 km in Northern Ireland alone. The soils of intensive agricultural land are often biologically impoverished in terms of microarthropods, with communities geared towards bacterial pathways in mostly high nitrogen systems with rapid turnover rates and poor soil structure. Hedgerows provide more stable soil systems with increased spatial structuring and higher diversity in soil invertebrates. Irish hedgerows typically consist of a mix of shrub and tree species, the most common being hawthorn *(Crataegus monogyna*) and ash *(Fraxinus excelsior)*. The ash population is currently at severe risk due to ash dieback and (potentially) the emerald ash borer. This study investigates the contribution of ash trees to the structure of the soil microarthropod community within hedgerows. Soil cores were taken under hedges with and without ash and sycamore trees. Sampling was replicated in space and time and particular attention was paid to the oribatid mite populations. Differences between types were statistically significant independent of soil properties and spatial and temporal variation. The hedgerow soils contained high species richness, with hedgerow tree communities positioning between hedges and adjacent fields in ordination space. The results suggest that hedgerow trees foster distinct soil communities from the rest of the hedge, thus adding to overall biodiversity. Hedges play an important role in soil health on a landscape scale and could contribute to soil restoration following degradation related to agricultural intensification and widespread loss of trees due to disease.

Keywords: soil biodiversity, hedgerows, oribatid mites

Biodiversity and Ecosystem Services

Valuable biodiversity: Examining the values and impacts of biodiversity offsetting initiatives in Colombia

Jane Feeney[1]

[1]Geography Department, School of Natural Sciences, Trinity College Dublin, Dublin 2, Ireland.

Corresponding Author Email Address: feeneyj1@tcd.ie

Biodiversity is essential for the healthy functioning of ecosystems and the provision of critical ecosystem goods and services such as food, water and climate regulation. However, biodiversity loss remains a global meta-challenge, representing one of the United Nations Sustainable Development Goals. Increasingly, the use of market-based approaches to conservation are being put forward as a way to meet conservation objectives while simultaneously supporting economic growth and development. One of these approaches, biodiversity offsetting, aims to compensate for biodiversity loss as a result of development projects (e.g. infrastructure, mining) by conserving or restoring biodiversity of equivalent 'value' elsewhere. This paper explores the state of knowledge around biodiversity offsetting. It presents the findings from a review of literature on biodiversity offsetting research detailing the focus, scientific approaches and geography of research and researchers involved. Most of the research to date has taken place in the Global North, particularly the USA, followed by Australia, but this trend is shifting, with an increasingly international focus and a move away from a concentration on wetlands to an application of the approach to different ecosystem types. As biodiversity offsetting initiatives expand globally, there is a need to critically evaluate their form, governance and impacts in territories beyond the Global North. In Latin America and the Caribbean, the most biodiverse region of the world, Colombia is leading the way in market-based conservation, with a regulatory framework requiring biodiversity offsetting and the first habitat bank in the region. This paper concludes with a plan for research to address this research lacunae and progress understanding of the opportunities and challenges offered by biodiversity offsetting, in a Global South context.

Keywords: biodiversity offsetting, conservation, biodiversity, Colombia

Biodiversity and Ecosystem Services

Functional vegetation dynamics, substrate and eco-morphological relations in the mediation of fluvial erosion and transport in a coastal dune-fen system

R. Tighe[1], A. Gilmer[1], E. McGovern[2]

[1]Environmental Sustainability and Health Institute, The Greenway Hub, Dublin Institute of Technology, Grangegorman, Dublin 7, Ireland.
[2]Spatial Information Sciences Group, School of Surveying and Construction Management, College of Engineering and Built Environment, Dublin Institute of Technology, Bolton Street, Dublin 1, Ireland.

Corresponding Author Email Address: C10719073@mydit.ie

Morphodynamic processes in coastal dune systems are caused by the feedback loop that exists between the local topography and the fluid dynamics that act upon it. Hydrology, substrate, vegetation and the climatic regime are key components in driving these processes. This research focuses on such dynamics taking place at Buckroney-Brittas Dunes and Fen SAC located approximately 55 km south of Dublin City in County Wicklow, Ireland. The site is afforded EU designation and protection status owing to its high level of biodiversity and international conservation importance. Initial investigation of the vadose zone and shallow water table hydrodynamics show the existence of complex interdependent relationships between vegetation composition, plant spatial distribution and dune morphology. Parameters controlling fluid dynamics within this system such as the sediment substrate, topography, precipitation and exogenous inputs will be identified and analysed. A range of different surveying technologies will be employed to conduct topographical analysis of the dune-fen complex including LIDAR, UAV for topographic modelling and multi-spectral analysis. LIDAR possesses the ability to record bare-earth data from which a DEM (Digital Elevation Model) can be generated. UAV software enables the production of detailed orthomosaics and 3D models of dune-fen topography for further analysis and prediction. UAV multi-spectral sensor technology has the ability to capture imagery from four different spectral bands; near-infrared, red-edge, red and green allowing for, inter alia, vegetation demarcation and health determination. Little available research exists presently which utilises drone-based multi-spectral sensors in vegetation analysis. The ultimate objective of this research is the development of a conceptual and heuristic model derived from a mechanistic understanding of process and function which will result in an eco-hydrological simulation of a dune-fen morphological system. This model will serve as a management tool for dune-fen systems and improve cohesion across research and user communities dealing with these vulnerable coastal zones.

Keywords: hydrology, dune-fen system, vegetation, morphology, unmanned aerial vehicle (UAV)

Nanotechnology and the Environment

The role of state of the art 2D materials in water treatment applications

Saoirse Dervin, [1,2] Umar Khan [b] and Suresh C. Pillai [1,2]

[1]Centre for Precision Engineering, Materials and Manufacturing Research (PEM), Institute of Technology Sligo, Sligo, Ireland.

[2]Nanotechnology & Bio-Engineering Research Group, Department of Environmental Science,

Institute of Technology Sligo, Ash Lane, Sligo, Ireland.

Corresponding Author Email Address: Saoirse.Dervin@mail.itsligo.ie

The emerging water crisis is a substantial threat to humanity. A mere 2.5% of our Planet´s fresh water resources are available for human consumption. However, many of these water bodies are a chemical cocktail of synthetic pollution or the end point for biological waste. As a result approximately 894 million people globally lacking access to clean water. Conventional means of water purification are currently incapable of providing the globe's population with an economical or satisfactory supply of potable water. However, substantial advances have recently been made in understanding the possibility of confronting water scarcity and pollution with cutting edge nanomaterials. Recent progress in the development of nanoporous graphene filtration has generated enormous potential for water purification technologies. Consequently, interest among the use of alternative 2D materials for water treatment has also been increased. The unique properties of such state of the art materials can enhance the performance of many water treatment techniques including desalination, contaminant filtration and adsorption, as well as bacterial photoinactivation. To date, a mere handful of 2D materials, including 2D boron nitride nanosheets, graphyne, molybdenum disulfide (MoS_2), tungsten chalcogenides (WS_2) and titanium carbide ($Ti_3C_2T_x$) have been explored for water treatment applications and all have exhibited great promise. Furthering such works, the prospect of combining graphene with other 2D crystals will produce materials capable of suppressing the drawbacks currently faced by grapheme materials for water treatment technologies. The current research therefore aims to examine the potential of a 2D composite for the generation of clean water.

Reference:

Dervin S., Dionysiou D.D. and Pillai S.C (2016) 2D nanostructures for water purification: graphene and beyond. Nanoscale, 8, p.15115.

Keywords: graphene, 2D materials, water treatment

Nanotechnology and the Environment

Anatase to rutile transition in TiO_2 nanomaterials for environmental applications

Ciara Byrne[1,2], Lorraine Moran[3], Daphne Hermosilla[4], Steven J. Hinder[5], Suresh Pillai[1]

[1]Nanotechnology Research Group, Department of Environmental Science, Institute of Technology Sligo, Sligo, Ireland.

[2]Centre for Precision Engineering, Materials and Manufacturing Research (PEM), Institute of Technology Sligo, Sligo, Ireland.

[3]Department of Life Sciences, Institute of Technology Sligo, Sligo, Ireland.

[4]Department of Agricultural and Forest Engineering, University of Valladolid, Campus Duques de Soria, 42005 Soria, Spain.

[5]Surface Analysis Laboratory, Department of Mechanical Engineering Sciences, University of Surrey, Guilford, Surrey, GU2 7XH, UK.

Corresponding Author Email Address: Ciara.Byrne@mail.itsligo.ie or pillai.suresh@itsligo.ie

The semiconductor titanium dioxide (TiO_2) ocurrs in nature in three main phases, anatase, brookite and rutile. Due to it's nontoxicity, ease of preperation, cost efficency, long term stability and strong oxidising ability, TiO_2 still remains to be one of the most researched photocatalysts. Antatase and brookite are both metastable phases which irriversibly transform into ruitle at elevated tempertures. In pure synethic TiO_2 samples, this normally occurs between 600 °C and 700 °C. Of the three titania phases, anatase is widely considered to be the most photocatalytically active phase. Dopants, chemical additives and chemical modifiers can be added to TiO_2 in order to alter the transition temperature and photocatalytic activity. For example, dopants such as Cu^{2+}, Co^{2+} and Fe^{2+} cause this transition to occur at elevated temperatures, whereas dopants such as SO_4^{2-} and PO_4^{3-} cause the transition to occur at temperatures below 600 °C. There continues to be extensive research into the inclusion of dopants into the TiO_2 matrix to produce a stable anatase phase photocatalyst at elevated temperature (≥ 1000 °C) and improving its photocatalytic activity. Environmental applications include water and wastewater treatment (removal of hazardous substances/disinfection), air purification, self-cleaning and antimicrobial tiles (for bathroom, surgical wards etc.), antimicrobial sanitary wares (e.g. sinks), energy conversion (solar cell) and water splitting (hydrogen evolution). This presentation considers the use of a dopant to affect the anatase to rutile transition and how this effects TiO_2 ability to degrade chemicals in water.

Keywords: titanium dioxide, anatase to rutile transition, photocatalyst, dopants, chemical degradation

Nanotechnology and the Environment

Silver nanoparticles in the environment: an overview

Eoin Mc Gillicuddy[1,2], Iain Murray[3], Siobhan Kavanagh[4], Liam Morrison[5], Andrew Fogarty[3,4], Martin Cormican[1,2], Martina Prendergast[2], Peter Dockery[6], Neil Rowan[3,4], Dearbháile Morris[1,2]

[1]Antimicrobial Resistance and Microbial Ecology Group, School of Medicine, National University of Ireland, Galway, Ireland.

[2]Centre for Health from Environment, Ryan Institute, National University of Ireland, Galway, Ireland.

[3]Bioscience Research Institute, Athlone Institute of Technology, Dublin Road, Athlone, Co. Westmeath, Ireland.

[4]Department of Life and Physical Science, Athlone Institute of Technology, Dublin Road, Athlone, Co. Westmeath, Ireland.

[5]Earth and Ocean Sciences, National University of Ireland, Galway, Ireland.

[6]Discipline of Anatomy, School of Medicine National University of Ireland, Galway, Ireland.

Corresponding Author Email Address: eoin.mcgillicuddy@nuigalway.ie

Silver nanoparticles (AgNPs) have been incorporated into numerous consumer products including textiles, medical products, domestic appliances, food containers, cosmetics, paints, and nano-functionalised plastics. These applications of AgNPs have led to interest in the impact they may have once released into the receiving environment. AgNPs may be released into the environment during any phase of the lifecycle of the products. These concerns have led to numerous studies being undertaken investigating the release of particles from nano-functionalised products, the detection of the particles in the aquatic environment and the potential environmental toxicology of these AgNPs to aquatic organisms. There are many uncertainties surrounding the fate and effects of AgNPs following their release into the environment. The levels at which AgNPs are present in waters are also difficult to determine. In natural waters the fate of AgNPs is influenced by several factors including; particle coating, particle concentration, particle size, morphology, temperature, organic matter content, concentration of ligands, pH, and ionic strength. Particles may aggregate/agglomerate, dissolve or associate with ligands present in the water. The complicated reactions that the AgNPs may undergo following release leads to difficulty in determining the ambient levels, as it is difficult to discriminate particulate and ionic silver, and the low expected concentrations of AgNPs in natural waters make detection difficult. Therefore, with actual figures for the concentrations in the environment being unavailable ambient concentrations are modelled to be in the low ng/L range.

Keywords: silver nanoparticles, chemical analysis, environmental fate

Nanotechnology and the Environment

Standardizing non-invasive toxicological analysis of nano-carriers within freshwater aquatic environments

Andrew Reynolds[1], Gordon Chambers[1], Michelle Giltrap[2]

[1]FOCAS Institute, Dublin Institute of Technology, Kevin's Street, Dublin 8, Ireland.

[2]School of Food Science and Environmental Health, Dublin Institute of Technology, Cathal Brugha Street, Dublin 1, Ireland.

Corresponding Author Email Address: C11354601@mydit.ie

Modern industry is moving into the use of various new technological and chemical techniques, amongst which is a growing interest in developing the application of "nano-carriers", which are nanoparticles designed to contain certain chemicals in a manner that reduces the overall concentration of the various chemicals used, along with using specialised compounds and capsules to control the mechanisms behind chemical release to ensure optimal application of the active ingredients. However despite the peaking interest on these novel products, there is a noted lack of research in the potential toxicological effects related to the nano-carriers. The purpose of this research is to determine if a consistent and non-invasive testing method of analysis may be produced for determining morphologic complications and toxicity/mortality effects of specific nano-carriers within freshwater organisms to act as a realistic but controlled in-vivo comparative assessment to the potential results from nano-carriers present in effluent wastewater products. Test organisms were chosen with a relatively transparent anatomy that will permit numerous analytical techniques to be conducted without requiring fixations or dissections to examine the presence of the nano-carriers within the organism. Additionally, the test species need well-documented growth pattern from conception which permit easy identification of morphological malformations during embryotic or early stages development. Initial use of specialised fluorescent nano-carriers would be used in combination with fluorescence and dissection microscopy to analyse general nanoparticle flow patterns within the samples, along with general comparisons with set controls to determine forms and degrees of morphology and toxicological alterations. Later, compounds detection analysis would be conducted by a combination of compound-detecting spectral techniques such as Raman and UV-Vis spectroscopy, along with other methods as final confirmation for the presence of nano-particles.

Keywords: nanotechnology, environmental toxicology, freshwater, nano-carriers

Nanotechnology and the Environment

The capture of silver nanoparticles from solution using activated charcoal

Eoin McGillicuddy[1,2], Liam Morrison[3], Martin Cormican[1,2], Dearbhaile Morris[1,2]

[1]Antimicrobial Resistance and Microbial Ecology Group, School of Medicine, National University of Ireland, Galway, Ireland.

[2]Centre for Health from Environment, Ryan Institute, National University of Ireland, Galway, Ireland.

[3]Earth and Ocean Sciences, National University of Ireland, Galway, Ireland.

Corresponding Author Email Address: eoin.mcgillicuddy@nuigalway.ie

Silver nanoparticles (AgNPs) have been incorporated into numerous consumer products including; medical products, domestic appliances, food containers, cosmetics, paints, and nano-functionalised plastics due to their reported antibacterial activity. The incorporated AgNPs can be released into the environment during the production, use and end of life disposal of these products. Uncertainties surround the concentration, fate, and effects of AgNPs in the aquatic environment. This project examines activated charcoal as a potential capture material for AgNPs from the aquatic environment. Activated charcoal (Norit® CA1 (Sigma-Aldrich)) was exposed to 100 ppb, 25 nm PVP coated AgNPs (nanoComposix) prepared in Milli-Q water. These solutions were exposed to charcoal granules for 20 hours after which the decrease of silver concentration was measured using ICP-MS. To improve the removal, the surface area of the charcoal was increased firstly by grinding with a pestle and mortar and secondly by milling the charcoal using an agate ball mill running at 500 rpm for 5 minutes. In the initial tests, approximately 10% of the silver was removed from the water samples using the unaltered activated charcoal granules. Further experiments were carried out to compare the unaltered granules with the ground and milled charcoal. These tests were carried out similarly to the previous test however lower concentration of 10 ppb was used. After 20 hours of exposure the granule samples, again, showed approximately a 10% reduction in silver content, with the ground charcoal giving approximately a 30% reduction in silver concentration, and in the sample exposed to milled charcoal, approximately a 60% reduction in silver concentration was observed. These tests found that increasing the surface area of the charcoal increased the silver removal from the solution. Data suggest that charcoal may be a suitable material for use in the capture of AgNPs from water samples.

Keywords: silver nanoparticles, chemical analysis, environmental fate

Environmental Socioeconomics

Estimating individual willingness to pay for community flood defences

Finbarr Brereton[1], Craig Bullock[1], Peter Clinch[1], Eoin O'Neill[1], Christina Ryan[2]

[1]University College Dublin, Ireland.

[2]Dublin Institute of Technology, Ireland.

Corresponding Author Email Address: finbarr.brereton@ucd.ie

Flooding is damaging to the environment, human health and economic activity. The experience of flooding is affected by climate change, urbanisation processes, shifting agricultural practices and outdated urban drainage systems and exacerbated by fragmented policy responses. Flood policies are increasingly based on risk based probabilities, as opposed to flood probability alone. This is typified by the 'English Make Space for Water' programme and the Dutch 'Room for the River' programme. Awareness among policy makers of climate change and increased flood risk has delivered this change in the approach to flood management. The change in the approach from managing the probability of floods to managing the probability and consequences of a flood event has also influenced changes in the planning and governance structures of flood management. Responsibility is no longer attributed solely to the government but shared among a variety of actors across the private and public domains. This requires creating partnerships between individuals, communities and government agencies. Financial support to build flood defences provides a role for local residents in responding to flood risk. However, the acceptability among residents to financially contribute to the cost of building defences is unknown. This study explores the willingness of local residents to financially support a community flood relief scheme in Bray, Co Wicklow. Although research concerning the willingness to pay for other types of risk reduction measures provides valuable insights, to the authors' knowledge, no empirical study has explored the acceptability and potential of local residents to financially contribute to flood defences. Findings suggest that 50% of individuals in our sample are willing to pay towards the cost of structural flood defences, with a mean WTP of €237 p.a. This has implications for the funding of structural flood defences, particularly in the context of economic recession and withdrawal of government financial support.

Keywords: willingness to pay, community flood defence, flood risk, flood management

Environmental Socioeconomics

Gender and the sustainable energy transition

Christine Gaffney[1], Niall Dunphy[1]

[1]Cleaner Production Promotion Unit, School of Engineering, University College Cork, Ireland.

Corresponding Author Email Address: christine.gaffney@ucc.ie

ENTRUST is an interdisciplinary research project exploring the human factor in the energy system. This research project explores how people interact with the energy system, and how our everyday practices around energy are shaped by both technical and socio-demographic factors, including in particular: age, gender, and socio-economic status. This paper focuses on the gender aspect of this research. ENTRUST is working in six varied communities in five different European countries: an Irish rural community; a cohort of university students; residents of an eco-village in a large French city; the urban customer base of a Spanish utility company; a disadvantaged suburban neighbourhood in the UK; and the residents of an Italian port town. These communities provide a diverse range of socio-demographic characteristics, life experiences, and policy contexts. Based on the data that we are producing from our varied engagements with these communities, we explore the role that gender plays in how people engage with the energy system. We look at how gender affects how we use energy in our daily lives. We also explore how gender intersects with other sociopersonal attributes – socioeconomic status and age in particular – with regard to our consumption of energy.

Keywords: sustainable energy transition, socio-demographics, gender, low-carbon energy system, intersectionality, participatory research

Environmental Socioeconomics

Sustainability accounting and reporting for origin green: A national sustainability programme for the Irish food and drink industry

Rebecca Maughan[1], Aideen O'Dochartaigh[1]

[1]Quinn School of Business, University College Dublin, Belfield, Dublin 4, Ireland.

Corresponding Author Email Address: aideen.odochartaigh@ucd.ie

The aim of this paper is to develop our understanding of accounting and reporting for sustainability at an industry level through a case study of Bord Bia's Origin Green programme, a sustainability programme for the Irish food and drink sector. Accounting scholars are increasingly engaged with environmental issues and sustainability accounting and reporting is of growing importance in practice. As sustainability is a systems-based concept, there is a growing recognition that sustainability reporting needs to move beyond single-entity reports towards multiple organisation reporting, such as industry, supply chain and sector-level reports. However, while organisational sustainability reports abound, multiple organisation sustainability reports are rare. To the best of our knowledge, the Origin Green programme is the first attempt to account for and report on sustainability at a sector level. In 2012, Bord Bia launched its Origin Green programme, a "national sustainability programme for the Irish food and drink industry" (Bord Bia, 2015). The aim of this programme is to lower the industry's carbon footprint, and requires Bord Bia to form partnerships with farmers and food and drink companies. To date, Bord Bia has completed the auditing and carbon footprinting of over 90,000 farms, while 222 companies have become an Origin Green "member" by submitting a sustainability plan including specific measurable targets. In 2015, Bord Bia produced its first "Origin Green Sustainability Report", a 113 page account of farm assessment and company targets. The paper aims to identity the motivations for this report and to examine the emergence and evolution of the Origin Green accounting and reporting process. We will engage with tensions and conflicts in this arena to better understand how sectoral sustainability may be maximized. Our analysis will ultimately contribute to making sustainability accounting and reporting a substantive process, with the potential to measure the environmental impacts of multiple organisations.

Keywords: sustainability, sustainability accounting, sustainability reporting, Origin Green, Bord Bia, sector-level sustainability reporting, Irish food and drink industry

Environmental Socioeconomics

Educating designers on multi-sensory acknowledgement within the built environment

Aoife Hayes[1]

[1]Department of Architecture, CIT, Melbourne Road, Bishopstown, Cork, Ireland.

Corresponding Author Email Address: aoife.hayes@mycit.ie

The 21st century has seen massive developments in smart technologies and environmental strategies within the built environment, and is further advancing on a daily basis. While multi-disciplinary design teams try to combat environmental concerns, the current positioning of the user experience on the hierarchy is inferior. The WHO (1999) confirmed that the majority of people spend up to 90% of their daily lives inside. This staggering percentage should root the importance of user-centred design when developing the built environment, yet the majority of designed spaces do not provide user-centred considered schemes. A trend of *occular-centric* dominance has seen a slew of visually similar spaces, "cloned, banal, branded landscapes" (Tallon, 2010) – that rarely engage the people who move through them (Lehtovouri, 2010) in a positive manner. This reliance on one sensory modality has seen the auditory experience, for example, forgotten, resulting in a ¼ of the European population being exposed to significant levels of noise pollution, causing 10,000 premature deaths yearly, 900,000 cases of hypertension, and 8,000,000 cases of insomnia (EEA, 2013). Combating environmental challenges is pivotal in order to design sustainable environments, but creating eco-friendly environments, which do not sustain people, seems counter-intuitive and futile. Multi-disciplinary design teams must ensure the human multi-sensory experience is validated as schemes are proposed and developed throughout the design process. Assessing and managing the potential multi-sensory output of schemes, can only be achieved if designers are educated. This research aims to create an educational resource pack, primarily for third-level education, in order to sensitize designers entering the industry, and provide them with the necessary competencies to provide multi-sensory sensitive environments.

Keywords: multi-sensorial experience, sensory output, sensory stimuli, user centred design

Air Quality and Urban Development

Quantifying the influence of ambient environmental quality on the effectiveness of green exercise

Aoife Donnelly[1], Tadhg MacIntyre[2], Giles Warrington[2], Andree Walkin[2], Nollaig O'Sullivan[2], Christopher Gidlow[3], Marc Jones[3]

[1]Dublin Institute of Technology, Ireland.

[2]Health Research Institute, University of Limerick, Ireland.

[3]Center for Health and Development (CHAD), Staffordshire University, UK.

Corresponding Author Email Address: aoife.donnelly@dit.ie

Green exercise is defined as undertaking physical activity whilst being directly exposed to nature. Recent research has shown that green exercise can be used as an influential tool to help combat the rising rates of both physical inactivity and non–communicable disease. However, there is still a need to investigate the influence of the quality of ambient environment on observed health benefits. It is well established that exposure to high levels of particulate matter (PM) air pollution can contribute to a range of negative physical health effects. However, it is not clear whether elevated PM levels can lessen the positive changes in mental health and wellbeing that can be achieved through green exercise. This novel research in the field of public health uses the natural laboratories of Clarisford Park in Killaloe, Co. Clare and the Phoenix Park in Co. Dublin to study the influence of ambient air quality on mood pre, mid and post green exercise. At each location runners/walkers are equipped with portable Dylos DC1100 Particulate Matter samplers to gather air pollution data during their green exercise. Their activity is tracked using a mobile GPS application. Based on these data, their exposure to PM was calculated. Mood questionnaires were used to establish the change in well-being as a result of the green exercise. Results were compared across locations and the influence of elevated PM levels on the effectiveness of green exercise were quantified. This research will be expanded to include a greater number of locations with varying degrees of "greenness" and will contribute towards furthering our understanding of the impacts and underlying processes that surround green exercise and contribute to the potential effects on population health and well-being.

Keywords: air pollution, green exercise, well-being, nature-based solutions

Air Quality and Urban Development

Characterization of primary organic aerosols of domestic wood, peat, and coal burning in Ireland

Chunshui Lin[1], Jurgita Ovadnevaite[1], Darius Ceburnis[1], Rujin Huang[2], Colin O'Dowd[1]

[1]School of Physics and Centre for Climate and Air Pollution Studies, Ryan Institute, National University of Ireland Galway, University Road, Galway, Ireland.

[2]State Key Laboratory of Loess and Quaternary Geology and Key Laboratory of Aerosol Chemistry and Physics, Institute of Earth Environment, Chinese Academy of Sciences, 710075, Xi'an, China.

Corresponding Author Email Address: C.LIN7@nuigalway.ie

Ambient particulate matter (PM) adversely affects human health and has a great influence on climate. An Aerosol Chemical Speciation Monitor (ACSM) was deployed to study the primary non-refractory submicron particulate matter (NR-PM_1) emissions from burning of commercially available solid fuels (peat, coal, and wood) in a typical domestic stove commonly used in Europe. Organic mass spectra (MS) from burning wood, peat, and coal were characterized and inter-compared for factor analysis against ambient data. Real time measurements of NR-PM1 captured pollution events with peak concentration of 207 μg/m^3 occurring at around 21:00 Jan 22, 2017 at UCD, Dublin, an urban background monitoring site. The night time pollution corresponds to domestic heating activities. As possible source candidates of OA, wood, peat, and coal, as well as oil burning emission were evaluated using PMF source apportionment technique to assess their contribution to the extreme air pollution events. ACSM-PMF results show the importance of solid fuel burning during the pollution events, with the combined contribution of coal, peat, and wood of 78% to the total OA. Among solid fuels, peat was the dominant OA factors and peaked at around 21:00 in the evening, accounting for 41% of total OA which is consistent with the popularity of peat and International Energy Agency (2013) data that shows peat was mostly consumed solid fuel in Ireland. The contribution of coal was only around 8%, which is consistent with the ban on sales of smoky coal in Dublin. OOA was relatively stable compared to primary OA with elevated concentration during early night which might from the condensation of volatile organic matter. OOA is prevalent throughout the day while all primary factors fell to background levels during the day. Back trajectory of air masses shows OOA might come from mainland Europe.

Keywords: particulate matter, solid fuels, primary organic aerosols

Air Quality and Urban Development

Sources and abundance of black carbon in atmospheric particles around Ireland

Paul Buckley[1], Ian O'Connor[1], Eoin McGillicuddy[1], Stig Hellebust[1], Jovanna Arndt[1], John Wenger[1]

[1]Environmental Research Institute, Department of Chemistry, University College Cork, College Road, Cork, Ireland.

Corresponding Author Email Address: paulbuckley@umail.ucc.ie

Black Carbon (BC) is a major component of atmospheric particulate matter, which consists of soot particles produced from the burning of fossil fuels, wood and other biomass material. BC influences climate directly by absorbing solar radiation and is recognized as the second most important human-derived contributor to global warming after carbon dioxide. BC can also affect human health by aggravating respiratory diseases and causing cardiovascular problems. The main sources of BC in Ireland are domestic solid fuel burning and vehicle emissions, however there is little information available on their respective contributions. The aim of this work, which is being carried out in conjunction with the EPA-funded SAPPHIRE project, is to identify the sources of BC in residential areas of Ireland. To date, field measurements have been made in three small towns in different parts of the country (Killarney, Enniscorthy and Birr) during the winter months of 2014-2015 and 2015-2016. A 7-wavelength dual-spot Aethalometer was used to measure BC, which showed very clear diurnal patterns at all three sites, with greatly enhanced levels of BC observed in the evenings, when solid fuel burning for home heating was taking place. The Aethalometer was also used in a series of burning experiments to obtain unique light absorption signatures for different solid fuel types, i.e., coal, peat and wood. Interestingly, the emissions from wood- and peat-burning contained significant amounts of Brown Carbon (BrC), which is similar to BC, but absorbs light at lower wavelengths and therefore affects the radiation balance differently. The results from the burning experiments significantly help to identify and separate the contributions of solid fuel burning from vehicle emissions. The results are compared with those recently obtained in Dublin as part of the EPA-funded AEROSOURCE project and also discussed in relation to national policy on solid fuel burning and vehicle emissions.

Keywords: atmospheric particles, particulate matter, black carbon, aethalometer

Water Quality and Resources 1 (RIA Session)

Lake ecological assessment metrics in Ireland: relationships with phosphorus and typology parameters and the implications for setting nutrient standards

Gary Free[1], Deirdre Tierney[1], Ruth Little[1], Fiona L. Kelly[2], Bryan Kennedy[1], Caroline Plant[1], Wayne Trodd[1], Caroline Wynne[1], Rossana Caroni[1], Colin Byrne[1]

[1]Environmental Protection Agency, McCumiskey House, Richview, Clonskeagh Road, Dublin 14, Ireland.

[2]Inland Fisheries Ireland, 3044 Lake Drive, Citywest Business Campus, Dublin 24, Ireland.

Corresponding Author Email Address: g.free@epa.ie

The current national surface water monitoring programme in Ireland includes 224 lakes. Monitoring data from the period 2012-14 are used to evaluate the performance of ecological assessment metrics in responding to eutrophication pressure, as indicated by average total phosphorus concentration (TP). For 70 surveillance lakes, the r^2 for relationships with TP was 0.65 for phytoplankton, 0.65 for macrophytes, 0.59 for phytobenthos and 0.32 for fish. Following normalisation of the Ecological Quality Ratios (EQR) to a 0-1 scale; averaging together the results for phytobenthos, phytoplankton and macrophytes resulted in a higher r^2 of 0.84 with TP. Using the ecological boundaries intercalibrated across the EU, the corresponding TP concentrations for the high/good and good/ moderate boundary ranged from 8 to 11 and 16 to 30 ug l^{-1} respectively. Non-parametric multiplicative regression was used to examine the strength of influence of typological parameters on the relationship between the assessment metrics and TP. Typological factors found to be significant for these models included lake area, mean depth and alkalinity. However, the most important model parameter, as indicated by higher sensitivity values, was TP. This was in part because metrics were designed to detect eutrophication pressure, but also because typological factors are already considered in both metric application and through type-specific EQR boundaries (for example, through incorporating depth or alkalinity in typology). Marl lakes may represent a more sensitive lake subtype requiring derivation of separate, more appropriate environmental quality standards. Further analysis in this regard is required.

Keywords: lake, ecological assessment, phosphorus, typology, nutrient standards

Water Quality and Resources 1 (RIA Session)

Fish in tidal freshwater transitional waters in Ireland: recommendations for assessment, policy and management of ecological quality under the Water Framework Directive (WFD)

James G. Wilson[1], Michelle Giltrap[2], Fiona Kelly[3]

[1]Zoology Department, Trinity College Dublin, Dublin 2, Ireland.

[2]Nanolab, FOCAS Institute, Dublin Institute of Technology, Dublin 8, Ireland.

[3]Inland Fisheries Ireland, 3044 Lake Drive, Citywest Business Campus, Dublin, Ireland

Corresponding Author Email Address: jwilson@tcd.ie

As part of the national monitoring programme under the Water Framework Directive (WFD), seine, trawl and fyke net samples were taken of fish from thirteen locations in Tidal Freshwater Transitional Waters (TFTW) around Ireland. The results were highly variable, with some hauls completely empty while others returned high numbers of individuals, usually dominated by a single species. Thirty-four species were recorded, of which *Pomatoschistus microps* and *Platichthys flesus* accounted for 63% of all individuals. Seine netting was the most successful in terms of both number of species and abundance, and consequently had the highest diversity metric values. The fish communities of the Lee, the Tolka and the Slaney systems were significantly different from the others. While the Lee had markedly fewer species (S = 3) and lower abundance (N = 8) than the rest, the Tolka had relatively high number of species (S =13) and the highest total abundance (N = 4,089). In terms of ecological quality standards (EcoQS), the relative consistency of diversity metrics offers some prospect of setting meaningful quality thresholds. Multimetric indices, incorporating fish guild and functional criteria could be more reliable, but the actual thresholds may have to be linked to the individual systems.

Keywords: Water Framework Directive, tidal freshwater transitional waters, ecological quality, fish

Water Quality and Resources 1 (RIA Session)

Integrating observed, inferred and simulated data to illuminate environmental change: a limnological case study

Eleanor Jennings[1], Catherine Dalton[2], Barry O'Dwyer[3], David Taylor[4]

[1]Centre for Freshwater and Environmental Studies, Dundalk Institute of Technology, Ireland.

[2]Department of Geography, Mary Immaculate College, University of Limerick, Ireland.

[3]Environmental Research Institute, University College Cork.

[4]Department of Geography, National University of Singapore, Singapore.

Corresponding Author Email Address: B.ODwyer@ucc.ie

Effective management of aquatic ecosystems requires knowledge of baseline conditions and past variations in stressors and their effects in order to mitigate the impacts of future variability and change. This study utilizes combined monitoring, sedimentary and hindcast computer model data to reconstruct and examine the eutrophication history of a lake in southwest Ireland over a c. 60-year period and uses computer models to simulate future responses in water quality as a result of projected changes in land use and climate. The study site, Lough Leane, has major national and international importance, but is currently regarded as "at significant risk" of not meeting the water quality objectives of the EU Water Framework Directive. Palaeolimnological reconstructions and hindcast modelling results confirmed that current eutrophication in the lake dates at least to the 1950s, and particularly from the 1970s. When used to simulate future conditions the same computer models indicated that climate change will likely worsen the current situation. The approach described, synthesising data from a range of sources, can inform future-proofing of lake management plans and objectives by enabling the accommodation of future changes in catchment and climate conditions.

Keywords: catchment, climate change, eutrophication, phosphorus, pollution, water framework directive

Water Quality and Resources 1 (RIA Session)

What have we learnt from over two decades of monitoring riverine nutrient inputs to Ireland's marine environment?

Shane O'Boyle[1,5], Rebecca Quinn[1], Noelle Dunne[1,2] , Eva M. Mockler[3], Sorcha Ní Longphuirt[4]

[1]Environmental Protection Agency, McCumiskey House, Richview, Clonskeagh Road, Dublin 14, Ireland.

[2]Teagasc, Agriculture and Food Development Authority, Johnstown Castle, Wexford, Ireland.

[3]UCD Dooge Centre for Water Resources Research, University College Dublin, Dublin 4, Ireland.

[4]Environmental Protection Agency, Inniscarra, Co Cork, Ireland.

[5]European Commission, DG Environment, Beaulieu, Brussels, Belgium.

Corresponding Author Email Address: shane.OBOYLE@ec.europa.eu

Excessive nutrient loading to the marine environment from different sources and pathways, including rivers, has led to nutrient over-enrichment and the phenomenon of eutrophication in estuaries and coastal waters. The systematic monitoring of riverine nutrient inputs to Ireland's marine environment began in 1990. Over this period there has been a large reduction in nutrient inputs with loads of total phosphorus, total ammonia and total nitrogen decreasing by 71.8% (4,716 tonnes), 77.3% (5,505 tonnes) and 39.0% (59,396 tonnes), respectively. The largest reductions, particularly in total phosphorus and total ammonia, were seen in the main rivers discharging to the Celtic and Irish Sea coasts, with smaller or no reductions in rivers discharging along the western and north-western Atlantic coast. The reductions indicate the success of measures to reduce nutrient loss but also the disproportionate reduction in phosphorus over nitrogen. The ratio between nitrogen and phosphorus loads has increased by 2.5% per year and by as much as 4.1% per year for discharges to the Celtic Sea. As a consequence, the stoichiometric N:P ratio of river inputs to the Celtic Sea has doubled over the period. The potential for this disparity to create a nutrient imbalance in downstream estuarine and coastal waters is discussed.

Keywords: river inputs, nutrients, phosphorus, nitrogen, eutrophication, marine environment, management measures

Water Quality and Resources 1 (RIA Session)

Understanding pathways transferring nutrients from source to sea: from study catchments to national modelling

E.M. Mockler[1,2], J. Deakin[2], S. Ní Longphuirt[3], M. Archbold[2], S. O'Boyle[2], B. Misstear[4], R. Flynn[5], R. O'Brien[4], A. Orr[5], C. Wynne[2], D.B. Stengel[6], M. Bruen[1], D. Daly[2]

[1]UCD Dooge Centre for Water Resources Research and UCD Earth Institute, University College Dublin, Dublin 4, Ireland.

[2]Environmental Protection Agency, Richview, Dublin, Ireland.

[3]Environmental Protection Agency, Inniscarra, Cork, Ireland.

[4]Department of Civil, Structural and Environmental Engineering, Trinity College Dublin, Ireland.

[5]School of Planning, Architecture and Civil Engineering, Queen's University Belfast, UK.

[6]Botany and Plant Science, School of Natural Sciences, Ryan Institute, National University of Ireland Galway, Galway, Ireland.

Corresponding Author Email Address: eva.mockler@ucd.ie

Despite considerable investment in recent years, approximately half of Irish water bodies still do not meet Water Framework Directive (WFD) objectives. Identifying appropriate measures to address eutrophication remains a major challenge. Four recent studies have improved understanding of hydrological and water quality processes in catchments by scaling up findings and extrapolating understanding from a relatively small number of well-studied catchments to develop national conceptual models. The EPA is implementing an integrated catchment management approach that incorporates assessment methods based on source-pathway-receptor relationships for all water bodies. By integrating the results from these studies, investigations and measures are efficiently targeted, and decision makers are better informed about the effectiveness of measures to date and the possible response of water bodies to future actions. Field and modelling studies were integrated in two hydro(geo)logically contrasting Irish catchments to identify the main pathways delivering flow and nutrients to streams. The transport of phosphorus (P) via overland flow and interflow, and from small point sources, proved the key issues in the catchment underlain by poorly draining soils. Measures in such catchments need to focus on intercepting pathways and mitigating the discharges. These field studies emphasise that achieving successful WFD outcomes depends on having a local, three-dimensional understanding of contaminant transfer pathways. The improved conceptual understanding of nutrient transfer pathways was used to develop national modelling tools, including the Source Load Apportionment Model (SLAM), which estimates N and P emissions to water bodies. Looking downstream, nutrient monitoring data shows a significant reduction in phosphorus from fifteen major catchments, with only four rivers showing

a concurrent reduction in nitrogen. Parallel improvements in estuarine water quality were evident in eight downstream systems, highlighting the complexity of response mechanisms. Load apportionment illustrated that the effectiveness of measures depended on land use and proximity of large agglomerations to the estuary.

Keywords: integrated catchment management, nutrients, load apportionment modelling, phosphorus, nitrogen

Invasive Species

Predicting invasive species impacts under context-dependencies

Jaimie T.A. Dick, James W.E. Dickey

[1]Institute for Global Food Security, School of Biological Sciences, Queen's University Belfast, MBC, 97 Lisburn Road, Belfast BT9 7BL, Northern Ireland.

Corresponding Author Email Address: j.dick@qub.ac.uk

Invasive species impacts are notoriously unpredictable, or at least highly context-dependent, making ecological impact prediction difficult. Our new metric of invader impact, "Relative Impact Potential" (RIP) blends: (1) the classic Functional Response (FR; consumer per capita effect) and Numerical Response (NR; consumer population response), that is, the Total Response (TR = FR × NR), with; (2) the "Parker-Lonsdale equation", where Impact = Range × Abundance × Effect, to give; (3) RIP = FR × Abundance. The RIP metric is an invader/native ratio, values >1 predicting that invader ecological impact will occur, and increasing values above 1 indicating increasing impact. Across a diverse range of trophic and taxonomic groups, including predators, herbivores, animals and plants (22 invader/native systems, 47 individual comparisons), high impact invaders were significantly associated with higher FRs compared to native trophic analogues. However, the RIP metric substantially improves this association, with 100% predictive power of high impact invaders. Further, RIP scores were significantly and positively correlated with two independent ecological impact scores for invaders, allowing prediction of the degree of impact of invasive species with the RIP metric. Since both per capita effects and abundances of invaders can be measured across abiotic and biotic contexts, the RIP metric could substantially improve invader impact prediction. For example, we show that FRs are sensitive to temperature, oxygen, salinity, parasitic infection and multiple predator effects (MPEs). We also present a framework for the use of RIP in other contexts, particularly spatio-temporal patterns of invader replacement of native analogues. Since invaders may initially add to the existing ecological impacts of native species prior to replacing those species, and then increase in abundance rapidly after native species replacement, ecological impacts may follow multi-modal spatio-temporal patterns, which RIP can resolve. RIP thus provides an explanatory and predictive tool for scientists, managers, practitioners and legislators.

Keywords: context-dependence, ecological impact, functional response, numerical response, relative impact potential

Invasive Species

First record of the Asian clam Corbicula fluminea (Müller, 1774) (Bivalvia, Cyrenidae) in Northern Ireland

Joe Caffrey[1], Jaimie Dick[2], Frances Lucy[3], Eithne Davis[3], Art Niven[4], Neil Coughlan[2, 3]

[1]INVAS Biosecurity, 6 Lower Ballymount Road, Walkinstown, Dublin 12, Ireland.

[2]Institute for Global Food Security, School of Biological Sciences, Queen's University Belfast, Northern Ireland.

[3]Centre for Environmental Research Innovation and Sustainability (CERIS), Institute of Technology, Sligo, Ireland.

[4]Loughs Agency, 22 Victoria Road, Derry, BT47 2AB, Northern Ireland.

Corresponding Author Email Address: ncoughlan02@qub.ac.uk

Since its first detection on the island of Ireland in April 2010, the invasive Asian clam Corbicula *fluminea* (Müller, 1774) has been confirmed present at five sites within the Republic of Ireland (RoI). In March 2016, specimens of C. *fluminea* were first discovered in Northern Ireland (NI) within the River Foyle, which delineates the border between RoI and NI. In a subsequent benthic survey in June 2016 an established population was confirmed to be present within the River Foyle, where densities of clams attained 384 individuals m^{-2}. Height frequencies of a randomly chosen sub-sample of specimens (n = 207) would suggest a maximum population age of 3 years. This highly invasive species can potentially represent a significant threat to freshwater environments. While densities recorded in the River Foyle are not high in comparison with other infested waters on the island of Ireland and elsewhere, current densities indicate that C. *fluminea* has established a sustainable population and is now poised to expand its frequency and spread throughout this catchment. Therefore, increased biosecurity awareness and enforcement of existing legislation is needed to prevent further spread.

Keywords: invasive alien species, Asian clam, Corbicula *fluminea*, Corbiculidae, spread, Ireland, biosecurity

Invasive Species

Invasion history of Dreissena polymorpha, the zebra mussel in a Shannon Lake, Lough Key

Frances Lucy[1], Monica Sullivan[2], Helen Moran[1,2], Richard FitzGerald[4]

[1]CERIS - Centre for Environmental Research Innovation and Sustainability, Institute of Technology, Sligo, Ireland.

[2]Environmental Services Ireland, Lough Allen, Carrick-on-Shannon, Co. Leitrim, Ireland.

[3]Geo-Mara, Cois Cuain, Ballynamanagh, Clarinbridge, Co. Galway, Ireland.

[4]National University of Ireland, Galway, Ireland.

Corresponding Author Email Address: lucy.frances@itsligo.ie

The zebra mussel (*Dreissena polymorpha*) arrived in Ireland circa 1993 and spread to Lough Key, Co. Roscommon, from the interconnected River Shannon in the late 1990s. The mussels were monitored annually in this 9 km^2 lake between 1998 and 2003. The zebra mussel population (density and biomass) in Lough Key was assessed using a combination of snorkel and dive techniques along lake transects. In 2003, the population estimate was six billion (6×10^9) with high cover of zebra mussels on stones in near-shore areas of the lake. This invasion resulted in the extirpation of the only native unionid present (*Anodonta*), with no live specimens recorded in this study after 2000. In summer 2015, the transect survey was repeated to assess changes in the zebra mussel population after a twelve year gap in monitoring. The total number of zebra mussels in Lough Key was 3.51×10^9 , reflecting a significant decrease since 2002. Although the total number of zebra mussels in 2015 was only 11% of that in 2002, the relative biomass was 49%. This resulted from the significantly larger mussels present in 2015 and indicated that Lough Key was filtered every 20.9 days in 2015 compared with every 9.8 days in 2002. The reduction in the zebra mussel population is due to density-dependant effects, most likely resulting from interspecific competition for food. The study indicates that, approximately two decades after invasion of the lake, the zebra mussel population has stabilised in Lough Key, successfully recruiting annually, and has long-term impacts on the lake ecology. Although zebra mussel filter feeding improves lake transparency and chlorophyll levels and the general appearance of the water, this masks a problem since total phosphorus levels remain mesotrophic due to effluent entering the lake from Boyle wastewater treatment plant. T hese phosphorus loadings exert a long-standing and continuous pressure on the ecological status of Lough Key.

Keywords: zebra mussel population, *Anodonta*, mesotrophic

Invasive Species

EU Regulation on invasive alien species – will it make a difference in Ireland?

Joe Caffrey[1]

[1]INVAS Biosecurity, 6 Lower Ballymount Road, Walkinstown, Dublin 12, Ireland.

Corresponding Author Email Address: joecaffrey@invas.ie

Globalisation of trade and travel has facilitated the spread of invasive alien species (IAS) across the earth. There are currently over 12,000 non-native species in the EU, circa 15% of which are invasive, and their numbers are growing rapidly. Ireland is fortunate to host far fewer IAS due to its location on the western edge of Europe. Prior to the introduction of the EU Regulation on IAS (2015) there was no European framework for tackling IAS comprehensively and few IAS (other than pests and pathogens) were addressed by EU legislation. In order to determine the issues that were deemed to be most important regarding IAS in Europe, and to support policy makers as they prepared the EU legislation on IAS, an international conference (Freshwater Invasives – Networking for Strategy FINS) was convened in Ireland in 2013. This identified the top 20 IAS issues for Europe at that time and proposed measures to assist in the development of this legislation. The Regulation addresses IAS by imposing restrictions on 'IAS of Union concern'. These are a list of 37 high impact invasive species that was ratified in August 2016 and will be updated via collective agreement on a regular basis. The restrictions include preventative (surveillance, early detection and rapid eradication) and reactive (eradication, population control and/or containment) measures. Already in 2016, two species of 'Union concern' (Coypu and Curly waterweed) in Ireland have been subject to rapid eradication measures, as per 17 of the Regulation. While the passing of this international legislation has addressed many of the complex issues relating to IAS management in Europe, considerable challenges (e.g. lack of dedicated funding) remain. These challenges, as well as progress with IAS issues since the implementation of the Regulation, will be discussed during the presentation.

Keywords: non-native, legislation, Europe, early detection, rapid response, eradication

Invasive Species

Parasite-mediated effects of an invasive fish on native brown trout

Paula A. Tierney[1], Joe M. Caffrey[2], Celia V. Holland[1]

[1]Department of Zoology, Trinity College, Dublin 2, Ireland.

[2]Inland Fisheries Ireland, Swords Business Campus, Swords, Co. Dublin, Ireland.

Corresponding Author Email Address: tiernep1@tcd.ie

The role of parasites in biological invasions is becoming increasingly recognised. The differential effects of parasites on native and invasive hosts can amplify or mitigate the negative impacts of invaders on native hosts, thereby mediating the effects of invasions and altering invasion outcomes. Since 1980, the invasive dace (*Leuciscus leuciscus*) has gone from being confined only to the Munster Blackwater to, in 2014, having the highest density of all fish species in the upper River Barrow. Its rapid spread has raised concerns of potential impacts on sympatric native freshwater fish, particularly given the dearth of information on its parasite fauna. In the first comprehensive study of the parasite community of invasive dace in Ireland, we have compared the parasite fauna of dace at the edge and core of its invasive range with that of native brown trout (*Salmo trutta*) from the same sites. Our results show that while dace acquired acanthocephalan parasites, the parasites were smaller in size than those from brown trout and they did not reach sexual maturity in the invasive fish. Brown trout from the core of the dace's range had a lower infection burden of these parasites, indicating that by taking up but not distributing infective stages of the parasite, the invasive fish may be diluting acanthocephalan infection in brown trout. As heavy acanthocephalan infection can cause severe damage to host fish, we suggest that the presence of this invasive species may ultimately benefit native brown trout.

Keywords: parasite ecology, Acanthocephala, dilution effect, *Salmo trutta, Leuciscus leuciscus,* parasite community, invasive species

Invasive Species

Underpinning invasive species outreach with an effective communications plan

Eithne Davis[1], Frances E. Lucy[1], Joe M. Caffrey[2], Jaimie T.A. Dick[3], Neil E. Coughlan[1,3]

[1]Centre for Environmental Research, Innovation and Sustainability (CERIS), Department of Environmental Science, Institute of Technology, Sligo, Ireland.

[2]INVAS Biosecurity, 6 Lower Ballymount Road, Walkinstown, Dublin 12, Ireland.

[3]Institute for Global Food Security, School of Biological Sciences, Queen's University Belfast, Medical Biology Centre, 97 Lisburn Rd, Belfast, BT9 7BL, Northern Ireland.

Corresponding Author Email Address: Eithne.Davis@mail.itsligo.ie

Biodiversity in Ireland, like the rest of the world, is threatened by Invasive Alien Species (IAS). As an island our biodiversity is particularly vulnerable to this threat. However, islands also offer greater opportunities for protection from IAS than individual states in a continental land mass. A three-year research project (2016-2019) on the prevention, control and eradication of IAS, funded by the Environmental Protection Agency (Ireland), involves a whole-island approach involving the two separate political jurisdictions of Northern Ireland and the Republic of Ireland. Raising awareness of the risks associated with IAS and understanding methods to prevent their introduction and secondary spread is the biggest initial undertaking in any prevention campaign. Our communications plan is central to the impact of this project. A list of relevant stakeholders was identified through expert consultation with academic, governmental and other organisations in both jurisdictions. These stakeholders were then targeted through specific forms of communication chosen to maximise interactions and impact on the target audience. Communicating IAS issues effectively, to the general public, without the provision of sustainable dedicated funding, challenges programmes of prevention and rapid response. In the first 9 months, the project was featured on two national television programmes and two radio programmes. We have run a public workshop through the Fun Palaces initiative, and a successful citizen science project which contributed 188 new records to the National Biodiversity Map, putting *Petasites fragrans* into the top five most commonly recorded plants in Ireland in 2016. Social media has provided a new platform with which to freely open a conversation with a broad range of citizens. Through strategic use of facebook, in the first month of use we reached over 1,300 people in ten countries. Our Twitter account currently has 360 followers, almost exclusively ecologists. The participatory nature and conversational style of these platforms appears to suit the Irish psyche. In this project, by linking broadcast media opportunities to tailored social media campaigns, we have achieved positive responses both in species recording and in terms of opening the debate with key individuals and community groups. An interlinked and evolving communications plan has been crucial to these outcomes.

Keywords: communications, citizen science, prevention, management, IAS

Ecotoxicology

Designing an ecotoxicological toolbox for silver nanoparticles in the freshwater environment

Iain M.T. Murray[1], Neil J. Rowan[1], Andrew M. Fogarty[1]

[1]Bioscience Research Institute, Dept., Life andPhysical Sciences, Athlone Institute of Technology, Dublin Road, Athlone, Co. Westmeath, Ireland.

Corresponding Author Email Address: i.murray@research.ait.ie

The increasing number of nanoparticle applications and the dynamic nature of silver nanoparticles (AgNPs) in the freshwater environment suggests that a new approach to ecotoxicological risk assessment is urgently required. This study investigates the toxicity of AgNP to a freshwater multi-trophic test battery by traditional ISO standardised methods in addition to optimised methods specific to the eccentricities of AgNP fate and behaviour in the receiving environment. Advancements in nanoparticle functionalised materials to improve the longevity of nanoparticles adsorption suggests that the AgNPs themselves may no longer be the toxicant species of primary concern but instead the ionic form shed from functionalised surfaces and textiles. The freshwater test battery employed in this study includes the algae *Pseudokirchneriella subcapitata;* the crustaceans Daphnia pulex & Daphnia magna; the ciliate protozoan *Tetrahymena thermophila* and the freshwater polyp Hydra *attenuata*. Both AgNP and Ag^{+} were assessed using this multi-trophic test battery. Results from algal testing indicate that a compromise may be required between test sensitivity and adherence to strict ISO validity criteria. *Pseudokirchneriella subcapitata* was shown to be several orders of magnitude more sensitive to AgNP in chelating agent free media, however growth rates were affected. *Tetrahymena thermophila*, Hydra *attenuata* and Daphnia *pulex* all yielded acute IC_{50} values several orders of magnitude higher than the predicted environmental concentration thus acute testing of AgNP may be insufficient to fully assess toxicity in the freshwater ecosystem. There is also a need for chronic and sub-lethal assessments to fully understand the potential effects of AgNP on our freshwater ecosystem. Results presented in this paper suggest that ecotoxicologists need to think outside of the existing toolbox and employ novel approaches that enshrine chronic and sub-lethal assessment at environmentally relevant concentrations.

Keywords: silver, nanoparticles, ionic, ecotoxicology, multi-trophic

Ecotoxicology

Nematodes and environmental change

Thomais Kakouli-Duarte[1], Aoife Egan[1], Eileen Kelly[1]

[1]Molecular Ecology and Nematode Research Group, EnviroCore, Dargan Centre,

Institute of Technology Carlow, Kilkenny Road, Carlow, Ireland.

Corresponding Author Email Address: thomae.kakouli@itcarlow.ie

Many anthropogenic factors have a negative impact on the quality of soil, air and water, leading to detrimental environmental changes. The field of environmental nematology was born by a few colleagues a few decades ago, realizing the potential of nematodes as environmental and ecological indicators and key ecosystem players. Since the pioneering work of Aldo Zullini, Gregor Yeates, Tom Bongers and Howard Ferris, to mention a few, the planet has witnessed environmental change of a high magnitude. This field has considerable applied, economic and societal significance, as scientific awareness grows of the potential consequences of global warming, pollutants and environmental contaminants, and the need to decompose and recycle human, urban, and industrial wastes. In relation to soil health alone, soil degradation costs the EU at least €38 billion annually. These costs are mainly borne by the European society. This presentation will focus on providing an introduction to the area of environmental nematology, from a historical and state of the art perspective, and will emphasize the role of nematodes as environmental indicators especially in complementing environmental monitoring and remediation projects. This role will be further highlighted by work in the author's laboratory in (1) developing nematodes as sentinels of soil pollution and (2) utilizing nematode communities as indicators of the bioremediating ability of bacterial endophytes.

Keywords: nematodes, environmental change, ecological indicators, environmental indicators, soil pollution

Ecotoxicology

Endocrine disruptors and the environment – the current state of play in Europe (pesticides)

Aisling Redmond[1]

[1]Toxicology Unit, Pesticide Registration Division, Department of Agriculture, Food and the Marine, Ireland.

Corresponding Author Email Address: aisling.redmond@agriculture.gov.ie

The endocrine system is a complex interplay of receptors, hormones and glands that form an intricate network responsible for regulating the reproductive, immune, metabolic and behavioural systems. The World Health Organisation defines an endocrine disruptor as "an exogenous substance or mixture that alters function(s) of the endocrine system and consequently causes adverse health effects in an intact organism, or its progeny, or (sub)populations". To date the majority of information of the impact(s) of EDCs on health pertains to wildlife as wildlife appears to be the most sensitive entity. Incidents of reported EDC effects include abnormal thyroid functioning, decreased fertility, egg-shell thinning and reduced hatching success in birds, malformation of genitalia in reptiles, feminisation/masculinisation in fish, and reproductive and immune system abnormalities across mammalian species. These observed effects have been observed across a wide range of man-made chemicals, including pesticides. The term 'pesticide' encompasses a wide range of chemicals that are essential components of our daily lives (e.g. insecticides, fungicides, herbicides, rodenticides, and disinfectants). The benefits of pesticides are exponential: disease control, improve food productivity and quality, crop protection, and protect human and animal health. However, their use is not without risk. The inherent properties of these chemicals can negatively impact health and the environment if not used correctly. One such property of certain pesticides is the interference, either directly or indirectly, with the endocrine system or associated organs. Two separate pieces of legislation govern pesticide regulation in the EU: Plant Protection Product Regulation 1107/2009 and Biocides Product Regulation 528/2012. The regulation and safe-guarding of human and environmental health from EDCs has proven to be a sensitive and controversial topic both from a protective standing but also from the socio-economic impacts the restriction or banning of such chemicals would have on the economy and life in general. This review focuses on the impact of EDCs in the environment, the current european regulatory position and the associated socio-economic impact.

Keywords: endocrine disrupter, pesticides, regulation

Ecotoxicology

Evaluating the success of different rehabilitation strategies of bauxite residues: a risk assessment of trace elements along the food chain

Elisa Di Carlo[1], Ronan Courtney[2]

[1]Department of Biological Sciences and The Bernal Institute, University of Limerick, Castletroy, Limerick, Ireland.

Corresponding Author Email Address: elisa.dicarlo@ul.ie

Bauxite residues are the by-product of the aluminium industry, resulting from the extraction of alumina from bauxite ore through the Bayer process. To date, approximately 2.7 billion of bauxite residues have been produced, with an increasing global rate of 120 million tonnes/year. Bauxite residues disposal has raised concern worldwide especially because, due to the presence of trace metals (such as As, Cd, Ga, V), the bauxite residues represent a potential source of pollution for air, soil and water. Phytostabilization has proven to be a promising, cost-effective and non-resource intensive option for bauxite residues rehabilitation. Its primary objective is to stabilise residues against air dispersion and water erosion but, in the long-term, a successful revegetation should also aim at creating a sustainable soil ecological community, capable of performing essential soil functions. So far, a number of strategies have been successfully tested so as to overcome the inherent physicochemical characteristics of the bauxite residues (mainly high salinity, high sodicity, high alkalinity) that hinder plants growth. However, there are still few studies evaluating the long-term success of the rehabilitation programme and most of them overlooks important ecotoxicological aspects. The present study aims to assess rehabilitation strategies for bauxite residues considering the ecotoxicological risk to those organisms that live or feed in the rehabilitated areas. To this end, samples of bauxite residues/soil, plants and macroinvertebrates were collected from different sites so to be representative of various rehabilitation strategy and history. Selected physiochemical parameters were characterized in the bauxite residues. Content of trace elements in residues/soils, plants and macroinvertebrates were determined by ICP-MS. Finally, ecotoxicological bioassays (such as Rhizotest) with plants and biomarkers analysis with macroinvertebrates were conducted. In conclusion, through a multidisciplinary approach, the present research is likely to provide useful guidelines for the selection of future effective rehabilitation programmes for bauxite residues.

Keywords: bauxite residues, rehabilitation strategies, trace elements, ecotoxicological risk

Ecotoxicology

An ecotoxicological investigation on the effects of pulsed ultraviolet light on selected aquatic chemical disinfectants

Sarah M. Naughton[1], Alex M. Tahar[1], Siobhan Kavanagh[1], Neil J. Rowan[1], Andrew M. Fogarty[1]

[1]Bioscience Research Institute, Athlone Institute of Technology, Dublin Road, Athlone, Ireland.

Corresponding Author Email Address: s.naughton@research.ait.ie

Aquaculture is the fastest-growing food sector in the world due to the increased consumption rates per capita. The freshwater aquaculture sector in Ireland is worth an estimated €115 million. However, to remain competitive in line with the European aquaculture industry, advanced recirculating aquaculture systems (RAS) have been introduced in Ireland, where the water source is either entirely or partially treated within the farm. There are many advantages associated with RAS for example, reduced land and water use, strict water quality control, lower environmental impact and higher biosecurity. However, this method of production can result in a higher bioburden in the recirculated water which necessitates the increased use of chemical disinfectants to prevent disease outbreaks. MOREFISH is a multidisciplinary project that investigates innovative technologies including advanced disinfection systems and aeration processes to significantly improve sustainability and production management at inland aquaculture sites. With the potential initiation of new stringent regulations regarding effluent discharge, it is critical that aquaculture waste water management is addressed in terms of detoxification. This study investigates the use of pulsed ultraviolet light (PUV) in a combination treatment system with chemical disinfectants to improve the efficiency of freshwater aquaculture. A multi-trophic test battery was performed to determine the effect of PUV on commonly used chemical disinfectants in freshwater fish farms, namely Bronopol and Chloramine-T. This ecotoxicological assessment involved a range of bioassays including *Pseudokirchneriella subcapitata, Artemia salina and Hydra attenuata* to determine the change in toxicity of the selected chemicals pre and post PUV exposure.

Keywords: freshwater aquaculture industry, pulsed ultraviolet light, MOREFISH, aquatic chemical disinfectants, ecotoxicology, multi-trophic test battery, effluent discharge

Ecotoxicology

Genomic insights into the virulence capacity of soil-adapted E. coli

Nicholas Waters[1,2], Leighton Pritchard[2], Florence Abram[1], Ashleigh Holmes[2], Fiona Brennan[1,3]

[1]National University of Ireland, Galway, Ireland.

[2]The James Hutton Institute, Dundee, Scotland.

[3]Teagasc: Environmental Research Centre, Wexford, Ireland.

Corresponding Author Email Address: n.waters4@nuigalway.ie

Escherichia coli's remarkable ability to thrive both in the gut and in soil confounds many assumptions made about the bacterium's ecological niche specialization, and a growing body of research has challenged the long-held assertion that *E. coli* can only survive transiently outside of the gut. In order to probe the genetic mechanisms that allow for such long-term adaptation and assess any potential human-health risks associated with soil-adapted *E. coli,* whole-genome sequencing was performed on 153 long-term soil-adapted *E. coli* isolates. The isolates were collected from maritime temperate soils that had been protected from fecal contamination for periods of at least 9 to 13 years. Further understanding of these isolates will potentially lead to improved water quality diagnostics and a more complete knowledge of stress adaptation and virulence in E. coli. The isolates had previously been shown to be genotypically and phenotypically diverse and to possess phenotypic characteristics that may enhance their capacity to survive in the soil environment. Average nucleotide identity on aligned genomes revealed 7 distinct subgroups; while certain subgroups correlated well with the phylo-groups assigned to them by Clermont 2013 typing method, others showed more heterogeneity. We determined the presence or absence of ~65 virulence or virulence-related genes using BLAST. Our findings show that while *stx* toxin genes are absent in all of our soil-adapted strains, many virulence-associated genes (including *fim, traT rfaH, EAST1,* and others) are present, and may be functional in large proportion of the isolates. Future work will include comparison of the pangenome of these soil-persistent isolates to a wider panel of *E. coli* isolates from different environmental and ecological niches, and assessment of genome composition in relation to phenotypic characteristics of the strains.

Keywords: soil bacteria, *E. coli*, virulence, reservoir

Sustainable Land Use and Agriculture 1

Irish potato rhizobacterial isolates show promise as biocidal alternatives and plant growth-promoters

Darren Heenan Daly[1], Barbara Doyle Prestwich[1]

[1]School of Biological, Earth and Environmental Science, Butler Building, Distillery Fields, North Mall Campus, University College Cork, Cork, Ireland.

Corresponding Author Email Address: 108590052@umail.ucc.ie or b.doyle@ucc.ie

A preliminary analysis of 120 rhizobacterial isolates from Irish potato soils has revealed a diverse morphological range of isolates. Both organic and conventional potato crop sites across Cork County were investigated for their potential to yield plant growth-promoting rhizobacteria (PGPR). The diverse range of colony morphology is reflected in their differing abilities to aid in plant growth both directly and indirectly via activities such as phosphate solubilisation, NH_3 production, hydrogen cyanide production, and fungal inhibition. Isolates deemed worthy of further study will be sequenced to reveal their respective identity. Solid-phase microextraction gas chromatography mass spectrometry (SPME GC/MS) was utilised to investigate the potential for ten isolates which efficiently inhibited fungal growth *in-vitro*, to produce volatile organic compounds (VOC's). A number of these VOC's have the ability to promote plant growth and disease resistance via 'biopriming' activity, suppression of fungal growth or a combination of these activities working synergistically. Indeed, the volatilomes of many of these native PGPR isolates show homology to many well documented PGPR reported in the literature. With compounds such as 2,3 butanediol and 1-undecene, a plant growth-promoting and fungal-inhibiting volatile respectively, being produced by native PGPR. With a growing world population set to reach ~9 billion by 2050 food security is a major concern. Coupled with this is the increasingly restricted use, especially in the EU, of synthetic biocides and fertilisers due to their negative environmental effects. PGPR represent an opportunity to move away from almost complete dependence on synthetic biocides and fertilisers and this is reflected in the increased amount of research activity from both academia and industry across the world in this area, indeed almost 4% of the global market for biocidal plant treatment is occupied by products directly derived from PGPR VOC's and this is set to rise steadily over the coming years.

Keywords: rhizobacteria, plant growth promotion, biocide

Sustainable Land Use and Agriculture 1

Using Geographical Information Systems (GIS) to build a risk assessment model for the potential impact of atmospheric ammonia

David Kelleghan[1], Enda Hayes[2], Mark Everard[2], Thomas P. Curran[1]

[1]UCD School of Biosystems and Food Engineering, University College Dublin, Belfield, Dublin 4, Ireland.

[2]University of the West England, Bristol, UK.

Corresponding Author Email Address: david.kelleghan@ucdconnect.ie

Geographical Information Systems (GIS) is a useful tool when dealing with environmental data, which can vary across large scales. Large amounts of data have been collected and stored by different bodies, such as the Environmental Protection Agency (EPA), the Central Statistics Office (CSO), and the Centre for Environmental Data and Recording (CEDaR). Atmospheric ammonia from agriculture has long been recognised as having harmful impacts on the environment, with agriculture producing 98 % of Ireland's atmospheric ammonia emissions. As agriculture is a significant component of Ireland's economy it is vitally important to consider existing impacts on the environment on a national scale, especially considering ongoing expansions. This project used nitrogen sensitive lichen records stored by CEDaR, data from the 2010 agricultural census stored by the CSO, in addition to monitored ammonia concentrations and the locations of intensive agricultural units stored by the EPA. Using GIS it was possible to simplify data from these datasets to scales of 0 – 5, where 5 was most likely to represent a negative impact (i.e. higher proportion of nitrogen tolerant lichens, closer to an intensive agricultural unit, or have a larger cattle population). Simplifying these large datasets to produce a map of areas most likely to be impacted by current agricultural practices acts as an early stage risk assessment. This is of benefit to policy makers and planners encouraging economic expansion bearing in mind environmental sustainability, essentially "Putting the Eco in Economy". Further details of the overall EPA-funded research project can be found at https://twitter.com/AmmoniaN2K.

Keywords: ammonia, air pollution, environmental impact, agriculture, CEDaR, CSO, EPA

Sustainable Land Use and Agriculture 1

Hill farmers: under-valued custodians of hill ecosystems

Brian Dunne[1], Claire Chambers[1]

[1]Wicklow Uplands Council, Main St, Roundwood, Co Wicklow, Ireland.

Corresponding Email Address: bdunne@wicklowuplands.ie

The unenclosed lands of the Wicklow uplands are managed landscapes, largely designated under Annex I of the Habitats Directive. These habitats are widely deteriorating due to changes in farming practices and restrictive legislation. There are 117 commonages of unenclosed grazing, shared amongst 349 farmers covering 26,000 hectares in the Wicklow uplands but fewer farmers use these grazing rights. Maguire (2015, MSc AgrSc Thesis, UCD) found the reasons for the decline are: off-farm employment, age profile, inadequate financial return from hill sheep, low ewe fecundity and restrictions in effective habitat management. Much of the deterioration in upland habitats is due to the change to the Wild Life Act, 2000. The burning season closes on Feb 28th instead of April 15th. This restriction is largely unworkable due to heavy winter rainfall. This has resulted in overgrown woodier heather leading to increased risk of wild fires in drier weather. Wild fires destroy peat layers, increase erosion, reduce carbon sequestration and encourage bracken invasion. The traditional upland management of regular controlled burning of vegetation provided a mosaic of vegetation that improved palatability and nutritional benefit for all fauna. Wicklow Uplands Council, have been responsible for commissioning 2 studies to date. The first was to develop a vegetation management strategy to increase biodiversity taking 'best practise' from similar regions within the British Isles and marrying them with traditional techniques in the Wicklow uplands. (Tubridy, 2013). The second, 'Inventory of Biodiversity in the Wicklow/Dublin uplands' collating existing databases (Lauder, 2015), showed a paucity of recent data in the uplands. Currently commonage groups and other stakeholders are working together to support farmers improve the biodiversity but it is a slow process requiring more than a five-year plan. Dialogue, between farmers, ecologists and recreational users, is essential as the improvements are mutually beneficial. Hill farmers are not just trying to make a living by restoring the vegetation, but are custodians enhancing the landscape and as such do need to be recompensed.

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Keywords: upland farming, vegetation management, upland biodiversity, sustainable agriculture

Sustainable Land Use and Agriculture 1

Socio-Cultural Valuation of ecosystem services – a tool for effective stakeholder engagement to inform land-use planning and management: a case study

Deirdre Joyce[1], Craig Bullock[1], Marcus Collier[1]

[1]UCD School of Architecture, Planning and Environmental Policy, University College Dublin, Richview Campus, Clonskeagh, Dublin 14, Ireland.

Corresponding Author Email Address: deirdre.joyce@ucdconnect.ie or craig.bullock@ucd.ie

Ecosystem Services Valuation is a method that aims to demonstrate how nature supports human well-being. As a component of ESV, Socio-Cultural Valuation, provides a specific place for people's voices to become heard so that their values for the environment can also inform policy and decision making, alongside other criteria. This is consistent with the so called 'Ecosystem Approach' to decision making. This paper presents the findings of a case study that explored the practice of Socio-Cultural Valuation in the context of coastal land use planning in Fingal, north County Dublin. It analyses the potential and relevance of the method from two perspectives, firstly from a process perspective investigating how participants respond to the method and secondly examining what the outputs might speak to in land-use planning terms. The research used a mixed methods approach comprising workshops, participatory mapping, semi-structured interviews and value ranking to explore the potential of Socio-Cultural Valuation. The findings show that Socio-Cultural Valuation may offer a new and novel way to engage the public and other stakeholders in consultative fora about the benefits of ecosystem services. It also demonstrates that the knowledge it generates may assist decision makers in their work in the planning and management of land-uses.

Keywords: ecosystem services valuation, socio-cultural valuation, stakeholder consultation

Sustainable Land Use and Agriculture 1

The potential of gaseous nitrogen mitigation and offsetting in agricultural systems

M. Ibrahim Khalil[1]

[1]UCD School of Biology and Environmental Science and UCD Earth Institute

University College Dublin, Belfield, Dublin 4, Ireland.

Corresponding Author Email Address: ibrahim.khalil@ucd.ie

The demand for nitrogen fertilizers (e.g., urea, potassium nitrate and ammonium sulfate/nitrate) to grow more foods and feeds has been increasing (~3.5% per year). Consequently, a rapid rise in gaseous nitrogen emissions such as nitrous oxide (N_2O), ammonia (NH_3) and nitrogen oxides (NO_x) from agricultural systems is likely in coming decades. These directly and/or indirectly trigger negatively to greenhouse gas (GHG) offsetting potential of carbon sequestrating in agriculture, forestry and other sectors, undermining global efforts to keep the <2°C rise of post-industrial warming. Tackling climate change challenges, relating closely to agricultural gaseous nitrogen emissions, and environmental degradation while attaining food security and sustainability are vital. Reactive nitrogen, such as ammonium and nitrate, is an indispensable nutrient for agricultural production and that the application of nitrogen fertilizers either in the form of inorganic or organic or both simultaneously have been increasing. Among the nitrogen fertilizers, nitrates give higher crop yields than urea particularly in temperate regions and vice-versa in tropics linking to volatilization, denitrification and leaching losses. Urea has a lower carbon footprint during production but higher following field applications resulting from direct CO_2 release and more gaseous nitrogen emissions compared to ammonium and ammonium nitrate fertilizers. Atmospheric pollution through gaseous nitrogen drives far beyond critical environmental thresholds without mitigation actions. Technological attempts to decrease gaseous nitrogen species emitting from agricultural systems are being progressed. The recent developments and future prospects of improving site-specific nitrogen use efficiency in crop and animal production systems include precise nitrogen fertilization and manuring, matching with types/compositions of nitrogen fertilizers and other sustainable farming techniques. A transition of current agricultural systems into highly resource-use efficient systems is needed. This paper focuses on opportunities to mitigate gaseous nitrogen and the GHG offsetting potential particularly through carbon sequestration in agricultural systems.

Keywords: greenhouse gas, gaseous nitrogen, carbon sequestration, nitrogenous fertilizers, sustainable agriculture

Sustainable Land Use and Agriculture 1

An evaluation of the GrassVESS technique for soil structural quality

Eileen Jeuken[1], Cait Coyle[1], Owen Fenton[2]

[1]Centre for Environmental Research, Innovation and Sustainability (CERIS), Department of Environmental Science, IT Sligo, Sligo, Ireland.

[2]Teagasc, Crops Environment and Land Use Programme, Johnstown Castle, Wexford, Ireland.

Corresponding Author Email Address: eileen.jeuken@mail.itsligo.ie

The study evaluates the GrassVESS method, which is a Visual Soil Evaluation (VSE) technique for the assessment of soil structural quality on grassland with respect to land management (machinery and livestock). The study forms part of the Teagasc led Soil Quality and Research (SQUARE) project, which examines the relationship between soil structural health and soil functions in Ireland. The aim of the study is to independently evaluate the GrassVESS technique by means of a number of key criteria. In order to determine the influence of user bias, the GrassVESS technique was conducted in 2016 on 20 grassland sites, which had been assessed in 2015 by another user. The influence of key soil characteristics (moisture content, organic matter content, texture and bulk density) on the reproducibility of the method were also investigated. Furthermore, the application of the GrassVESS method by teams of agricultural advisors in the west and northwest of Ireland is proposed to evaluate the accuracy and reproducibility of the GrassVESS technique. The findings from a survey of 80 participants at Discussion Group events for the farming community, whereby they were introduced to GrassVESS, indicate that it provides a useful, fast and simple method to assess soil structural quality. A survey of key stakeholders with knowledge of Visual Soil Evaluation techniques is being used to collect feedback on the evaluation of existing VSE methods by means of an online questionnaire. It is anticipated that the findings from the study will make a valuable contribution to the validation of the GrassVESS technique as a suitable VSE toolkit for assessing land management impacts on the structural quality of Irish grassland soils.

Keywords: soil quality, soil functions, soil structure, assessment toolkit, Irish grassland, land management, GrassVESS technique

Water Quality and Resources 2

Meeting the requirements for the EU Water framework for the GC-MS amenable pesticides in water with LV-PTV-GC-MS/MS technology

John Adey[1], Gemma Ellison[2], Greg Johnson[2], Joachim Gummersbach[3]

[1]National Laboratory Services, Starcross, Exeter, UK.

[2]Thermo Fisher Scientific, Hemel Hempstead, UK.

[3]Thermo Fisher Scientific, Dreieich, Germany.

Corresponding Author Email Address: gemma.ellison@thermofischer.com

A validated method on pesticides in various water matrices with large volume injection into GC-MS after liquid-liquid extraction will be presented. Various pesticides were analyzed in the standards and matrix samples using a TSQ 8000 Evo triple quadrupole GC-MS/MS instrument coupled with a Thermo Scientific™ TRACE™ 1310 GC. Sample introduction was performed with a Thermo Scientific™ TriPlus™ RSH autosampler, using large volume PTV with a glass sintered liner and compound separation was achieved on a Thermo Scientific™ Trace GOLD TG-35MS 30 m x 0.25 mm I.D. x 0.25 µm film capillary column. The EU Water Framework directive was introduced in August 2013 amending EU directive 2000/60/EC and 2008/105/EC; laying down a strategy against the pollution of water to be applied to all European Union member states. It involves the identification of priority substances and the monitoring of different classes of contaminants. The directive encourages the development of novel monitoring methods such as passive sampling and other tools. CIP 2 UK regulations investigates the occurrence, sources and removal of trace substances in waste water treatment facility effluent. This regulation helps to establish priorities for premeditative action to ensure surface waters meet new Environmental Quality Standards (EQS). The CIP 1 program was managed by UK Water Industry Research (UKWIR) and implemented from 2010-2013. The CIP 2 program is a follow up program of sampling and analysis to be implemented between 2014 and 2020. The primary objective of CIP 2 is to identify and characterize sites where EQS levels are breached. In the programme 70 priority substances were determined from 162 sewage treatment works (STW) effluents. 11 pharmaceuticals were also identified as priority monitoring candidates. It is important to note that EQS is defined for only 3 pharmaceutical compounds Diclofenac, E2 and EE2. All substances selected for monitoring analysis were detected previously in waste water effluent samples. The determined environmental concentrations of many priority substances in effluent exceeded EQS.

Keywords: EU Water Framework, GC, GC-MS, pesticides, water analysis

Water Quality and Resources 2

An investigation of the hydrology, ecology, and ecosystem function of groundwater dependent wetlands

Victor Perelló[1], Raymond Flynn[2], Valerie McCarthy[1]

[1]Department of Applied Sciences, Dundalk Institute of Technology, Co. Louth, Ireland.

[2]School of Planning, Architecture and Civil Engineering, The Queen's University of Belfast, David Keir Building, Stranmillis Road, Belfast, BT9 5AG. Northern Ireland.

Corresponding Author Email Address: victor.perello@dkit.ie

Groundwater dependent wetlands (GWDWs) are wetlands which critically depend on groundwater flows and/or chemistry. Groundwater has chemical and physical properties which differ from those of surface water. Protecting the ecosystem functioning of GWDWs forms an implicit component of the EU Water Framework Directive (2000/60/EC). The functioning of GWDWs can be detrimentally impacted through excess loadings of nutrient-enriched water through both subsurface and surface pathways. The relationship between the potential risk of nutrient inputs to twelve GWDW habitats in the border region of Ireland and onsite water quality variables was examined. The GWDW sites investigated included a variety of habitat types such as wet grassland, fens, transition mire, reed swamp and open water. Based on the Source-Pathway-Receptor (S-P-R) approach using available datasets and GIS software, the potential risk posed to GWDWs of various land use activities was estimated, which took into account the role of numerous factors potentially influencing nutrient attenuation and delivery mechanisms to GWDW receptors. The sites were then sampled between spring 2015 and winter 2016 and surface water samples collected from a number of sampling points within each site, which varied depending on the site, but normally included inflows, outflows, open water and groundwater influenced standing water (where present). Samples were analysed for a range of hydrochemical parameters using standard protocols. Water quality data at the sites of this study indicated a relatively high degree of within site heterogeneity. For example, average NO_3-N concentrations ±SE ranged between 0.09 ± 0.02 and 2.5 ± 0.74 mgL^{-1}. Generally, high NO_3-N concentrations were found in inlets discharging directly to GWDWs, while outlet and onsite samples contained lower NO_3-N concentrations. Nevertheless, there was a relationship between estimated risk of nutrient inputs and average onsite measurements of water quality parameters. Results indicate that an integrated understanding of sources and pathways provides valuable insights into natural processes influencing GWDW status.

Key words: groundwater dependent wetland, nitrate, source-pathway-receptor

Water Quality and Resources 2

The value of a desk study in building a river obstacle inventory

Siobhán Atkinson[1], Michael Bruen[2], Jonathan Turner[3], Jens Carlsson[1], Bernie Ball[1], Craig Bullock[4], John O'Sullivan[2], Colm Casserly[3], Mary Kelly-Quinn[1]

[1]School of Biology and Environmental Science, University College Dublin, Ireland.

[2]UCD Dooge Centre for Water Resources Research, School of Civil Engineering, University College Dublin, Ireland.

[3]School of Geography, University College Dublin, Ireland.

[4]School of Geography, Planning and Environmental Policy, University College Dublin, Ireland.

Corresponding Author Email Address: siobhan.atkinson@ucdconnect.ie

This paper evaluates a desk-based approach for creating a river obstacle inventory for use in developing a validated methodology for prioritising man-made river obstacles, such as dams, bridge aprons, weirs, and culverts for modification or removal. It is part of an EPA-funded project (Reconnect) to study the effect of obstacles on hydromorphology, aquatic ecology and connectivity in Irish freshwater systems. Typically these obstacles prevent or delay the up- or downstream movement of fish, invertebrates and natural river material. The creation of a river obstacle inventory is a logical first step in developing a prioritisation process for obstacle removal and/or modification. An efficient desk-based method of locating obstacles that utilises a variety of mapping techniques is presented. As an example, a desktop GIS analysis of the River Nore and its tributary network, using historic maps, satellite imagery and OSI discovery series maps was undertaken, and a geo-referenced layer of all the potential river obstacles was created. In order to determine the effectiveness of the desk study, the located obstacles were cross-referenced with obstacles recorded in a walk-over survey of the catchment carried out previously by Inland Fisheries Ireland (IFI). The desk study of the Nore catchment identified almost 3,000 potential obstacles, of which over 80% were road crossings. Of the 508 obstacles in the Nore catchment, known from the IFI survey, over 90% were successfully identified in the desk study. Almost half of the obstacles 'missed' in the desk study were located in Strahler 1st order streams. The results of this research indicate that a desk study can be an efficient and effective method of locating river obstacles and can guide subsequent field surveys for confirming the presence of obstacles, in particular eliminating large stretches of the river that would otherwise need to be walked, reducing the time and cost involved.

Keywords: reconnect, river obstacle, inventory, desk study.

Water Quality and Resources 2

Sediment transport on the river Bandon, Ireland

Laurence Lomasney[1], Joe Harrington[2]

[1]Department of Civil, Structural and Environmental Engineering,

[2]School of Building & Civil Engineering, Cork Institute of Technology, Bishopstown, Cork.

Corresponding Author Email Address: laurence.lomasney@mycit.ie

The 72 km long River Bandon is located in the South Western River Basin District and drains a catchment of 608 km^2. Bandon town, the largest settlement within the catchment, has a history of flooding, most recently in December 2015. River improvement works are planned for the Summers of 2017 and 2018; test dredging was undertaken in September 2016. Sediment transport is an active feature of the river system and this paper presents results of the analysis of bed load and suspended sediment behaviour and transport on the river. Bed load sampling was undertaken at a number of locations within the river reach on a monthly basis over a three year period providing baseline conditions. Bed-load pit traps were installed at a number of locations and applied, for the first known time in Ireland, to monitor bed sediment transport. D_{50} bed sediment grain size values ranged from 3 to 47 mm with gradation values from 2 to 3.25, indicating uniformly to well-graded sediment. Analysis of sediment collected in the bed traps over a number of flow events indicated sediment transport rates from approximately 2.4 tonnes to 5.8 tonnes during the sediment movement period for flow rates from 12 to 64 m^3/s. The slope break analysis method was applied yielding incipient bed transport flow rates from 10 to 14 m^3/s thus field data and the slope break predictive method provide agreement, an important finding for sediment transport prediction on the river. Suspended sediment was monitored through a combination of a long-term manual sampling programme, continuous turbidity monitoring and automatic water sampling. Flow rate, suspended sediment and turbidity data are analysed and presented for a range of flood events using the three separate sources of field data. Indicative potential impacts of dredging works based on suspended sediment and turbidity field data are also presented.

Keywords: river Bandon, bed load, suspended load, dredging

Waste Management 1

Death by digesters: eliminating pathogens in agricultural waste products

Agathe Auer[1], Nathan H. Vande Burgt[1], Stephen Nolan[2], Fiona Brennan[3], Annetta Zintl[1]

[1]University College Dublin, Veterinary Science Center, Belfield, Dublin 4, Ireland.

[2]National University of Ireland Galway, School of Natural Sciences, Galway, Ireland.

[3]TEAGASC, Environment Research Centre, Johnstown Castle, County Wexford, Ireland.

Corresponding Author E-mail Address: agathe.auer@ucdconnect.ie

Wastes of animal origin contain a variety of pathogenic bacteria, parasites and viruses. Currently, the majority of agricultural waste within Ireland is directly applied to farmland as *fertiliser*, creating potential pathways for pathogen spread, including *Cryptosporidium spp*., which are one of the most common enteric pathogens of animals and humans. Recently, a small number of mesophilic anaerobic digesters (AD) have begun to process agricultural waste within Ireland, generating energy while reducing the amount of waste. However, the prevalence and surviveability of pathogens in Irish AD is poorly understood. This study investigated the prevalence of *Cryptosporidium spp*. in Irish AD plants and their surviveability in lab scale AD reactors. The presence of *Cryptosporidium spp*. was assessed by surveying five currently operating Irish AD plants that use primarily agricultural waste as input material. Throughout one year, samples from multiple stages of the AD process including raw material, digestate and fertiliser were analysed using nested PCR (Xiao et al., 2001). *Cryptosporidium spp*. were detected in multiple stages of the AD process. To assess the viability of *Cryptosporidium spp*. after the AD process, a lab scale batch reactor was spiked with *Cryptosporidium parvum* oocysts. The organisms were monitored over 4 weeks and viability was assessed by a PMA-qPCR assay (in-house). I n addition, we analysed the efficacy of pasteurisation of the raw material before AD processing and of the digestate after AD processing. The results indicate that digestion without pasteurization significantly reduces C. *parvum* viability. However, pre-pasteurisation of raw material is more efficient at eliminating viable oocysts. Overall, our results suggest that implementation of mesophilic AD, as a source of alternative energy within Ireland, would increase the safety of landspread agricultural waste by reducing pathogen presence and viability.

Keywords: agricultural anaerobic digestion, cryptosporidium, pathogen viability

Waste Management 1

Phosphorus (P) removal, recovery and reuse in wastewater using bauxite residue

Patricia B. Cusack[1,2,3], Mark G. Healy[2], Eva Ujackzi[3,4], Lisa M. T. O' Donoghue[4], Teresa Curtin[5], Ronan Courtney[1,3]

[1]Department of Biological Sciences, University of Limerick, Castletroy, Co. Limerick, Ireland.

[2]Civil Engineering, National University of Ireland, Galway, Ireland.

[3]The Bernal Institute, University of Limerick, Castletroy, Co. Limerick, Ireland.

[4]Design and Manufacturing Technology, University of Limerick, Castletroy, Co. Limerick, Ireland.

[5]Chemical Sciences Department, University of Limerick, Castletroy, Co. Limerick, Ireland.

Corresponding Author E-mail: patricia.cusack@ul.ie

Aluminium production by the Bayer process generates bauxite residue (red mud) at a rate of approximately 120 Mt per annum. An estimated 2.7 Bt has been produced to date, which is either landfilled or collected in land storage facilities. As European Union (EU) policy advocates the reuse of materials, the aim of this study was to investigate if bauxite residue could be used in the removal of phosphorus (P) from synthetic wastewater. Fresh samples of bauxite residue were obtained from two European alumina refineries, and characterised on their mineralogical, chemical and physical composition. The mineralogical composition typically comprises residual iron (Fe), titanium (Ti) and aluminium (Al) oxides, namely hematite, perovskite, zeolite and ilmenite, and has a large specific surface area for P adsorption. Elemental composition was investigated using EDS in conjunction with SEM, and the main elements found on a weight percentage basis were Fe (44.07±9.28%), Al (10.66±2.32%), Na (5.84±0.33%), Ti (14.24±3.99%), Si (6.21±1.80%), Ca (16.92±4.92%) and Cu (1.06±0.19%). The bauxite samples were then modified with either gypsum or seawater, to determine if modification of bauxite could enhance its P adsorption capacity. Untreated and treated samples (with either gypsum or seawater) were placed in 50 ml capacity containers and were overlain with water made up to concentrations of 0, 10, 20, 30, 50, 60, 80, 100 and 150 mg P/L. They were then placed on a reciprocating shaker for 24 hours, before being allowed to settle and the supernatant water tested for its P concentration. Langmuir adsorption isotherms were then used to model the data. Preliminary results from the study indicates that untreated bauxite has an adsorption capacity varying between 370 and 1000 mg P/kg, and that seawater and gypsum substantially enhances the adsorption capacity. Future work will examine the use of gypsum and seawater treated bauxite residues in filtration studies.

Keywords: bauxite residue, adsorption, bauxite residue filter, wastewater effluent, phosphate removal

Waste Management 1

Pathogen survival in agriculture-based anaerobic co-digestion with FOG

Stephen Nolan[1,2], Agathe Auer[3], Nathan H. Vande Burgt[3], Fiona Brennan[2], Owen Fenton[2], Karl Richards[2], Vincent O'Flaherty[1], Florence Abram[1]

[1]Functional Environmental Microbiology Group, NUI Galway, Ireland.

[2]Teagasc, Johnstown Castle Research Centre, Wexford, Ireland.

[3]University College Dublin, Veterinary Science Center, Belfield, Dublin 4, Ireland.

Corresponding Author Email Address: stiofnolan@gmail.com

Organic fertilizers such as slurry contain high levels of faecal pathogen indicators and can be a reservoir for a range of bacterial, viral and zoonotic pathogens. In Ireland, slurry is managed through land application without treatment. In terms of pathogen loss to the environment this may pose a significant risk to human and animal health through inhalation as bioaerosols or pathogen contamination of soils, plants and watercourses. Presently in Ireland several agriculture-based anaerobic digestion (AD) plants process slurry to produce renewable energy. A knock-on benefit may be the reduction of pathogen load when landspreading the end product. These plants require a co-digestion substrate to improve methane output and balance C:N ratio. Fats, oils and grease (FOG), the problematic waste from food production greasetraps, are commonly used. The aim of this study was to examine the impact on pathogen survival of the use of FOG as co-substrate under various operating conditions used in AD systems. However, spiking laboratory-scale reactors with specific pathogens, such as *Cryptosporidium*, under varying process configurations, is hampered by availability of sufficient pathogen quantities. Hence, triplicate miniature-scale (50ml) assays were compared with laboratory-scale (10l) reactors across a range of parameters including biogas, volatile solids and pathogen indicator survival. Results showed that in both reactor scales, greater than 3-log10 reductions in both faecal coliforms and E. coli, were observed after 7 days, with a 2.5-log10 reduction in Enterococci numbers in 28 days. The correlation between reactor scale performance data and pathogen indicator survival suggest that 50 ml assays are suitable for preliminary investigation into the impact on pathogen survival caused by changes to AD process configuration. Future work will move to the field to determine comparative risk from digestate and unprocessed slurry. The combined results of this research across the scales of investigation will contribute significantly to Irish AD policy.

Keywords: anaerobic digestion, pathogens, FOG, policy

Waste Management 1

Screening of polystyrene insulation foams from construction and demolition waste for flame-retardant persistent organic pollutants using X-ray fluorescence

Martin Sharkey[1], Harald Berresheim[1], Mohamed Abdallah[2], Daniel Drage[2], Stuart Harrad[2]

[1]Centre for Climate and Air Pollution Studies, School of Physics, National University of Ireland Galway, Ireland.

[2]School of Geography, Earth and Environmental Sciences, University of Birmingham, UK.

Corresponding Author Email Address: m.sharkey6@nuigalway.ie

The brominated flame retardant (BFR) hexabromocyclododecane (HBCDD) has been extensively applied to a wide range of polymer materials, most notably in polystyrene insulation foams for buildings. However, epidemiological studies coupled with inherent chemical properties have highlighted its environmental hazards as a persistent organic pollutant (POP). United Nations and EU legislation have therefore been established in recent years to eliminate its further use and curtail its introduction into the environment via recycling and waste streams. Our research sought to evaluate the suitability of a portable X-ray fluorescence device (Niton, XLt3-900 GOLDD) as a rapid, cost-effective and accurate screening tool for the quantification of BFRs in excess of EU-defined low-POP concentration limits (LPCLs) in waste plastics. Samples of expanded polystyrene (EPS) and extruded polystyrene (XPS) were collected from several waste sites around Galway county. Analysis via XRF was then carried out on all samples for an estimation of bromine content before samples were transferred to collaborators in Birmingham for HBCDD quantification via LC-MS/MS. 81 samples were collected and analysed; the results from which showed concentrations of HBCDD ranging from 0 to ~10,000 ppm. Approximately 30% of samples exceeded 1,000 ppm (or 0.1% w/w), the EU-defined LPCL for this chemical. Comparisons show high correlations between XRF and LC-MS/MS measurement techniques, with R^2 values exceeding 0.95 for both EPS and XPS samples. Results were not perfectly congruent, with the XRF over-estimating concentrations of bromine as a result of polymer-matrix effects influencing; however, corrections to this over-estimation using suitable EPS and XPS calibration standards would nullify this issue, allowing for the XRF instrument's use as a screening tool for excess POP-BFRs in waste building insulation foams.

Keywords: X-ray fluorescence, brominated flame retardant, polystyrene insulation foam, persistent organic pollutant, EU legislation compliance

Environmental Management

NUI Galway's journey towards sustainability – Learn-Live-Lead

Michelle O'Dowd Lohan[1], R. Manton[1], J. Goggins[1], F. Fahy[1], D. O'Donovan[1], M. Cormican[1], L. McIlrath[1], R. Hynes[1], C. Loughnanne[1], B. Seoige[1], J. Hannon[1], M. Keane[1], M. Prendergast[1], C. Carlin[1], C. Brown[1]

[1]Community and University Sustainability Project, Ryan Institute, NUI Galway, Ireland.

Corresponding Author Email Address: michelle.odowd@nuigalway.ie

The Community and University Sustainability Project (CUSP) was launched in 2015 under the direction of the Registrar and Deputy President and aims to make NUI Galway one of the greenest, smartest and healthiest campuses in the world. The CUSP team is multidisciplinary, consisting of both students and staff, drawn from a range of University facilities and services. CUSP is supported in its mission by the University, Students' Union, Saolta University Healthcare Group and Galway City Council. In June 2016, CUSP launched an engaging, *holistic and inclusive Sustainability Initiative* for NUI Galway and its communities. The Sustainability Initiative is based on a Learn-Live-Lead model whereby the university will build on its core strengths in teaching and research to learn about the environment and new techniques, analyse campus operations and user habits to live more sustainability and connect to the broader community to lead by example. To date, we have launched Battle of the Buildings as a sustainability demonstrator engagement project. A sustainability platform has been developed within the universities website structure to collect all research, teaching and outreach relating to sustainability and gather input from the wider campus community. The Sustainability Initiative has embarked on an extensive engagement process whereby views of the University and wider community are gathered through a four-step approach, including: awareness, outreach, action and empowerment. This process will contribute to the development of a three-year Sustainability Strategy and Implementation Plan for NUI Galway.

The Community and University Sustainability Project is funded by the NUI Galway Students' Union through the Student Projects Fund.

Keywords: learn, live, lead, inclusive, holistic, engaging

Environmental Management

Sustainable development (SD) in higher education (HE) – Learning from global best practice to inform meaningful action in Ireland.

Maria Kirrane[1], William Horan[1], Yvonne Ryan-Fogarty[1], Richard Moles[1], Bernadette O'Regan[1]

[1]Centre for Environmental Research, Department of Chemical Sciences, School of Natural Sciences, University of Limerick, Ireland.

Corresponding author email address: maria.kirrane@ul.ie

Higher Education Institutions (HEIs) exert a significant impact on the environment. They are also charged with educating future leaders, thereby extending this impact beyond the campus boundaries. Addressing national policies such as *Ireland's Transition to a Low Carbon Economy*, and the *National Strategy on Education for Sustainable Development (2014-2020)* requires urgent action on the part of HE. HEIs can be viewed both as distinct communities, and complex systems delivering numerous functions i.e. operations, education, research and outreach. This "whole systems" approach is being targeted by programmes such as An Taisce's Green Campus, but some challenges to its successful implementation exist. Targets and benchmarks for the sector are lacking, while a lack of resources means that opportunity identification and prioritisation is key. Internationally, a number of HEIs have excelled in incorporating SD. This EPA-funded research project develops case studies of "best practice" in order to identify mitigation actions suitable to the Irish context. International HE sustainability assessments were reviewed and a list of best practice examples compiled. Case studies were developed through review of online documents, semi-structured expert interviews with key actors, and site visits. Through these case studies, a suite of policies have been identified and the impact of their implementation on campus sustainability will be measured. The Sustainability Evaluation Metric for Policy Recommendation (SEMPRe), designed for communities, will be adapted for HE to guide opportunity identification. A participatory process through the use of facilitated workshops will guide the adaptation of the tool, and introduce it to practitioners. The results of this research will provide policy recommendations backed by sound scientific evidence to inform better decision making at national and local level.

Keywords: sustainable development, education, whole systems, mitigation, policy recommendation.

Environmental Management

Assessment of environmental conditions affecting the performance of eelgrass Zostera marina meadows in western Ireland

Pedro Beca-Carretero[1], Dagmar B. Stengel[1]

[1]Botany and Plant Science, School of Natural Sciences, and Ryan Institute, National University of Ireland Galway, Ireland.

Corresponding Author Email Address: pedropersiobk@hotmail.es

Seagrass meadows rank among the most valuable ecosystems worldwide due the numerous ecological services they provide. These include reduction in coastal erosion, high productivity and the provision of habitats and nursery grounds. *Zostera* marina (eelgrass) is the most dominant subtidal seagrass in Ireland, but its biology and ecology has received only little attention. As part of an ongoing study, for the first time, populations of the eelgrass *Zostera* marina in western Ireland were monitored and characterized to assess seasonal responses and physiological adaptations. Ecological niche models (ENMs) were also used to calculate the *Z. marina* habitat suitability at local and regional scale in Ireland. To evaluate the validity of modelled data, ground-truthing by diving/snorkelling was conducted. Our results demonstrate a much larger distribution of *Zostera* in western Ireland than previously described. Moreover, potential responses to projected scenarios of global warming (IPCC 2014) were studied under laboratory controlled temperature conditions analysing physiological responses and growth rates. Results indicate that future scenarios of global warming may enhance the eelgrass performance and increase their distribution in western Ireland. As eelgrass populations are under threat globally, an accurate distribution map and a better understanding of the reactions of these valuable ecosystems to climate change impacts of eelgrass in Ireland will be critical to define adequate future conservation policies. This project therefore constitutes an essential contribution to current efforts in seagrass monitoring and management across Europe.

Keywords: *Zostera marina*, ecological niche models, environmental factors, global warming

Sustainable Land Use and Agriculture 2

White clover for pasture production systems: does ploidy affect clover proportion?

Clare Guy[1, 2], Trevor Gilliland[2, 3], Deirdre Hennessy[1], Fergal Coughlan[1], Brian McCarthy[1]

[1]Animal and Grassland Research and Innovation Centre, Teagasc, Moorepark, Fermoy, Co. Cork, Ireland.

[2]Institute of Global Food Security, Queen's University Belfast, Belfast, Northern Ireland.

[3]Agri-food and Biosciences Institute, Plant testing Station, Crossnacreevy, Belfast, BT5 7QJ, Northern Ireland.

Corresponding Author Email Address: clare.guy@teagasc.ie

White clover, *Trifolium repens L.*, is widely considered to be the most important forage legume for temperate agricultural production systems. Although white clover is capable of achieving increased pasture and animal production throughout the year, identification of the optimum sward white clover proportion may further improve its agronomic performance in pasture-based production systems. Perennial ryegrass, *Lolium perenne* L., ploidy has been used to manipulate sward white clover proportion, however most of the research on the effect of perennial ryegrass ploidy on grazing sward characteristics and white clover proportion has been undertaken on simulated grazing plots. Although useful in examining the varying effects of perennial ryegrass ploidy on sward white clover proportion, larger more realistic experiments are needed to yield practical, pragmatic results and identify issues that may arise at farm level. The objective of this study was to examine the effects of perennial ryegrass ploidy on sward white clover proportion under animal grazing at farm level. Two treatments were assessed; tetraploid-clover and diploid-clover, over three consecutive years (2014 – 2016), with sward white clover proportion assessed at every grazing event each year. Sward white clover proportion was, on average, 0.26 and 0.28 on the tetraploid-clover and diploid-clover treatments, respectively, across the three years, with sward white clover proportion decreasing each year. There was no effect of perennial ryegrass ploidy on sward white clover proportion contrary to previous studies. The implication of this research is that perennial ryegrass ploidy does not affect the management protocols for white clover inclusion in pasture-based production systems.

Keywords: *Trifolium repens L.*, *Lolium perenne L.*, ploidy, Ireland

Sustainable Land Use and Agriculture 2

Effects of planting density on the physiological and growth responses of three potential short-rotation forestry species in Ireland

Susan Foreman[1,2], Ian Short[2], Niall Farrelly[3], Brian Tobin[1], Conor O'Reilly[1]

[1]UCD School of Agriculture and Food Science, University College Dublin, Belfield, Dublin 4, Ireland.

[2]Teagasc, Ashtown Research Centre, Ashtown, Dublin 15, Ireland.

[3]Teagasc, Athenry Research Centre, Mellows Campus, Athenry, Co. Galway, Ireland.

Corresponding Author Email: susan.foreman@UCDconnect.ie

The European Union has set a target of 16% for Ireland to supply energy from renewable-energy sources by 2020. Biomass production from short-rotation forestry (SRF) may assist in meeting this target. There is little information available on best practice for growing the main candidate SRF species, especially in relation to optimum planting density to maximise production. It is necessary to plant SRF crops at closer spacing than in conventional forestry to ensure rapid exploitation of site resources, improving yield and biomass return over a substantially shorter rotation. Competition affects the physiological responses of trees, affecting the photosynthesis rates and reducing biomass production. The aim of this study is to investigate the physiological and growth response of Italian alder (*Alnus cordata (Loisel.) Duby*), Sitka spruce (*Picea sitchensis* (Bong.) Carrière) and shining gum eucalyptus (*Eucalyptus nitens* (Deane & Maiden) Maiden) trees to planting density in a controlled greenhouse experiment located in Teagasc Kinsealy, Co. Dublin, and which will inform a measurement strategy for use in a field trial at Teagasc Johnstown Castle, Co. Wexford. The observations and measurements included leaf-level gas exchange to assess photosynthetic activity, shoot growth phenology, tree stem height and diameter increments, chlorophyll content, specific leaf area and leaf area index. Photosynthesis rates in sun and shade leaves of alder were lower than in eucalyptus and decreased at low compared to high densities. Chlorophyll content in the shade leaves decreased as planting density increased. Both alder and eucalyptus had significantly greater height increment at low planting density than at medium or high density with no difference in increment between the three planting densities in Sitka spruce.

Keywords: gas analysis, biomass production, chlorophyll content, leaf area index, specific leaf area

Sustainable Land Use and Agriculture 2

Pasture based livestock systems: can white clover successfully over-winter?

Clare Guy[1, 2], Trevor Gilliland[2, 3], Deirdre Hennessy[1], Fergal Coughlan[1], Brian McCarthy[1]

[1]Animal and Grassland Research and Innovation Centre, Teagasc, Moorepark, Fermoy, Co. Cork, Ireland.

[2]Institute of Global Food Security, Queen's University Belfast, Belfast, Northern Ireland.

[3]Agri-food and Biosciences Institute, Plant testing Station, Crossnacreevy, Belfast, BT5 7QJ, Northern Ireland.

Corresponding Author Email Address: clare.guy@teagasc.ie

White clover, *Trifolium repens* L., is at a competitive disadvantage to perennial ryegrass, *Lolium perenne* L., due to its limited cold tolerance resulting in low growth rates at colder temperatures. The effect of perennial ryegrass ploidy on white clover morphology and growth over-winter, and its subsequent recovery in spring and the following growing season is little understood. Thus, identifying the morphological characteristics that contribute to white clover winter growth and survival is important. Such knowledge could indicate key plant and management factors that enhance spring growth potential. The objective of this study was to examine the growth patterns and structural characteristics during the winter period of diploid and tetraploid perennial ryegrass swards with and without white clover, and to present the dynamics of white clover growth in perennial ryegrass swards over-winter. Four treatments (tetraploid-only, diploid-only, tetraploid + clover, diploid + clover) were examined between November 2014 and February 2015, to monitor grass and white clover growth and morphology. Perennial ryegrass ploidy had no effect on herbage production and sward white clover proportion over-winter. However, the inclusion of white clover caused a significant decrease in herbage mass; grass-only (tetraploid-only and diploid-only) swards: 789 kg DM ha^{-1} in comparison with grass-white clover (tetraploid + clover and diploid + clover) swards: 534 kg DM ha^{-1}, and tiller density; grass-only swards had approximately 2152 more tillers m^{-2} than the grass-white clover swards. Therefore, including white clover in a ryegrass sward can alter winter sward dynamics, potentially causing difficulties in subsequent spring management and performance. Further studies should be undertaken to investigate the influence of the poor winter growth observed in grass-white clover swards on subsequent grazing season productivity.

Keywords: *Trifolium repens* L., *Lolium perenne* L., ploidy, winter, growth rates, grass production, Ireland

Sustainable Land Use and Agriculture 2

Nutrient cycling in an agricultural setting

Andrew C. Fowler [1,2], Iain R. Moyles[1], John G. Donohue[1],

[1]MACSI, University of Limerick, Limerick, Ireland.

[2]OCIAM, University of Oxford, Oxford, UK.

Corresponding Author Email Address: john.donohue@ul.ie

Phosphate (P) and sulphate (S) are essential nutrients for plant growth. However, the only natural source of P is the slow chemical weathering of phosphate-bearing rocks. This supply is unable to meet the demands of modern agriculture, potentially leading to a phosphate crisis. Though plants can absorb sulphur dioxide directly through their leaves, cropped soils are nonetheless likely to experience sulphur deficiency without additional S input from the atmosphere or fertilizers. In order to manage soil nutrient resources in the long term, a better understanding of soil-plant nutrient cycles is required. We propose mathematical models of P and S cycling at the scale of a single plant. These models explicitly include the returning of nutrients from plants to the ground surface as well as the microbe-mediated conversions in the soil. Using these models, we aim to develop a qualitative and quantitative understanding of biologically mediated cycling effects as well as the abundance and bio-availability of P and S throughout the depth of a soil profile. Our P and S models are being developed in tandem with a series of experiments carried out at the Department of Life Sciences at the University of Limerick. Laboratory experiments involve planting soil columns with English ryegrass and applying phosphate and sulphate fertilizers. Some preliminary modelling and experimental results will be presented in this talk.

This research was supported by Science Foundation Ireland under grant number SFI/13/IA/1923.

Keywords: nutrients, cycling, phosphate, sulfate, agriculture, microbes

Water Quality and Resources 3

The ecological impacts of cattle access on freshwater ecosystems

Matt O'Sullivan[1], Daire Ó hUallacháin[2], Patrícia Oliveira Antunes[3], Eleanor Jennings[3], Suzanne Linnane[3], Sarah Murnaghan[3], Fiona Regan[4], Mary Kelly-Quinn[1]

[1]School of Biology and Environmental Science, Freshwater Ecology Research Group, University College Dublin, Dublin, Ireland.

[2]Teagasc, Johnstown Castle Research Centre, Wexford, Ireland.

[3]Centre for Freshwaters and Environmental Studies, Dundalk Institute of Technology, Dublin Road, Dundalk, Co. Louth, Ireland.

[4]MESTECH, Dublin City University, Glasnevin, Dublin, Ireland.

Corresponding Author Email Address: matthew.o-sullivan.1@ucdconnect.ie

Pollution related to agriculture poses a serious threat to freshwater ecosystems and drinking water quality. In Ireland, agricultural activities make up 65% of total land use with cattle related activities dominating the landscape. Where cattle have access to freshwater bodies, water quality deterioration via stream bank degradation, habitat homogenisation and nutrient enrichment can occur. Empirical evidence is largely of US and Australasian origin although research in the context of Western Europe is growing. In Ireland, seasonal effects of cattle access on high order, lowland rivers have been detected. However, little evidence exists in relation to low order streams. These small streams form 77% of the river network in Ireland and are highly vulnerable to pollution impacts due to their high connectivity with agricultural land and low dilution capacity. In 2016 a national, multi-institute study on the potential impacts of cattle access on stream water quality was initiated. It also involves an assessment of the environmental, ecological and socio-economic impact of existing and potential measures that prevent cattle access to watercourses. This paper reports on a component of this study which has assessed the potential impacts of cattle access on first and second order streams through investigations of macroinvertebrate and floral communities as well as the levels of sedimentation upstream and downstream of the access points. Macroinvertebrate communities have been sampled in spring and autumn. Analysis of the spring data has revealed statistically significant impacts at certain cattle access points largely due to reductions in abundances of certain ephemeropteran species and increases in sediment tolerant Oligochaeta and Chironomidae. Significant increases in deposited sediment mass were also recorded at a number of cattle access points during the autumn sampling season.

Keywords: benthic ecology, cattle, sediment

Water Quality and Resources 3

Candidate method identification for arsenite detection and quantification in water using optochemical strategies

Annija Lace[1], David Ryan[1], John Cleary[1]

[1]EnviroCore, Institute of Technology Carlow, Kilkenny Road, Carlow, Ireland.

Corresponding Author Email Address: John.Cleary@itcarlow.ie

Arsenic is very toxic in its inorganic form particularly in the arsenite form which is one hundred times more toxic than arsenate (Tuzen, 2010). Because of its toxicity arsenic is listed as apriority hazardous substance under the European Directive on Environmental Quality Standards (Directive 2008/105/EC). The greatest threat to public health due to arsenic originates from contaminated groundwater. In order to monitor arsenic concentration in water resources, reliable, highly sensitive and selective monitoring methods are needed. At the moment water quality assessments are mostly based on manual sampling and laboratory analysis using standard laboratory techniques such as atomic absorption spectroscopy, mass spectroscopy and ion exchange chromatography. Although these methods are reliable and sensitive the cost is very high. Alternatively autonomous monitoring systems can be used for water monitoring. Autonomous devices for detection and quantification have been developed for analytes such as phosphate, nitrate, ammonia and pH (Cleary, Maher and Diamond, 2013). There are, however, only few commercially available systems for arsenic quantification. Autonomous monitoring systems based on microfluidic chips combined with suitable colorimetric methods would enable more time and cost efficient arsenic quantification in water. The aim of this research is to identify and assess candidate colorimetric methods for arsenite detection in water. Following an extensive literature analysis and method selection process, preliminary assessment of method's performance was carried out using UV-vis spectroscopy as a standardized method. The best performing methods were selected for further assessment and optimization. This project will improve the range of techniques available for water monitoring and water quality analysis.

Keywords: heavy metals, colorimetric methods, microfluidics

Water Quality and Resources 3

How do river channels and their floodplains adjust to changes in flood flows?

Patrick Belmont[1,2], Bruce Call[1]

[1]Department of Watershed Sciences, Utah State University, Logan, Utah 84322, USA.

[2]Geography Department, National University of Ireland, Galway, Galway, Ireland.

Corresponding Author Email Address: patrick.belmont@usu.edu

Traditional floodplain inundation models typically rely on the assumption of stationary flood frequency distributions and static channel hydraulic geometries. However, changes in climate, land cover, or water management have been shown to systematically shift the mean, variance and skew of flood flows. Some amount of change in the flood regime will be absorbed by changes in the channel conveyance, via changes in channel width and/or depth. Therefore, predicting the magnitude and frequency of floodplain inundation in response to a change in flood flows is not trivial. We present a numerical model that predicts changes in channel geometry and floodplain inundation in response to a time series of synthetically generated floods. Flood time series are generated by pulling random values from generalized extreme value probability density functions (PDFs) with specified mean, variance and skew. To simulate non-stationary flood flows, we modify the mean, variance and/or skew of the governing PDF during each run. Theoretical results suggest that a river's floodplain inundation regime is more sensitive to changes in variance of the flood frequency PDF than to changes in the mean. We illustrate the relevance of the model with several examples from the upper Midwestern USA, where streamflow has changed drastically and variably with 5% exceedance flows increasing 60-100% in recent decades, as increases in precipitation have been amplified by agricultural land management and artificial drainage. We document significant, spatially variable changes in the width of mainstem channels and discuss implications for floodplain inundation, flood routing and flood risk mapping in Ireland.

Keywords: flood risk, floodplain, river channel morphology

Water Quality and Resources 3

Pumps as turbines technology for energy recovery from water supply systems

Daniele Novara[1], Aonghus McNabola[1]

[1]Department of Civil, Structural and Environmental Engineering, Trinity College Dublin, Ireland.

Corresponding Author Email Address: novarad@tcd.ie

The Dŵr Uisce project began in 2016 as cooperation between Trinity College and Trinity Business School (Dublin, IE) and Bangor University (Bangor, UK). Its main aim is to increase the sustainability of water sectors in Ireland and Wales, moving towards less energy intensive, CO_2-free, smart and reliable Water Supply Systems (WSS). Among the investigated practices and technologies, the implementation of Micro-Hydropower (MHP) schemes to exploit the existing potential along WSS and generate renewable energy is seen as a promising strategy. Current limits to the application of MHP to drinking water networks however include lack of knowledge on small-scale hydro turbines and the relatively high investment cost required for such small projects. A promising technology of water turbines characterized by low purchase cost and simple maintenance is that of reverse running pumps, also known as Pumps as Turbines (PAT). Within the Dŵr Uisce project a procedure to design a MHP scheme adopting PAT technology has been developed, enabling the choice of the optimal pump type and dimensions for a determined site within a WSS. Besides, a cost analysis has been carried out to predict the purchase price of a PAT and connected asynchronous motor/generator unit. Results show that PATs can work with acceptable efficiency as generating technology in MHP schemes, having a cost per kW installed between 4 and 12 times lower than hydraulic turbines of conventional design. A planned extension of the work carried out is the design a full-scale (75 kW) demonstration MHP plant to be built in North Wales exploiting the potential energy of water at the outfall of a Wastewater Treatment Plant. Prior to pilot plant realization, in order to assess and verify the proposed design guidelines, a scaled lab model of Welsh plant will be tested at Trinity College Dublin facilities during 2017.

Keywords: cost analysis, energy recovery, micro-hydropower (MHP), pump as turbine (PAT), water supply systems (WSS)

Waste Management 2

Backcasting: a means to deliver sustainable healthcare priorities

Yvonne Ryan-Fogarty[1], Bernadette O'Regan[1], Richard Moles[1]

[1]Centre for Environmental Research, University of Limerick, Limerick, V94 T9PX, Ireland.

Corresponding Author Email Address: yvonne.ryan@ul.ie

Healthcare has significant impacts on the environment however implementation of environmental protection measures proves difficult due to constraints arising from aging infrastructure, resource scarcity and the primacy of patient wellbeing and safety. Complex problems necessarily require a suite of carefully considered solutions, with attention to a range of stakeholders, therefore finding solutions requires novel approaches. This paper presents findings from an Environmental Protection Agency project to develop frameworks to evaluate environmental impacts of infant feeding. In particular, the use of backcasting methods, where future visions aligned key health (*WHO Global Strategy on Infant and Young Child Feeding and HSE Infant Feeding Policy*) and environmental (*EU Waste Framework Directive*) policies. Problem orientation showed that ~800,000 bottles of ready to use breast-milk substitute are purchased per annum, 61% of contents go to waste. This is caused by quantities required, hospital policies on use, and sizing of bottles relative to infant stomach capacity. Backcasting methods revealed 15 alternative solutions for avoidance and management. Solutions included waste prevention techniques, product innovation, procurement and waste management practices. Competency framework analysis revealed >20 stakeholders who require awareness or specialised training as a result. Opportunities for economic, social and environmental gain were identified. Breastfeeding provides significant waste avoidance and has proven wider public health ramifications protecting from ill health, thereby reducing overall healthcare demand. Where this is not possible product redesign and access to healthcare professionals to help new parents with infant feeding can further reduce waste. Producer responsibility, for example, smaller portions, decanting solutions or a return to powdered infant formula shows promise. Initial problem orientation and scenario development were conducted as a back office exercise, findings of which have recently been verified using real data from maternity services. This demonstrates the effectiveness of backcasting methods where policy frameworks exist and targets can be established.

Keywords: green healthcare, food waste, sustainable health, backcasting, scenarios, policy development

Waste Management 2

Assessing the potential for industrial symbiosis in Ireland

Rosemarie D. Mac Sweeney[1], Niall P. Dunphy[1], Donald Lyons[2]

[1]Cleaner Production Promotion Unit, School of Engineering, University College Cork, Ireland.

[2]Head of Department (Geography), Geography Building, University College Cork, Ireland.

Corresponding Author Email Address: rmacsweeney@ucc.ie

The EEA estimate that the current ecological footprint of the EU is more than double its biological capacity – meaning that more than two planets are needed to sustain our way of life. The biosphere simply cannot keep up with the rate of anthropocentric consumption of materials and energy and associated generation of waste. To address this problem, society needs to become more resource efficient *i.e.*, reducing the amount of materials used and the amount of waste produced – treating waste as a resource is a key part of resource efficiency. The concepts of industrial ecology and industrial symbiosis use the metaphor of a natural ecological system to consider a model of an industrial system that operates in a closed loop reusing all materials and energy in an endless cycle, wherein the technosphere mimics the biosphere, and a circular economy develops. In such a scenario – all waste is a resource that can be exchanged, re-used or recycled elsewhere in the system. Industrial symbiosis specifically relates to the creation of networks of industries or organisations sharing reusing, redistributing and recycling each other's waste materials, energy, water and by-products (Kalundborg, Denmark being an exemplar case). Such networks typically comprise a range of diverse organisations that are traditionally separate industries and do necessarily have other links – while geographic proximity is useful, co-location is not a prerequisite. While Ireland does not currently have any fully-fledged examples of industrial symbiosis as yet, our research shows that resource exchanges are already taking place across the country – albeit at a relatively low level. This paper presents research undertaken in Ireland to assess the prospects for industrial symbiosis. The study uses a mixed methods approach including, extensive documentation reviews and semi-structured in-depth interviews with diverse stakeholders to ascertain the potential for, and to identify barriers to, industrial symbiosis in Ireland.

Keywords: industrial symbiosis, industrial ecology, circular economy, closed loop systems, material and energy flows, biosphere, technospere, waste, resource exchange, re-use, recycling

Waste Management 2

Evaluation of a reuse technology for bauxite residue – Extraction of critical raw materials

Éva Ujaczki[1], Patricia Cusack[2], Teresa Curtin[3], Ronan Courtney[2], Lisa O'Donoghue[1]

[1]School of Engineering, University of Limerick, Limerick, Ireland.

[2]Biological Sciences Department, University of Limerick, Limerick, Ireland.

[3]Chemical Sciences Department, University of Limerick, Limerick, Ireland.

Corresponding Author Email Address: Eva.Ujaczki@ul.ie

The world economy is confronted with an increasing supply risk of critical raw materials. These are defined as materials with high supply risk and above average economic importance compared to other raw materials. In the search for alternative sources, bauxite residue may offer potential. Bauxite residue or red mud is a major by-product of the aluminium industry, with an annual global production of 150 million tonnes and a total inventory of 2.7 billion tonnes. Depending on the source, bauxite residue can contain considerable amounts of critical raw materials and its extraction may be economically feasible. However, a detailed inventory of critical raw materials with their economic value in bauxite residue does not currently exist. This research, therefore, discusses the possibility of recovering economically interesting elements from bauxite residue. An extensive inventory of critical raw materials, including rare earth elements, in bauxite residue was created using thermogravimetric analysis (TGA), differential scanning calorimetry (DSC), scanning electron microscopy (SEM), X-ray diffraction (XRD), energy-dispersive X-ray spectroscopy (EDS) and microwave-assisted aqua regia digestion with subsequent inductively coupled plasma optical emission spectrometry (ICP-OAS) analysis. Furthermore, the extraction of valuable elements from bauxite residue by selective acid leaching was explored. A number of mineral acids (hydrochloric, sulfuric, nitric) were investigated for the extraction process in addition to a low molecular weight organic acid (oxalic acid). This acid can be biologically produced and can be considered a greener alternative to the mineral acids.

Financial support for this project was provided by The Irish Environmental Protection Agency (2014-RE-MS-1).

Keywords: bauxite residue, critical raw materials, hydrometallurgy

Waste Management 2

Preliminary investigations on the utilisation of vermitea as an alternative nutrient source for plant growth

Mary Fitzpatrick[1], Andrew Lloyd[1], Thomais Kakouli-Duarte[1]

[1]EnviroCore, Molecular Ecology and Nematode Research Group, Department of Science and Health, Dargan Centre, Institute of Technology Carlow, Kilkenny Road, Carlow, Ireland.

Corresponding Author Email Address: mary.fitzpatrick@itcarlow.ie

The use of chemical fertilisers is an issue which is becoming apparent in recent times. Both the environmental and financial impact of chemical synthetic products, which aid in the enhancement of plant growth through the provision of essential macro and micronutrients, is enormous. The effects of chemical fertilisers can vary from the pollution of waterbodies, ecosystems and ground and surface waters, to potential threats to human health. This work looks at the possibility of using vermitea, as an alternative and sustainable plant nutrient source. Vermitea is an organic solution derived from vermicompost which in turn is a product of the vermicomposting process. Vermicomposting is a novel approach which utilises earthworms to treat raw vegetable and fruit waste. Preliminary trials are conducted to (1) determine an optimum preparation protocol for vermitea, which reflects the nutrient concentration required to enhance plant growth, and (2) investigate the ability of vermitea to aid seed germination. The essential macronutrients nitrogen (N), phosphorous (P) and potassium (K) are analysed using UV spectroscopy, and seed germination is recorded over time and various vermitea concentrations. These experiments are currently ongoing and their results will be discussed in the context of the overall aim of this project.

Keywords: chemical fertiliser, vermitea, nutrients

Environmental Policy and Communication

Mobilising finance for conservation: a national biodiversity expenditure review for Ireland

Rachel Morrison[1], Craig Bullock[1]

[1]UCD Planning and Environmental Policy Research Group, Richview Building, University College Dublin, Dublin 17, Ireland.

Corresponding Author Email Address: rachel.morrison@ucd.ie

Recent estimations highlight that finance for biodiversity conservation is at only a fraction of projected needs. The mobilisation of greater public and private finance is widely acknowledged as a key challenge to achieve internationally agreed objectives to halt biodiversity decline. Although the scaling-up of finance for biodiversity conservation is considered critical, historically, the availability of information and research on biodiversity finance has been scarce. Over the decade there has been a growing emphasis on financial reporting in the conservation sector, and a proliferation of researchers, governments and multi-national organisations undertaking what can be best described as Biodiversity Expenditure Reviews in order to track, analyse and understand flows of international and domestic conservation finance. The term Biodiversity Expenditure Review is used to collectively describe audits of the financial resources available for conservation, and seen as a means to understand who spends on conservation, how much, which domains of biodiversity receive funding and, therefore, how effectively funding is being used. Not only are expenditure reviews portrayed as a means to improve our understanding of conservation financing they are also idealised as accountability exercises, means to track commitments to the CBD and attitudes towards conservation, opportunities to better coordinate funding sources, and even foster national dialogue and discussion on biodiversity conservation. However, there is no internationally agreed methodology for biodiversity expenditure reviews and a high degree of variability is evident in the remit, scope and scale of existing national biodiversity expenditure reviews. This presentation critically examines the process of conducting a biodiversity expenditure review for Ireland, highlighting some of the key methodological choices and issues, and reflecting on the value and utility of these financial reviews as tools for the discussion and mobilisation of finance for conservation.

Keywords: conservation finance, biodiversity expenditure reviews, financial reporting, biodiversity conservation

Environmental Policy and Communication

Sustainable voluntary urban communities: supports for sustainable development actions

Anne Bennett[1], Rosemary Byrne[1], Bernadette O'Regan[1]

[1]Centre for Environmental Research, University of Limerick, Limerick, V94 T9PX, Ireland.

Corresponding Author Email Address: anne.bennett@ul.ie

The principal context for this research is that well planned Sustainable Urban Development (SUD) helps achieve national environmental policy targets. Communities in other countries implemented ambitious SUD programmes, resulting in greater environmental and socio-economic gains. EU sustainable communities have gained certification to schemes such as the Europan Energy Award and Covenant of Mayors, which are important in accessing finance, acknowledging progress, and providing incentives for further actions. With few exceptions, Irish communities have not done so and are therefore not in a position to avail of socio-economic advantages associated with SUD. 'Community' here refers to 'bottom-up' organisations of people living in urban settlements or neighbourhoods who voluntarily organise themselves to achieve more sustainable lifestyles. They may work closely with Local Authorities, but themselves decide what actions to take. Motivation varies greatly, but important is the desire to 'do the right thing'. However, frustration over inability to achieve significant movement towards sustainability often results in burn out and loss of cohesion in the community. Funded by the Environmental Protection Agency, researchers in the Centre for Environmental Research (CER), UL, worked with Irish communities to identify aids and barriers to motivation and activity. Additionally, they developed and successfully trialled a method for measuring the effect on sustainability of different community-led actions (SEMPRe). While this work generates technical and academic information, it is not easily accessed or understood by communities. Discourse revealed that communities struggle to achieve all objectives, due to deficient technical information, and difficulty understanding implications of information provided by 'top-down' organisations. Currently, CER are assembling technical, financial and legal information proven relevant to Irish and EU communities. From this, an on-line decision support tool specifically for communities will be developed. Interactive and accessible, the tool will provide access to community relevant information, supported by regularly updated financial and legal manuals.

Keywords: sustainable urban development, legal and financial opportunities and constraints, interactive decision support tool

Environmental Policy and Communication

Catchments.ie – communicating the story of water from source to sea

Paddy Morris[1], Donal Daly[1], Marie Archbold[1], Jenny Deakin[1]

[1]Environmental Protection Agency

Corresponding Author Email Address: p.morris@epa.ie

The EPA assesses water quality for river, lake, transitional and coastal waterbodies across Ireland as part of Water Framework Directive (WFD) characterisation. The EPA has developed a structured database to store and analyse information on water quality, and is using over 140 datasets to assign a Risk score to almost 5,000 waterbodies to help decide on appropriate actions to protect or restore waterbodies to favourable status (*i.e.* High or Good). For this cycle of the WFD, Integrated Catchment Management has become the agreed approach to achieve WFD objectives and sustainable use of water and land resources. This will involve collaboration and partnership between local communities, public bodies, the private sector and charities/NGOs. To support this as much information and data as possible is being made public. A website www.catchments.ie has been launched as an inter-agency collaboration between the EPA, the Department of Housing, Planning, Community and Local Government and the new Local Authorities Waters and Communities Office. It provides data, graphics and mapping to give a comprehensive picture of water quality – status, trends and future risks - across Ireland as a means of promoting understanding and participation by the general public and specialists alike. The website has been built with open source software, and as much data as possible are Open Data. A new quarterly 'Catchments Newsletter' is highlighting science, policy, and the work of local communities around Ireland. A key focus of this is sharing stories of what works to encourage social learning. The website will support public consultation on the River Basin Management Plans for the 2nd Cycle of the WFD in the first half of 2017. This talk will highlight this new approach to how we talk about and value water, and the data sources and tools used to assess and protect the health of our waters.

Keywords: water, communications, catchments, policy, story, science, social learning, values

Environmental Policy and Communication

Particulate matter from diesel vehicles: Emission & exposure in Dublin

Meabh Gallagher[1], Aonghus McNabola[1], Balz Kamber[2], Laurence Gill[1], Bidisha Ghosh[1], Saniul Alam[1]

[1]Department of Civil, Structural and Environmental Engineering, Trinity College Dublin, Ireland.

[2]Department of Geology, Trinity College Dublin, Ireland.

Corresponding Author Email Address: megalag@tcd.ie

Particulate Matter is one of the most problematic pollutants across Ireland, and recently the associations between exposure to ambient particulate matter and adverse health outcomes have been more firmly established. Diesel vehicles in particular are known for their significant contribution to overall emissions of particulate matter ($PM_{2.5}$) in the atmosphere, and therefore constitute a significant threat to public health and the environment. A recent investigation of national emissions in the road transport sector in Ireland has highlighted that private diesel passenger vehicles contribute the largest proportion of total emissions in both CO_2 and particulate matter of all vehicle categories. Owing to the recent growth in private diesel vehicles since 2008, this vehicle category represents a significant pressure on the quality of the urban environment in Ireland. Determination of the proportion of total $PM_{2.5}$ concentration in urban areas, which has originated from diesel vehicle emissions using source apportionment techniques, is invaluable in assessing the impact of diesel emissions on population exposure in Ireland. We are generating evidence on the impact of diesel vehicles in Ireland on the exposure of the population to $PM_{2.5}$, through field measurement of ambient $PM_{2.5}$ and direct sampling of $PM_{2.5}$ sources. Here we present a substantial dataset of chemical fingerprints of the major sources of $PM_{2.5}$ in Dublin. These include a wide variety of vehicular exhaust emissions, solid fuels including wood, peat and coal, sea-spray, mineral dust and road dust. Additionally, 24 hr samples of ambient $PM_{2.5}$ are being collected at a number of sites representative of residential and roadside microenvironments, and also in critical indoor locations such as the home and workplace. This paper's aim is to develop a source apportionment model for attributing ambient $PM_{2.5}$ in Dublin to these various sources, and estimate the contribution of $PM_{2.5}$ that can be attributed to emissions from diesel vehicles.

Keywords: particulate matter, $PM_{2.5}$, diesel emissions, source apportionment

Marine and Coastal 1

Monitoring internal moisture and salinity changes in Irish coastal sand dunes

Ciaran Nash[1], Mary C. Bourke[1]

[1]Department of Geography, School of Natural Sciences, Trinity College, Dublin 2, Ireland.

Corresponding Author Email Address: nashci@tcd.ie

Coastal sand dune systems are among the most physically dynamic landscapes; their susceptibility to geomorphic change is rooted in a host of interconnected processes and feedbacks. Soil moisture and salinity are fundamental environmental variables capable of exerting a geomorphic influence but have not been thoroughly investigated in coastal dunes. In northwest Europe, dunes are predominantly sediment-limited systems with reduced capacities to avoid severe morphological changes arising from storms. Climatic changes are predicted to manifest as more frequent and intense storms with the potential to enact severe geomorphic change in coastal environments. A lack of data pertaining to internal dune hydrosaline dynamics suggests we are missing part of the bigger picture. We conducted a pilot study of moisture and salinity dynamics within the upper 50 cm of the vadose zone of a vegetated dune system at Golden Strand, Achill Island. Golden Strand is a roughly 800 m long embayed sandy beach, backed by vegetated dunes that protect a low-lying machair grassland. A study transect was established across this dune-machair system, perpendicular to the shore. I nnovative instrumentation in the form of capacitance probes and internal dune thermochrons were deployed at 10 cm depth intervals sampling every 10 minutes and coupled with on-site rainfall data. Results indicate that dune moisture tracks rainfall inputs up to 30 cm depth. Antecedent moisture at depth was found to influence infiltration of water through the dune profile. Salinity within the study transect decreased with distance from the beach, suggesting that salt spray is the primary salt delivery mechanism in the dune system. We also noted that moisture and salinity below 30 cm depth failed to respond to rainfall events of varying intensities. Relatively constant moisture and salinity were observed at all depths within the machair. Predictions of climatic change for Ireland suggest more intense short-period precipitation events, this may increase infiltration depth. Baseline data collected will prove informative in predicting the response of Irish coastal dunes via changes in vegetation and dune stability.

Keywords: coastal, geomorphology, sand dunes, moisture, salinity

Marine and Coastal 1

Re-inventing the wheel: an alternative fisheries management system

Debbi Pedreschi[1], Hannes Höffle[2], Sarah Kraak[3], Amos Barkai[4], Keith Farnsworth[2], David Reid[1]

[1]Marine Institute, Rinville, Oranmore, Co. Galway, Ireland.

[2]School of Biological Sciences, Queen's University Belfast, 97 Lisburn Road, Belfast, BT9 7BL, Northern Ireland.

[3]Thünen Institute of Baltic Sea Fisheries, Alter Hafen Süd 2,18069 Rostock, Germany.

[4]Olrac-SPS, Silvermine House, Steenberg Office Park, Tokai, Cape Town, South Africa.

Corresponding Author Email Address: debbi.pedreschi@marine.ie

Distribution and overlap between fish populations frequently changes on small spatial and short temporal scales. In mixed fisheries, avoidance of one species whilst targeting another requires fine spatial and temporal knowledge. Current management strategies are unable to account for these characteristics, generally operating at large scales and based on annual assessments. Increasing awareness of the need to manage fisheries within an ecosystem approach, along with a growing dissatisfaction with the complexity and ineffectiveness of the status quo has led to a growing push for alternative management strategies. Real-time Incentives (RTI) offer a viable alternative to current management systems, one that can operate on finer spatial and temporal scales, incorporate management for important ecosystem components, and serve to simplify rules for both management and fisheries, whilst providing choice to fishers and incorporating their views. RTI uses fishery and ecological data to calculate tariff maps, internalising costs and leaving fishers free to determine their best tactics to maximise profit sustainably. Here we illustrate the RTI system, and provide details as to how we are currently testing it via a management strategy evaluation (MSE) approach.

Keywords: real-time incentives, fisheries management, stakeholder engagement, management strategy evaluation

Marine and Coastal 1

DiscardLess: Assessment of some impacts of the landing obligation and the development of tools and strategies to achieve its goals within the Irish fishing fleet

Julia Calderwood[1], Dave Reid[1]

[1]The Marine Institute, Rinville, Ornamore, County Galway, H91 R673, Ireland.

Corresponding Author Email Address: Julia.calderwood@marine.ie

The 2013 reform of the EU Common Fisheries Policy came into force in January 2014 and included a Landing Obligation whereby the discarding of quota species will be prohibited by 2019. This represents a major change for the management of EU fisheries and will introduce a number of challenges to the Irish fleet, particularly in the demersal mixed fisheries fleet segment. DiscardLess, a Horizon2020 funded project, aims to provide the knowledge, tools and methods required for the successful reduction of discards in European fisheries. By adopting a collaborative approach between scientists, stakeholders and policymakers DiscardLess will provide relevant and cost effective strategies to assist in achieving the goals of the Landing Obligation. To examine the impact of the Landing Obligation on the Irish fishing industry and explore possible mitigation strategies we conducted trials on commercial fishing vessels in 2015. Skippers were challenged to reduce levels of unwanted catches as much as possible through the adoption of existing technical measures and/or adjustments to their fishing behaviour and tactics. The trials had mixed success and for the demersal whitefish vessel involved the adoption of tactical measures failed to reduce unwanted catches or reduce the economic impact of the Landing Obligation. As a result we have examined fishing behaviour amongst the Irish fleet to determine what motivates fishing strategies and how best tactical decisions can be made to avoid unwanted catch. We have further produced maps using survey data collected by the Marine Institute to identify discarding hotspots thus providing tools that can inform best practise under the Landing Obligation. By arming the industry with such knowledge and information it is hoped the Irish fishing fleet can remain economically viable whilst operating under the Landing Obligation.

Keywords: landing obligation, common fisheries policy, discards, fisheries, marine

Environment and Human Health 1

Engagement with nature: An exploratory study of 'savouring' nature among college students

Tadhg MacIntyre[1], Aoife Donnelly[1], Giles Warrington[1], Andree Walkin[2], Nollaig O'Sullivan[1], Christopher Madan[2]

[1]Health Research Institute, University of Limerick, Ireland.

[2]Department of Psychology, Boston College, USA.

Corresponding Author Email Address: tadhg.macintyre@ul.ie

Nature based solutions to well-being have been suggested as a means of jointly tackling several societal challenges. Among the main challenges are climate change, physical inactivity mental health issues and positive attitudes towards the environment. Engagement with nature, through for example green exercise (physical activity in natural settings) is one possible solution to these broader problems. A consistent issue for researchers is the extent to which participants are attending to natural stimuli while performing exercise in this context. This concept of engagement has been explored by researchers, using the idea of 'savouring' from positive psychology. Savoring is a form of emotion regulation used to prolong and enhance positive emotional experiences. In a recent study, Passmore and Holder (2016) reported that a two-week savouring intervention increased positive affect and prosocial orientation among a 'nature' group when compared to controls. Students were allocated to one of three groups of students and were required to photograph and assign emotions and descriptions to the images (G1: natural settings; G2: built environment; G3 control condition. The current study attempted to advance upon the previous findings by including measures of individual differences relating to emotion regulation, cognition and familiarity with natural stimuli. The aim of the study was to investigate if these variables moderated the savouring effect. In addition, post-hoc comparisons of the images chosen by the participants were analysed for visual complexity and ratings of pleasantness by the participants. Thirty participants volunteered to engage in the two-week campus-based intervention. While maintaining their normal commuting routes across campus students were asked to take photographs when they noticed that a specific object or scene evoked a strong emotion. The findings of this study will be discussed in light of the need for methodological rigour in the exploration of nature-based solutions for well-being.

Keywords: green exercise, attention restoration theory, nature-based solution, well-being, attention

Environment and Human Health 1

Influence of ambient temperature on biosand filter performance for domestic drinking water treatment

Greg Beechinor[1], Deborah V. Chapman[1]

[1]School of Biological, Earth and Environmental Sciences, University College Cork, Ireland.

Corresponding Author Email Address: greg.beechinor@umail.ucc.ie

Biosand filters (BSFs) are small-scale, intermittently-operated, slow sand filters used for domestic drinking water treatment in developing countries in the absence of a piped water supply. Given the geographical distribution of BSFs the operating temperature of filters is expected to vary. The aim of this study was to determine the effect of ambient temperature on filter performance relating to the removal of a microbial indicator organism and the development of the schmutzdecke. Six laboratory scale filters were used in the study, with triplicate filters being operated in parallel at two different temperatures (10 ± 1˚C and 26 ± 1˚C). Filters were fed once daily with river water spiked with E. coli. Analysis of feed and filtered water included, pH, DO, EC, TON, nitrite, orthophosphate, DOC, UV_{254} and E. coli colony forming units. Changes in the metabolic activity and diversity of the schmutzdecke were determined using Ecoplates™ (Biolog, UK). Filters operated at the lower temperature (10 ˚C) had a higher mean E. coli $\log_{10}$ reduction (1.48 $\log_{10}$) when compared to the filters operated at 26 ˚C (1.18 $\log_{10}$). Filtered water from the 26 ˚C filters had a lower nitrate and nitrite concentration and higher DO consumption when compared to filters operated at the lower temperature. The highest removal of *E. coli* was found to occur in the top 5 cm of the sand column in both temperature treatments.

Keywords: biosand filters (BSFs), household water treatment, drinking water, *E. coli*

Environment and Human Health 1

Using Geographic Information Systems to map human cases, and risk of shiga-toxigenic Escherichia coli in the west of Ireland

Carina Brehony[1], John Cullinan[2], Belinda Hanahoe[3], Martin Cormican[1,3], Dearbháile Morris[1]

[1]Antimicrobial Resistance and Microbial Ecology Group, School of Medicine, National University of Ireland, Galway, Ireland.

[2]School of Business & Economics, National University of Ireland, Galway, Ireland.

[3]Department of Medical Microbiology, University Hospital Galway, Galway, Ireland.

Corresponding Author Email Address: Dearbhaile.Morris@nuigalway.ie

Shiga-toxigenic *Escherichia coli* (STEC) are pathogenic *E. coli* that cause infectious diarrhoea that can lead to significant outcomes in some populations such as renal failure and death. The incidence of laboratory detected human infection due to STEC in Ireland is the highest in Europe. Private water supplies are associated with the majority of waterborne outbreaks of STEC infection in Ireland. The aim of this project was to examine the spatial incidence of human infection with STEC in a region with a reported high incidence of number of cases annually. A total of 542 anonymised confirmed STEC patient records were obtained for the Irish Health Service Executive West (HSE-W) region, with metadata including; location (District Electoral Division (DED)), date of sample, and gender. Population and water supply data were obtained from the Irish Central Statistics Office Census of 2011. ArcGIS was used to generate STEC incidence per 1000 by DED for the three-county HSE-W region. Incidence data used to identify hotspots and coldspots using the Getis-Ord Gi* spatial statistic. Incidence rate ranged from 0 to 13.76 cases per 1000 across the region. Initial analyses identified a number of hotspots/coldspots in the region under investigation. GIS analysis shows that STEC incidence shows significant local clustering. GIS is a valuable tool for public health and infectious disease epidemiology. In the case of STEC, this is particularly important in Ireland because so much of its transmission is unknown but risk factors such as private wells and ruminant animal contact have been identified. Here mapping was used to identify hotspots/coldspot areas within a HSE region with higher known incidence of STEC in Ireland. This will enable further analysis including the examination of potential risk factors such as water-source, socioeconomics and agricultural land use.

Keywords: STEC, *E. coli*, GIS, public health

Climate Change 1

The relationship between fluorescent particles and ice nuclei measured at two contrasting sites

David O'Connor[1], Ryan Mason[3], Min Si[3], Jixiao Li[2], Cedric Chou[3], Alan Bertram[3], Kyle Pierce[2], Dominique Baisnée[5], Roland Sarda Estève[5], John. A. Huffman[2]

[1]Dublin Institute of Technology, Dublin, Ireland.

[2]University of Denver, Denver, USA.

[3]Department of Chemistry, University of British Columbia, Vancouver, BC, V6T1Z1, Canada.

[4]Commissariat à l'Energie Atomique CEA/LSCE, Gif/Yvette, France.

Corresponding Author Email Address: david.x.oconnor@dit.ie

Recently there has been an increasing scientific interest in the evaluation and concentration determination of biological particles (pollen, fungal spores and bacteria) in the atmosphere. Such particles can indirectly affect the environment through their ability to act as ice nucleating particles (IN), thereby influencing the formation of clouds, their lifetimes and properties such as precipitation potential. However, few field studies have been performed to gauge the possible contributions of biological particles to such phenomena. A wideband integrated biological sensor (WIBS-4a) and a micro-orifice uniform-deposit impactor (MOUDI) were co-located at two sampling locations; one situated in Ucluelet, Canada (coastal site) and the other in Saclay, France (semi-urban site). Using the WIBS instrument, fluorescent particles were counted and categorized into classes defined by the channels of fluorescence each particle exhibited. Unique trends in size-resolved diurnal distributions were observed for the seven categories. Particle concentrations from each of the seven WIBS particle categories were compared to corresponding IN concentrations obtained using the MOUDI instrument. The quality of fit between fluorescent particle number and IN number varied significantly depending on the fluorescent particle categories used for the correlation, suggesting that not all fluorescent particle types exhibit the same ice nucleating ability. This data will present the beginning point for discussion regarding what particle types may contribute overall IN particle loading.

Keywords: bioaerosols, ice nuclei, wibs

Climate Change 1

Integrating GIS and modelling approaches for precise estimation of SOC stocks and their historical changes for different agricultural land uses in Ireland

M. Ibrahim Khalil[1], B. Osborne[1]

[1]UCD School of Biology and Environmental Science and UCD Earth Institute

University College Dublin, Belfield, Dublin 4, Ireland.

Corresponding Author Email Address: ibrahim.khalil@ucd.ie

The reduction of greenhouse gas (GHG) emissions and the reliable quantification of the GHG offsetting potential of soil organic carbon (SOC) accumulation are a global concern. Data generated previously through overlaying Land Parcel Identification Systems (LPIS) information and soil databases, such as the National Soil Database (NSDB) and the EPA Indicative Soil Types (ISTs), using GIS approaches, were reprocessed. These data were synthesized to improve non-linear depth-distribution models and pedotransfer functions, with R2 ranging from 0.53 to 1.00, to better represent soil types and depths, and improve estimations of SOC concentration and bulk density. The historical LPIS database (2000-2014) was used to categorize key land uses (LUs) such as grassland (G), rough grazing (R), tillage (T) and their rotations (GR, GT, RT), and the respective SOC concentrations. SOC densities/stocks in the different LUs and their rotations on mineral, organo-mineral and organic soils were also assessed. In the 0-10 cm layer, the weighted average of SOC density was higher from GR, R and RT (85-92 t ha^{-1}) than other LUs (30-56) with the lowest from tillage. Corresponding values for LUs in the 0-30 cm layer was 260-301 and 79-150 t ha^{-1}. In the 0-100 cm layer, the values were significantly higher from GR (1003 t ha^{-1}) than R (657) and RT (516) followed by the other LU categories (213-305). SOC density was exceptionally higher for RT on organo-mineral soils, (85 t ha^{-1}), requiring field investigation to provide more robust estimates, than for GT (46). The national share for grassland (G+R+GR), GT, T and RT was 87, 10, 1 and 1% of the total stocks: 270, 789 and 1894 Tg for the corresponding soil layers. The findings imply that these combined approaches could reliably estimate SOC density and stock change in agricultural LUs, and their GHG offsetting potential.

Keywords: depth distribution models, pedotransfer functions, GIS approaches, SOC densities and stocks, agricultural land uses and land use changes

Climate Change 1

Ensemble of Regional Climate Model Projections for Ireland

Paul Nolan[1,2], Ray McGrath[3]

[1]Irish Centre for High-End Computing (ICHEC), Dublin, Ireland.

[2]Met Éireann, Research and Applications Division, Dublin, Ireland.

[3]School of Mathematical Sciences, University College Dublin, Ireland.

Corresponding Author Email Address: paul.nolan@ichec.ie

The method of Regional Climate Modelling (RCM) was employed to assess the impacts of a warming climate on the mid-21st-century climate of Ireland. The RCM simulations were run at high spatial resolution (~4 km), thus allowing a better evaluation of the local effects of climate change. To address the issue of uncertainty, a multi-model ensemble approach was employed. Through the ensemble approach, the uncertainty in the projections can be partially quantified, thus providing a measure of confidence in the predictions. The COSMO-CLM and WRF RCMs were used to downscale the Max Planck Institute ECHAM5, UK Met Office HadGEM2-ES, Canadian Climate Centre CGCM3.1 and the EC-Earth consortium GCMs. To account for the uncertainty in future emissions, a number of scenarios (B1, A1B, A2, RCP4.5 and RCP8.5) were used to simulate the future climate. The projections for mid-century indicate an increase of 1–1.6°C in mean annual temperatures, with the largest increases seen in the east of the country. Warming is enhanced for the extremes (i.e. hot or cold days). Averaged over the whole country, the number of frost days is projected to decrease by over 50%. The projections indicate an average increase in the length of the growing season of over 35 days per year. Results show significant projected decreases in mean spring and summer precipitation amounts by mid-century. The projected decreases are largest for summer, with "likely" reductions ranging from 0% to 20%. The frequencies of heavy precipitation events show notable increases (approximately 20%) during the winter and autumn months. The number of extended dry periods is projected to increase substantially during autumn and summer. The energy content of the wind is projected to significantly decrease for the future spring, summer and autumn months. The projected decreases are largest for summer, with "likely" values ranging from 3% to 15%.

Keywords: regional climate change projections Ireland

Marine and Coastal 2

Stress in aquaculture: The use of a biomarker to measure stress levels in farmed fish

Sandra Bohan[1], David Dowling[1], Rosemary O'Hara[1]

[1]EnviroCore, Department of Science and Health, Dargan Centre, Institute of Technology Carlow, Kilkenny Road, Carlow, Co. Carlow, Ireland.

Corresponding Author Email Address: sandra.bohan@itcarlow.ie

Stress is a non-specific response the body has in response to any demand (physical or biochemical) that has been placed upon it. Once a stress has been placed on the body the Acute Phase Reaction (APR) is activated to combat the stress and return the body to its normal physiological state. During the APR, certain proteins increase in concentration to combat the stress/inflammation. These are known as the Acute Phase Proteins (APP) and the protein of interest for this study is Serum Amyloid A (SAA) which has been found to increase by up to 1000-fold during the APR. Using *Oncorhynchus mykiss* as the initial test species, mRNA was extracted from the internal organs including the liver where the largest concentration of SAA has been found. Other organs investigated were the heart, kidney, spleen, reproductive organs and fatty tissue from below the ribs to determine the SAA levels in the fish. Testing to date correlates with previous studies which determined that the highest levels of SAA are found in the liver, however, high levels of SAA were also found in the heart and kidneys which has not been reported previously. The fatty tissue samples gave the lowest SAA levels measured in the study. Further investigation is needed to determine the reason for the high SAA levels in the heart and kidneys.

Keywords: APR, APP, SAA, *Oncorhynchus mykiss*, mRNA

Marine and Coastal 2

The point system for fishing vessels - dead in the water?

Laurie O'Keeffe[1]

[1]Sea-Fisheries Protection Authority, Clonakilty, Co. Cork, Ireland.

Corresponding Author Email Address: laurieok20@gmail.com

The point system for licence holders of EU fishing vessels was introduced in order to develop an immediate, common system of enforcement across Member States for serious infringements of the Common Fisheries Policy. The implementation of the point system in Ireland has been far from plain sailing, demonstrating the difficulty in reconciling the EU regulatory framework with Irish national law. The Statutory Instrument which purported to implement the point system was struck down by the High Court in two separate judicial review cases. This article examines the point system under the EU regulatory framework and why its implementation into Irish law did not stand up to judicial scrutiny, which may be relevant to any future administrative sanctioning systems introduced in Ireland. A proposal now exists to move the application of points to after the conclusion of criminal proceedings under national law against the Master of the vessel. The article analyses the feasibility of this proposal and suggests how the point system might be implemented successfully following on from the High Court judgments.

Keywords: common fisheries policy, point system, judicial review

Marine and Coastal 2

Developing real-time PCR assays for the rapid identification of marine Actinomycete

Ciara McDonnell[1], Damien Brady[2], Donal Eardly[2], Siobhan Kavanagh[2]

[1]Bioscience Research Institute, Athlone Institute of Technology, Dublin Road, Athlone, Co. Westmeath, Ireland.

[2]Department of Life and Physical Sciences, Athlone Institute of Technology, Dublin Road, Athlone, Co. Westmeath, Ireland.

Corresponding Author Email Address: c.mcdonnell@research.ait.ie

The development of blue sky marine biotechnology research has become a key national objective. With the emergence of multidrug-resistant pathogens the search for new antibiotics with novel modes of action has become increasingly urgent. Since the 1950's terrestrial actinomycetes have been extensively screened for secondary metabolites with applications as antimicrobials, anticancer and antifungal drugs however, the discovery of novel compounds has steadily declined over recent years. Marine actinomycetes are particularly understudied and it is hypothesized that these organisms will prove to be a source of many novel compounds in the future including bioactives, enzymes and biopolymers. Due to this burgeoning interest in marine blue sky biotechnology the Marine Institute as an output of the Beaufort Marine Biodiscovery Research Programme has generated a national repository of marine-derived microbes from the economic exclusive zone of Ireland. These organisms are currently being screened for novel compounds but as of yet have not been positively identified. This project will use 16S rDNA PCR-sequencing technology to assign an identity to the microbes in the repository and from the sequence information generated real-time PCR assays will be developed to screen sediment and coral samples for key actinomycete species. Pre-screening of samples for key species prior to isolation will streamline the culturing process, allowing for more targeted isolation and improve the overall efficiency of future biodiscovery work.

Keywords: marine actinomycetes, real-time PCR assays, blue biotechnology

Marine and Coastal 2

The application of 3D geometric morphometric techniques to detect differences in shell morphology between populations of *Littorina littorea*

Darragh Doyle[1], Martin Gammell[1], Roisin Nash[1]

[1]Galway-Mayo Institute of Technology, Dublin Road, Galway, Ireland.

Corresponding Author Email Address: Darragh.doyle@research.gmit.ie

Phenotypic plasticity refers to the ability of one genotype to produce multiple phenotypes in response to a changing environment. For the intertidal gastropod L. *littorea*, shell morphology can be a highly variable trait. Previous studies have shown that L. *littorea* can alter its morphology in response to a particular environmental or anthropogenic stress e.g. wave exposure, predation, food availability, and harvesting. However variation in shape is often quite difficult to detect and previous methods of measurement which used distance measurements and ratio variables were prone to confounding size and shape. As such, reliable methods need to be employed which can measure morphological variation with accuracy and precision. This study will determine whether 3D geometric morphometrics can be used to detect differences in shell shape between populations of L. *littorea*. In recent years, the field of geometric morphometrics has emerged as a potential solution to differentiating populations and previous studies examining shell morphology have had success using 2D geometric morphometrics. However, the examination of 3D objects in 2D space leads to an entirely different set of problems; therefore this study incorporates 3D imaging of L. littorea shells from a number of shore types of varying exposure. Shells photographed from multiple angles using 2D digital photography are stitched together using proprietary software to form 3D models of each shell. These shells are then compared using morphometric software to allow differences in shape between individuals and populations to be assessed. This study may provide a potentially cost effective method for the examination of prosobranch gastropod morphology and could be particularly useful when assessing potential impacts on shores.

Keywords: phenotypic plasticity, 3D morphometrics, *Littorina littorea*

Marine and Coastal 2

Co-ReSyF: Opening a gateway for coastal research to capitalise on increasing Earth Observation data availability

Rory Scarrott[1], Eirini Politi[1], Eimear Tuohy[1], Abigail Cronin[1], Miguel Terra Homem[2], Hervé Caumont[3], Nuno Grosso[2], Antoine Mangin[4], Nuno Catarino[2], Fiona Cawkwell[5], Michelle Cronin[1], Eleanor O'Rourke[6]

[1]Centre for Marine and Renewable Energy, Environmental Research Institute, University College Cork, Cork, Ireland.

[2]DEIMOS Engenharia S.A., Lisbon, Portugal

[3]TERRADUE, Rome, Italy

[4]ACRI-ST, Sophia-Antipolis, France

[5]Department of Geography, University College Cork, Ireland.

[6]Marine Institute, Galway, Ireland.

Corresponding Author Email Address: r.scarrott@ucc.ie

Changing coastal processes, and human activity intensification can affect coastal regions in many ways. To fully understand the impacts and associated risks, geospatial approaches which harness both global and regional datasets, are needed. These can help characterise trajectories of change in coastal systems, improving our knowledge and understanding of the complex processes involved. Increasingly, such approaches often require Big Data solutions. Furthermore, they also typically require highly specialised data processing skillsets. Particularly with regard to satellite-derived Earth Observation (EO) data, targeting coastal uses of EO data requires collaborative approaches which involve both non-EO and EO data experts. The H2020-funded Co-ReSyF project aims to address this need, developing a cloud-based platform which enables EO novices and experts to collaboratively develop algorithms, access, view and process satellite data, and visualise and share their outputs. It is also deploying a series of Research Applications, whose discrete processing steps will be distilled into a set of modules. These can be used independently for data (pre-)processing, or combined with other modules to create novel processing chains. Coastal researchers can collaboratively create processing chains which extract relevant coastal information from EO data. EO experts can also collaboratively develop modules of their own, deploying them using the platform, and make them available to others. Inexperienced users can use the modules as they are, building process chains without needing to understand the underlying programming details. Meanwhile, advanced users will be able to use the Co-ReSyF functionalities to develop their own modules, or adapt configurations of existing ones. This presentation outlines the approach the Co-ReSyF project is taking, to unlock EO data's potential to contribute to coastal research. It also describes an example Research Application (and the modules to be made available)

focused on extracting spatio-temporal ocean information from temporally rich data cubes of Sea Surface Temperature measurements.

Keywords: Earth Observation, Big Data, coasts, oceans, cloud platform, Sea Surface Temperature

Environment and Human Health 2

Antibiotic resistance in Irish waters: Genetic analysis of the prevalence of antimicrobial resistance species in the aquatic environment

Karen Harney[1], Owen Naughton[2,3], Julie Naughton[1]

[1]School of Biological Sciences, DIT Kevin Street, Dublin, Ireand.

[2]Geological Survey Ireland, Beggars Bush, Dublin, Ireland.

[3]Department of Civil, Structural and Environmental Engineering, University of Dublin, Trinity College, Dublin, Ireland.

Corresponding Author Email Address: julieann.naughton@dit.ie

There is growing recognition of the importance of wetlands in the provision of ecosystem services such as climate regulation, biodiversity, flood control and ecotourism. Recent years have also seen an increase in the use of wetlands for water pollution control and the treatment of domestic, agricultural and industrial effluent. However, there is a growing concern that the elevated concentrations of antibiotics often found in wastewater may promote dissemination of antibiotic resistance to natural microbial communities. An EPA commissioned study, completed in 2012, demonstrated the widespread problem of contamination of surface water with faecal contaminants *Escherichia coli, Cryptosporidium and Enterococci.* In addition to an identified risk posed by *E. coli* resistant to antimicrobials, pathogenic and non-pathogenic bacteria not currently investigated in an Irish context, may act as accumulators and reservoirs for antimicrobial resistance. Of particular significance is the detection of the mcr^{-1} gene which confers resistance to colistin, the last resort antibiotic for treating resistant infections. The constant interaction between these environmental species and human and animal pathogens like *E. coli* pose the inevitable scenario of transfer of these resistance genes between species. Consequently, environmental bacteria may be a key component in potential pathways to humans and animals for antibiotic resistance genes, further adding to the loss of effective antimicrobial treatments available to clinicians. Samples were taken from a constructed wetland used for the treatment of domestic wastewater and tested for the presence of antibiotic resistance genes. Genetic amplification methods including qualitative and quantitative PCR were used to assess the prevalence of genes for resistance to colistin (mcr^{-1}), fluoroquinolone (qnr), sulfonamides (sul1, sul2), macrolides (ermF), tetracycline [tet(A), tet(O)], glycopeptides (vanA), and methicillin (mecA). Detailing the prevalence of these potential environmental reservoirs of antimicrobial resistance would provide key information that could aid in the design of policy and implementation of strategies to improve water quality and reduce the risk of spread of antimicrobial resistance genes.

Keywords: microbiology, antibiotic resistance, wetlands

Environment and Human Health 2

Contamination of Irish bathing waters with shiga toxigenic *Escherichia coli*

Carina Brehony[1], Bláthnaid Mahon[1], James Killeen[1], Martin Cormican[1], Paul Hickey[2], Shane Keane[2], Dearbháile Morris[1]

[1]Antimicrobial Resistance and Microbial Ecology Group, School of Medicine, National University of Ireland, Galway, Ireland.

[2]Environmental Health Service, Health Service Executive West, Ireland.

Corresponding Author Email Address: Dearbhaile.Morris@nuigalway.ie

Shiga-toxigenic Escherichia coli (STEC) are pathogenic E. coli associated with diarrhoea, haemorrhagic colitis and haemolytic uraemic syndrome. The incidence of laboratory confirmed human infection due to STEC in Ireland is the highest in Europe. Transmission is commonly attributed to waterborne and person-to-person routes. As recreational and occupational exposure to water is a potential source of infection we examined relevant water samples for STEC. Samples were collected from two sampling points between May and September 2016; seven times at location 1 and five times at location 2. Samples (30 L) from 3 freshwater streams flowing onto 2 beaches were collected on each sampling date at each location. All samples were filtered using large volume filtration method. Filters were enriched overnight at 42 °C in buffered-peptone water and enrichment broths were examined for the eae, stx1 and stx2 genes, and genetic determinants of 026 and 0157 by real-time PCR. Enrichments broths were also cultured on Chromagar STEC and subjected to immunomagnetic separation (IMS). STEC was detected (positive for eae and stx1 or stx2 gene and Chromagar STEC plate culture positive) at location 1 on all seven samplings and four out of five times at location 2. The O26 serotype was detected at location 1 on 6/7 occasions and at location 2 on 3/5 occasions. The O157 serotype was detected at location 1 on 3/7 occasions and at location 2 on 4/5 occasions. The consistent detection of STEC in these recreational waters is a cause for concern and highlights the importance of monitoring such amenities. This is particularly important for an organism such as STEC with which has a very low infectious dose (10 cells) and disproportionally affects the very young (< 5 years).

Keywords: STEC, *E. coli*, recreational waters

Environment and Human Health 2

The agri-food chain as a reservoir for antimicrobial resistant *Escherichia coli*

Bláthnaid Mahon[1], Nicolae Corcionivoschi [2], Martin Cormican[1], Carmel Kelly[2], Alice Hegarty[1], Aoife Carter[1], Dearbháile Morris[1]

[1]Antimicrobial Resistance and Microbial Ecology Group, School of Medicine, National University of Ireland, Galway, Ireland.

[2]Food Science Branch, Agri-Food & Biosciences Institute, Belfast, Northern Ireland.

Corresponding Author Email Address: b.mahon1@nuigalway.ie

Antimicrobial resistance is recognised globally as a major public health concern. There is currently insufficient data in Ireland and elsewhere on the presence of antimicrobial resistant *Enterobacteriaceae* (AMR-E) in the agri-food chain to support an assessment of risk associated with human infection. The aim of this study was to assess chicken caeca for the presence of AMR-E. A total of 36 chicken caeca samples were obtained from the Agri-Food and Biosciences Institute, Belfast (12 from 10 day old chicks, 12 from 21 day old chicks and 12 from 34 day old chicks). Samples were screened for the presence of; *carbapenemase*-producing *Enterobacteriaceae* (CPE), extended spectrum beta-lactamase producing *Enterobacteriaceae* (ESBL-PE) and fluoroquinolone resistant *Enterobacteriaceae* (FQR-E). Susceptibility to 14 antimicrobial agents was examined in accordance with EUCAST criteria. Isolates identified phenotypically as ESBL producers were examined for the presence of $bla_{\text{CTX-M-group 1}}$, $bla_{\text{CTX-M-group 2}}$ and $bla_{\text{CTX-M-group 9}}$ encoding genes by real-time PCR. E. coli isolates were classified into phylogenetic groups by multiplex PCR. All chicken caeca samples examined were positive for the presence of ESBL-producing E. coli. These isolates all screened positive for $bla_{\text{CTX-M-group 1}}$ and were classified into phylogenetic group F. A total of 23/36 (64%) of the caeca samples contained FQR-E (*all E. coli*). The frequency of detection of FQR-E in the caeca samples decreased with increasing age of the chicks (11/12 from 10 day old chicks, 7/12 from 21 day old chicks and 5/12 from 34 day old chicks). FQR-E isolates were classified into phylogenetic group B1. No CPE were detected. The similarity of the isolates, particularly the ESBL-producing *E. coli*, suggests dissemination of a common strain of *E. coli* and the possibility of vertical transmission among poultry. These findings highlight the need for increased surveillance of the presence of antimicrobial resistance in the agri-food chain.

Keywords: antimicrobial resistance, *Enterobacteriaceae*, agri-food chain

Climate Change 2

Storminess in the Irish Climate: what can we expect in the future?

Ray Mc Grath[1,2], Paul Nolan[1,3]

[1]Irish Centre for High-End Computing (ICHEC), Dublin, Ireland.

[2]UCD School of Mathematics and Statistics, Dublin, Ireland.

[3]Met Éireann, Research and Applications Division, Dublin, Ireland.

Corresponding Author Email Address: ray.mcgrath@ucd.ie

Storms are a significant feature of the Irish climate and often have a major environmental impact due to severe winds or heavy precipitation. This presentation looks at storminess in the Irish climate in recent years and the expected changes in Atlantic storm tracks due to climate change in the coming decades. Examples of recent storms are highlighted. The uncertainty inherent in climate projections are discussed. Weather systems (depressions) in the North Atlantic are evaluated using tracking software to map their spatial movement, size and intensity. The current/past climate of the region is analysed using ERA-Interim re-analysis data. Future projections for storm tracks are based on downscaled Coupled Model Intercomparison Project Phase 5 (CMIP5) datasets provided by the EURO-CORDEX project; projections for two future greenhouse gas scenarios (RCP4.5 and RCP8.5) are provided. These show a reduction of ~10% in the frequency of less intense winter storms affecting Ireland from mid-century and suggest an eastward extension of the more severe wind storms over Ireland and the UK. However, the accuracy of the results is dependent on the quality of the CMIP5 datasets; deficiencies in the ability to replicate the current/past storm track climate imply that projections on storminess remain uncertain and require further research.

Keywords: storms, climate change, uncertainty

Climate Change 2

Assessment and application of carbon footprint methods at a higher education institution

William Horan[1], Maria Kirrane[1], Richard Moles[1], Bernadette O'Regan[1]

[1]Department of Chemical Sciences, School of Natural Sciences, Faculty of Science & Engineering, University of Limerick, Ireland.

Corresponding Author Email Address: william.horan@ul.ie

Tackling climate change is strongly intertwined with socio-economic factors, which make it a complex challenge. This interdependency highlights the importance of tackling climate change in the context of a wider Sustainable Development agenda. Due to political uncertainty at the international level surrounding commitments to climate action, there is a need for national and community based approaches and solutions to enable societal transitions towards sustainability. Higher Education Institutions (HEI) have an important role to play in catalysing climate action, both by educating students and engaging with local communities to raise awareness of feasible and affordable actions and technologies. As "Living Laboratories" HEIs are in a position to demonstrate innovative solutions to societal challenges. Data availability allows HEIs to quantify their greenhouse gas emissions, and become catalysts for societal change through leading by example in reducing emissions. In this project, funded by the EPA, carbon footprints will be calculated for HEIs. The University of Limerick is used as a case study in which with bottom-up and top-down approaches can be evaluated for effectiveness in reducing this footprint. The bottom-up approach involves process life cycle analysis of the main carbon emitting components, and the top-down approach will be based in input-output analyses of supply chain emissions. By applying both approaches in a complementary manner it is intended that issues such as boundary truncation errors, resource and time constraints, and gaps in data will not significantly limit the value of outcomes. Preliminary results to date indicate that building heating and electricity, staff and student commuting, and supply chain emissions are the main contributors to carbon emissions. Evidence based policy options for each of these activities will be explored. This work is part of a wider EPA funded project "Developing the Potential of Third Level Campuses as Change Agents in Transition towards Sustainable Communities".

Keywords: climate change, carbon footprint, higher education institutions, evidence based policy

Climate Change 2

Dissolved carbon and nitrogen losses from decomposing woody forest debris

Brian Tobin, Gio Pastore, Martin Nieuwenhuis

University College Dublin

Corresponding Author Email Address: brian.tobin@ucd.ie

Woody debris (WD), the residual consequence of harvesting, is a major component of forest ecosystems. There is considerable current interest in carbon (C) and nitrogen (N) cycling, particularly in relation to sustaining fertility and limiting pollution effects in the context of changes in local and global nutrient cycles. The decomposition of WD is a major factor influencing C-retention in forest ecosystems and more accurate estimates of woody decay rates can significantly improve understanding of how and where C (and N) are lost from forests. Rainfall and throughfall were monitored over the course of a one-year period at a chronosequence of commercial forest stands. The age of WD at each stand (i.e. number of years since clearfell) ranged from 3 to 15 years. Leachate from windrowed WD was also monitored. Solute concentrations from both sources were compared. Fluxes of dissolved organic carbon (DOC), dissolved inorganic carbon (DIC) and total dissolved nitrogen (TDN) were calculated by multiplying the respective concentration at a single sampling date with the respective volumes collected. The annual net DOC fluxes (DOC from WD less DOC in rainfall) were estimated to be 78.0 (S.E. = 6.88), 67.1 (S.E. = 10.81), 90.2 (S.E. = 6.73), 76.4 (S.E. = 6.59) and 33.3 (S.E. = 3.68) kg C ha^{-1} yr^{-1}, for the five sites in respective chronological order. The flux of DIC at all stands was considerably lower (0.05 kg C ha^{-1} yr^{-1}). The mean annual fluxes of DOC, DIC and TDN in windrow leachates were positively correlated to annual precipitation/throughfall. Leaching represents a comparatively small, but continuous C-loss from WD in harvested ecosystems. DOC and TDN concentrations and leached quantities were higher in intermediate developmental stages of WD decay. TDN fluxes from WD leachate indicates that more N was retained than lost, suggesting that windrows acted as a net sink. This identifies one of the ecological roles of windrowed WD as a nutrient reservoir for N and a weak but steady C-source.

Keywords: forest woody decomposition, nutrient reservoir, rainfall, dissolved organic matter

Climate Change 2

Exploring the prospects of community led sustainability transformation in Ireland

Rosemary Byrne[1], Bernadette O'Regan[1]

[1]Centre for Environmental Research, University of Limerick, Plassey Road, Limerick, Ireland.

Corresponding Author Email Address: rosemary.byrne@ul.ie

A key element of 'Sustainability Transformation' is citizen engagement and the concept of community ownership. This study examines conflicting policies and resultant roadblocks experienced by communities in achieving such transformation. Collaborating with five Irish communities actively engaged in working towards improved sustainability in the areas of energy, waste, food and transport, information has been gathered on motivation factors and barriers to action experienced, through a process of structured interviews and application of the Q-method. Plans for the transformation to a low-carbon resilient society currently concentrate on achieving emission reductions through sectoral targets which do not include the views or opinions of communities or their citizens. Yet, the Irish Government Energy White Paper (2015) places an onus on citizens and communities becoming 'agents of change' with society being left to make, and act on, decisions to reduce CO_2. Preliminary results suggest that community groups face many obstacles to this in terms of planning, financing, and legal frameworks. To enable transformation, policies which support and facilitate environmental, economic and social development within communities are necessary. Currently there exists a contradiction in terms of policy whereby government both acknowledges this necessity but also protects the interests of large scale energy infrastructure through restrictive planning regulations that prevent community led sustainability transformation. To maintain momentum, communities participating in sustainability actions must also realise quantifiable socio-economic benefits. The need to put in place long-term strategies for achieving this transformation can be stymied by short-term political cycles, whereby controversial but necessary decisions may lose out to popularism and election winning. From analysis of information collected, policies that currently block progress will be highlighted to identify more effective support mechanisms which encourage partnerships between communities and government. This will result in bringing together bottom-up actions and top-down strategies to advance national sustainability and carbon reduction goals.

Keywords: carbon reduction policy, sustainable transformation, community engagement, socio-economic development

Energy

nZEB-RETROFIT: The influence of human behaviour on the energy consumption and internal environment of Irish residential buildings

P. Moran[1,2], M. Hajdukiewicz[1,2], R. Manton[1,2], H. Rau[2,3], J. Goggins[1,2,4]

[1]Informatics Research Unit for Sustainable Engineering (IRUSE), Department of Civil Engineering, College of Engineering and Informatics, NUI Galway, Ireland.

[2]Ryan Institute for Environmental, Marine and Energy Research, NUI Galway, Ireland.

[3]Department of Geography, Ludwig-Maximilians-University Munich, Germany.

[4]Centre for Marine and Renewable Energy (MaREI), Galway, Ireland.

Corresponding Author Email Address: p.moran3@nuigalway.ie

The Irish housing stock uses and emits substantially more primary energy and CO_2 than the EU average. To combat this, there are currently a range of government-initiated programmes geared towards energy-retrofitting existing residential buildings which focus on upgrading the technical-materials of the building. Energy use has been found to depend on multiple factors within households including dwelling type, household composition, income, habits, comfort and appliance ownership. Therefore, a greater understanding of the main factors influencing the energy consumption behaviour of different household compositions in Ireland is required. These programmes then need to be reconfigured to include an equally strong focus on researching and potentially changing the energy-related views and everyday practices of those who inhabit these buildings. This research project is exploiting full-scale demonstrator retrofitted buildings incorporating energy-efficient technologies through real-time monitoring, analysis, modelling and interpretation of the energy consumption, greenhouse gas emissions and internal environment data. This data combined with the demonstrator buildings' occupant (1) demographic profiles, (2) socio-economic status, (3) behaviour and attitudes towards energy consumption, energy conservation, the environment, environmental responsibility, thermal comfort, (4) views of quality of life and (5) what they consider to be a luxury and necessity in their life will allow the most effective retrofit measures to be identified that considers the profiles of both the physical building and its occupants. Monitoring the performance of each of the residential buildings pre- and post- retrofit will help reduce possible rebound effects and achieve lasting reductions in consumers' energy consumption through devising effective engagement actions, including providing historical feedback to the occupants on the energy consumption, greenhouse gas emissions and internal environment.

Keywords: energy in buildings, human behaviour, nearly zero energy buildings, retrofitting buildings

Energy

Energy behaviour change approaches in Ireland: a review of existing policy instruments

Alexandra Revez[1], Niall Dunphy[1]

[1]Cleaner Production Promotion Unit, School of Engineering, University College Cork, Ireland.

Corresponding Author Email Address: alexandra.revez@ucc.ie

The importance of changing energy-related behaviour is widely acknowledged, with many economic, societal, and environmental drivers to reduce our energy consumption – not least of which is climate change. Accordingly, reductions in energy use and transition towards energy conservation practices are key objectives for policy makers focused on energy. Such policies aim to transform existing energy systems by adding greater emphasis on sustainable energy behaviour and practices at grassroots level. This paper draws empirical evidence from a large-scale EU project (ENTRUST) and combines this with an evaluation of existing policy documents to provide a review of existing approaches to behaviour change policy in Ireland and offer a comparison with a number of other EU member states (UK, Spain, France and Italy). We use elements of narrative review methodology to consider behaviour from an intersectional viewpoint. The strength of this approach lies in considering interventions from a multi-dimensional perspective which include factors such as socio-economic background, gender and age. The paper argues that current energy policy strategies in Ireland has limitations in terms of both policy instruments used to promote energy behaviour changes as well as in the approaches, which by and large do not take into account and differentiate amongst different groups in society. We consider the implications of current approaches in terms of achieving carbon reduction targets and we provide recommendations for the refinement of existing strategies.

Keywords: energy behaviour, energy policy, energy transitions, Ireland

Energy

Experience, dialogue and negotiation: Identifying sustainable energy transition pathways

Breffní Lennon[1], Niall Dunphy[1]

[1]Cleaner Production Promotion Unit, School of Engineering, University College Cork, Ireland.

Corresponding Author Email Address: blennon@ucc.ie

This paper is informed by research that positions itself within current sustainable energy transition frameworks, the debates that inform these frameworks and moves towards a low-carbon, socio-economic system. Recognising that people lie at the heart of this transition, this paper explores some of the responses local people have had to current efforts to realise it and presents perspectives from two quite different communities. One is located in a predominantly rural area in Ireland, whereas the other live in an urban neighbourhood in France. Both communities face considerable challenges as they embark on their energy-transition pathways, given the varying levels of success so far in meeting the challenges posed from finding a sustainable energy transition. The emphasis on top-down technocratic solutions has not worked and this paper shifts the focus back to the human dimension of the energy transition, examining how individuals negotiate their way through the many (and sometimes hidden) competing landscapes of social and economic power that exist at the local level. People have usually been portrayed as either 'passive' or 'active' consumers in this transition, but as this paper suggests the reality can quite often be very different with local people occupying (re)active, participatory spaces that can ultimately influence the success or failure of a given (supra) national policy. Some in the literature suggest that people's attitudes and identities are informed by ideas of place attachment, which in turn determine the intensity of place-protective actions to a perceived threat. Here, we suggest that there is no reason why these narratives cannot also be informed by the opportunities presented by the ever-greater enmeshments of place and mobility in contemporary societies across the European Union. This paper will present the findings to date from research conducted as part of ENTRUST, an interdisciplinary H2020 research project exploring the human factor in the energy system

Keywords: sustainable energy transition, energy policy, environment, EU, comparative policy analysis

Energy

Store surplus electricity as renewable gaseous or liquid fuels

Truc T.Q. Vo[1,2], Jerry D Murphy[1,2]

[1]MaREI Centre, Environmental Research Institute, University College Cork, Ireland.

[2]School of Engineering, University College Cork, Ireland.

Corresponding Author Email Address: truc.vo@ucc.ie

Renewable energy production is increasing nowadays as a result of requirements for increasing energy security and reducing climate change. However, renewable energy such as wind and solar energy are intermittent and fluctuate. Thus, a method of storing surplus electricity is crucial. One method to store surplus electricity is to change the energy vector from electricity to gaseous or liquid fuel. This can be done through electrolysis to produce hydrogen, with a further methanation step combining the produced hydrogen with CO_2 (potentially from a biogas facility). Such a process is known as Power to Gas (P2G) or Power to Liquid (P2L). This not only provides an alternative storage solution for electricity but can potentially offset biogas upgrading costs for an anaerobic digester if biological P2G or P2L is used. The final products from P2G can be methane, and from P2L can be methanol, ethanol or isobutanol. Such P2G and P2L methods have significant potential to balance and facilitate high levels of variable renewable electricity. These end-products can be used as fuel in the heat and transport sectors. This work assesses the energy requirement to produce 1 GJ of each fuel. The assessment is based on stoichiometric equations and the relative efficiencies of each pathway. The preliminary assessment undertaken shows that the electricity required to produce 1GJ of biological methane; catalytic methane; methanol; ethanol or isobutanol is 1.64 GJ, 2.00 GJ, 1.95 GJ, 2.23 GJ and 4.70 GJ, respectively. This would suggest that on the basis of a preliminary assessment, power to methane is an optimal vector that storing surplus electricity.

Keywords: energy storage, power to gas, power to liquid, transport fuels

Waste Management 3

Examination of the economic content of waste LCD-TVs

Paul Moroney[1, 2], Teresa Curtin[1, 2], Seamus Gordon[1], Lisa O'Donoghue[1]

[1]School of Engineering, University of Limerick, Limerick, Ireland.

[2]Materials Science and Surface Institute, University of Limerick, Limerick, Ireland.

Corresponding Author Email Address: paul.moroney@ul.ie

The critical raw materials (CRMs) content in waste LCD-TVs was assessed and indium determined as the CRM with the highest economic value available for recovery. The indium content in LCD glass was measured using various spectroscopy techniques and ion coupled plasma-optical emission spectroscopy (ICP-OES) was found to yield the highest average measured indium content (582.3 mg/kg), closely followed by flame atomic absorption spectroscopy (FAAS) (521 mg/kg). Energy dispersive X-ray spectroscopy (EDX) provided a sweep of the other elements present on the glass and identified the main coexisting metals as Sn, Al and Mo. Elemental X-ray mapping demonstrated the existence of a continuous coating of indium tin oxide (ITO) on the glass front (GF) of the LCD panel and a discontinuous ITO coating on the glass back (GB). X-ray fluorescence (XRF) measured found 4 times as much indium on the GF (0.82 g/m^2) then on the GB (0.25 g/m^2) yielding a total of ~0.93 g of indium metal from a 32" screen. The ITO coating thickness (~150nm) was determined from combined cross-sectional imaging and Focused Ion Beam (FIB) milling. The crystallographic texture of the ITO layer was shown to have preferred orientation in the <211> or <111> directions while the ITO crystallite size was similar for the GF (78 nm) and GB (56 nm) coatings. Thermal analysis of the ITO coating showed that the glass front (GF) panel coating had significantly higher organic content (80%) then the glass back (GB) panel coating (20%) and this demonstrated that the carbon based colour filter on the GF was co-extracted during mechanical removal of the ITO coating. The effect of various pre-treatments routes on the measured indium content was examined with the maximum extracted indium content (594.8 mg/kg) obtained from unmilled glass leached with aqua regia. The results of this research can assist the development of a systematic process for the recovery of indium from waste LCD-TVs and inform recovery processes from alternative indium sources such as photovoltaics and LEDs.

Keywords: household waste, LCD-TVs, indium content, indium recovery

Waste Management 3

Anaerobic digestion for biogas production and its future in Ireland

Navodita Bhatnagar[1], David Ryan[1], Richard Murphy[2], Ann-Marie Enright[1]

[1]EnviroCore, Institute of Technology, Carlow, Ireland.

[2]Alltech, Dunboyne, Co. Meath, Ireland.

Corresponding Author Email Address: navodita.bhatnagar@itcarlow.ie

According to Irish EPA (Environmental Protection Agency) directives, the amount of waste going to landfills needs to be reduced to 35% of the total amount (by weight) of biodegradable municipal waste (BMW) produced in 1995. In a recent report, the Sustainable Energy Authority of Ireland (SEAI) concluded that the energy produced by renewable sources accounted to a gross final consumption (GFC) of 9.1% in 2015, wherein the electricity generated from these sources increased from c. 5% in 1990 to 27% in 2015. While energy from established wind and hydro generation accounted for 21.1% and 2.5 % of the electricity produced, respectively, biogas contributed only 1%. Diverting the focus to energy production by anaerobic digestion (AD) of farm waste and BMW to produce biogas is a suitable alternative to reducing amount of waste going to landfill. I t is also a highly promising technology which could contribute significantly in achieving the target of 16% renewable energy by year 2020. The current study focuses on batch scale assay to examine the potential of two substrates, grass silage and chicken litter, to produce biogas. Grass silage is used mainly as animal feed in Irish farms owing to its high nutritive value and intake potential based on its digestibility. Chicken litter is a mixture of poultry excreta, bedding and feed material, and is rich in organic matter. As a result, the properties of these substrates make them an ideal AD feedstock for biogas production. The results obtained in this study mean that the research will be scaled up further for a pilot scale anaerobic reactor. The project outcomes will be useful in bridging the gap between renewable energy demand and supply in Ireland, while addressing the demands of EPA directives.

Keywords: AD feedstock, anaerobic digestion, biogas, grass silage, chicken litter, anaerobic reactor

Waste Management 3

Biological phosphorus recovery during low-temperature anaerobic digestion wastewater treatment

Jasmine Connolly[1], Florence Abram[1], John McGrath[2], Vincent O'Flaherty[1]

[1]Microbial Ecology Laboratory, School of Natural Sciences, NUI Galway, Ireland.

[2]School of Biological Sciences, Queens University, Belfast, Northern Ireland.

Corresponding Author Email Address: j.connolly20@nuigalway.ie

Phosphorus is essential to life, as it is incorporated in DNA, RNA and ATP, but it is also a major pollutant in water systems. The main use of phosphorus is as an agricultural fertilizer, sourced from rock mining of phosphate. This mining process is highly unsustainable with the finite resource expected to be drained completely in 100-150 years. The recovery therefore of phosphorus from wastewater streams is essential to sustainability of agriculture, and the global food market. With increasingly strict effluent regulations removal is also essential to ensure clean water systems. Recovery systems currently in place include: chemical precipitation, crystallization, and enhanced biological phosphorus removal. These systems can remove up to 75% of phosphorus present however they often consume high amounts of energy and the removed phosphorus is sent to landfill in an unusable form. We have shown, in laboratory-scale trials, that the biological removal of phosphorus using low-temperature anaerobic digestion (LTAD) may be a feasible and energy efficient process, in which high levels of phosphorus are removed (>80%) and retained in a re-usable form. The further aims of this ongoing work are to optimise the process of phosphorus removal during LTAD and to shed light on the nature and limitations of the underpinning microorganism(s). Initially, the precise environmental conditions associated with the biological removal in the LTAD system must be characterised and then exploited in practice to optimise those parameters to increase the removal of phosphorus. The results of this research could significantly impact the way in which resource recovery is practiced in Ireland.

Keywords: low temperature anaerobic digestion, phosphorus

Waste Management 3

On-line fluorescence sensing of airborne fungal spores released from a green-waste/composting site in Ireland

Patrick Feeney[1], Michael Quirke[1], Shane Daly[1], Eoin McGillicuddy[1], John Wenger[1] and John Sodeau[1]

[1]Environmental Research Institute and School of Chemistry, University College Cork, Ireland.

Corresponding Author Email Address: paddy.feeney1@gmail.com

A monitoring campaign was carried out at a green-waste composting site in Ireland during Spring 2016. The site was chosen because high levels of potentially health-threatening bioaerosols are present in the air that can be readily inhaled by individuals working and visiting there. Three instrumental devices were deployed to carry out the measurements. (i) Wideband Integrated Bioaerosol Sensor (WIBS), which is a recently developed on-line technique that uses Light-Induced-Fluorescence (LIF) to provide number concentrations, size and "shape" of fungal spores; (ii) SporeWatch, an impaction technique employed to capture spores and pollen on sticky tape. This process is followed, several days after the collections have been made, by counting and characterization using optical microscopy (iii) Multiparameter Bioaerosol Sensor (MBS), a prototype real-time device that collects fluorescence spectral distributions and enables discrimination between bioaerosols. By comparison between the WIBS and SporeWatch data, it was shown that accurate representations of bioaerosols could be made continuously at high time resolution (seconds) compared to the SporeWatch that had a time resolution of one hour. Hence relationships between site activities like turning, agitation and waste delivery and WIBS data could be determined in a manner not possible with the SporeWatch approach. In particular, the co-location of WIBS with the impaction instrument made it possible to identify the real-time release behaviour of one specific spore, *Ustilago maydis*, which resulted from green-waste deliveries made by a local distillery company. Measurements using the MBS showed that it was possible to distinguish between airborne *Aspergillus fumigatus, Aspergillus niger and Penicillium spp.*

Keywords: composting sites, bioaerosols, air quality

Environ 2017

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Poster Presentation Abstracts

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Air Quality and Urban Development

1. Real-time monitoring of biological airborne particles in the hospital environment (ReM-BAPHE)

Meheal Fennelly[1], Patrick Feeney[1], David O'Connor[3],

Michael Prentice[2], John Sodeau[1]

[1]Environmental Research Institute, School of Chemistry, University College Cork, Ireland.

[2]Department of Microbiology, University College Cork, Ireland.

[3]School of Chemical and Pharmaceutical Sciences, Dublin Institute of Technology, Ireland.

Corresponding Author Email Address: 116224792@umail.ucc.ie

Direct bioaerosol sampling is in limited use as a quality control measure in hospitals. However, research has shown that the approach can be used to monitor and control airborne microorganism spread, guide epidemiological investigation of nosocomial infectious diseases, and monitor biohazardous procedures. A major limitation of current (off-line) sampling methods for bioaerosols in hospitals is the requirement for conventional culture, which takes some time for analysis. UV excitation of molecules, such as amino acids and NAD(P)H, now offers the opportunity for real-time specific counting and characterisation of living cells in air by on-line detection of their intrinsic fluorescence. The aim of project ReM-BAPHE is to assess two novel bioaerosol sensors termed Waveband Integrated Bioaerosol Sensor (WIBS-4A and WIBS-4+) as real time monitors for the detection of airborne biological particles in hospitals. The results presented here demonstrate a proof of principle application for the light induced fluorescence monitoring technique in a severe respiratory illness ward at Cork University Hospital. The ward was chosen because the patients' illnesses are directly affected by air quality. Hence, it is specially fitted with an air filtering system, which utilises a "DBD plasma" to ensure total destruction of viruses, bacteria, and moulds at a DNA level. Data are presented from a 7-day campaign held in January 2017. Trends in fluorescent particles concentration, shape and size over the campaign will be discussed but do provide clear evidence for increases in fungal/bacterial spore counts at visiting times and other periods of walk-in activity to the ward.

Keywords: bioaerosol, real-time analysis, indoor air quality, wibs

Air Quality and Urban Development

2. Enhancing renovation performance through participatory design

Niall Dunphy[1], Paul O'Connor[1], Rosemarie Mac Sweeney[1]

[1]Cleaner Production Promotion Unit, School of Engineering, University College Cork, Ireland.

Corresponding Author Email Address: n.dunphy@ucc.ie

Buildings represent the largest untapped source of cost effective energy savings and greenhouse gas reduction potential within Europe, with the built environment responsible for 40% of total energy consumption. It is estimated that nine of every ten existing buildings in the EU will still be in use in 2050 – reducing the energy intensity of the building stock therefore requires a substantial programme of building renovation. However, the exclusion of occupants from the renovation design process can often means the selection of technologies and interventions unsuitable for the occupants and/or which will be incorrectly used. This results in a significant gap designed and actual performances. The NewTREND H2020 project acknowledges the central influence of occupants on the expected impacts of interventions. Accordingly, a key objective of the project is to develop a design methodology will foster the involvement of building users and inhabitants across the whole life cycle of the retrofit project. This poster provides an overview of the work to date in the project on occupant involvement and presents a number of 'participatory design' approaches and techniques, which are being developed, tested and validated in three real refurbishment projects in Hungary, Finland and Spain.

Keywords: energy efficiency, refurbishment, occupants, users, participatory design

Biodiversity and Ecosystem Services

3. Results-based agri-environmental payment schemes: investigating the impacts on pollinator diversity in Burren grasslands

Michelle Larkin[1], Dara Stanley[1]

[1]Botany and Plant Science, Ryan Institute, School of Natural Science, National University of Ireland Galway, Ireland.

Corresponding Author Email Address: m.larkin102@gmail.com

Pollinators provide a vital ecosystem service by ensuring the successful pollination and reproduction of both wild flowers and many commercially important crops such as Oilseed Rape and Coffee. It is estimated that pollinators contribute €153 billion annually to the global economy and an estimated €53 million per annum to the Irish economy. Despite this, pollinators are experiencing an increasing global population decline as a result of agricultural intensification, spread of parasites and disease, and climate change. Due to increasing concerns of biodiversity declines across the agricultural landscape agri-environmental schemes (AES) have been introduced to mitigate any further declines. AES primary focus is to encourage farmers and other landowners to protect and enhance biodiversity by offering financial incentives. However AES varies greatly between European Countries and hence have experienced varying levels of success. A new Results-Based Agri-Environmental Payment Scheme has been developed in the Burren and has experienced high levels of success in conserving and enhancing both habitat quality and plant diversity. However the effects of this Results-Based Agri-Environmental Payment Scheme on pollinators and the services they provide have not been extensively studied. The principal objective of this project is to study how insect pollinators (i.e. bees, hoverflies and butterflies) are effected by the new Results-Based Agri-Environmental Payment Scheme in the Burren, County Clare. A survey of pollinators will be carried out across the Burren, using a variety of sampling methods. Through this I will also investigate the ecology of rare bumblebee species (in particular the Shrill Carder Bee and the Great Yellow Bumblebee) found in the Burren. Results from this work will be useful in understanding the ecology of rarer pollinating species and in informing pollinator conservation in Ireland.

Keywords: Burren, pollinator, agri-environment scheme, grassland, bees

Biodiversity and Ecosystem Services

4. Incorporating biodiversity impact potential into life cycle assessment of freshwater aquaculture using Water Framework Directive techniques.

Ronan Cooney[1], Alexandre Tahar[2], Alan Kennedy[1], Richard Fitzgerald[1], Eoghan Clifford[1]

[1]College of Engineering and Informatics, NUI, Galway.

[2]Athlone Institute of Technology, Athlone, Co. Westmeath, Ireland.

Corresponding Author Email Address: ronan.m.cooney@nuigalway.ie

The MOREFISH project is an innovative project led by NUI Galway and AIT that aims to enhance production efficiency and sustainability in Irish freshwater aquaculture systems. As wild fisheries production has decreased and the demand for fish products continues to rise, aquaculture has become the fastest growing source of fish protein. With this growth, there have been potential issues raised regarding environmental impact and compatibility with Water Framework Directive (WFD) objectives. As part of the project, a life cycle assessment (LCA) on the environmental impacts of rainbow trout production in semi-recirculating aquaculture systems in Ireland is being conducted. LCA is an ISO standardised framework which assesses the overall impacts in the production of a product. An area that is distinctly lacking in standard LCA, heretofore, is the incorporation of biodiversity impacts. The BioImpact metric, originally designed for assessing changes in land use with regards to forestry, allows for the accounting of biodiversity impacts from a point of potential eutrophication. Combining this metric and the techniques used in the WFD, it is proposed to incorporate a biodiversity impact potential into an enhanced LCA format. The MOREFISH project is funded by the Department of Agriculture, Food and the Marine (14/SF/872).

Keywords: aquaculture, biodiversity, water framework Directive (WFD), sustainability, fish, life cycle assessment (LCA)

Climate Change

5. Whole farm modelling of management factors affecting nitrous oxide (N2O) emissions from livestock production systems

Jonathan Herron[1, 2], Aidan Moloney[1], Thomas Curran[2]

[1]Teagasc, Animal & Grassland Research and Innovation Centre, Grange, Dunsany, Co. Meath, Ireland.

[2]UCD School of Biosystems Engineering, University College Dublin, Belfield, Dublin 4, Ireland.

Corresponding Author Email Address: jonathan.herron@ucdconnect.ie

Livestock production on grazed grasslands is a major source of atmospheric N_2O. In Ireland, agriculture accounts for nearly 90% of the national N_2O emissions with beef and dairy production systems being the largest contributors. N_2O emissions from agricultural practices are regularly predicted using default IPCC emission factors (EF). However, there is a large variation in these EF as a result of different management factors and climates. N_2O emissions from agricultural systems are not constant as suggested by the default IPCC EF but instead vary greatly depending on soil type, soil conditions, diet of animal, type of excreta applied, timing of application as well the type of synthetic fertiliser utilised. Whole farm models are currently used for the estimation of greenhouse gas (GHG) emissions from Irish beef and dairy systems. These are single year, static models, assuming that the production systems are in equilibrium where all GHG emissions emitted are converted to their 100 year global warming potential CO_2 equivalent. Direct on-farm GHG emissions of N_2O, CH4 and CO_2, the emissions associated with farm inputs and indirect GHG emissions associated with nitrate (NO_{3-}) leaching and ammonia (NH_3) volatilisation are simulated. Existing whole farm GHG models for Irish beef and dairy production systems will be updated where simulations will be carried out using these updated models to determine the effect of various management practices on N_2O emissions. Life cycle assessments (LCA) will then be conducted to estimate the whole farm GHG emissions from Irish beef and dairy farm systems. The main area of activity of this study is the partitioning of nitrogen where emerging information on composition of grazing pastures, intake regulation and nitrogen excretion by grazing dairy and beef cattle will be incorporated in to the updated models to improved predictions of urine nitrogen excreted per animal per day.

Keywords: nitrous oxide, GHG modelling, beef production, dairy production, nitrogen excretion

Climate Change

6. Tropospheric aerosol profiles over Southern Ireland using a backscatter Raman LIDAR

K. Acheson[1], A.A. Ruth[1]

[1]Physics Department and Environmental Research Institute, University College Cork, Cork, Ireland.

Corresponding Author Email Address: k.acheson@umail.ucc.ie

Global radiative effects of aerosol on the climate are still largely uncertain. The largest uncertainties in the ability to predict future climate change are associated with uncertainties in the distribution and properties of aerosol and clouds, and their interactions, as well as with limitations in how aerosol and clouds are represented in global climate models. Lidar is an active range-resolved optical remote sensing technique which allows for the measurement of a wide range of atmospheric parameters. The Raman backscatter lidar station in Cork is part of the European lidar network, EARLINET, which aims to provide a comprehensive database of aerosol distribution on a continental scale. Raman backscatter coefficients, extinction coefficients and lidar ratio were measured from April 2010 to May 2011, February 2012 to January 2015, and January 2016 to present. Statistical analysis of the profiles over these periods provided new information about the typical atmospheric scenarios over Southern Ireland in terms of aerosol load in the lower troposphere, the planetary boundary layer (PBL) height, aerosol optical density (AOD) at 532 nm and lidar ratio values. The most common aerosol type detected above Southern Ireland is marine in origin; however, aerosol events such as Saharan dust, volcanic ash, and forest fires are also detected. HYSPLIT air-mass back trajectory models are used to trace the origin of the detected aerosol layers. An aerosol forecast model, MACC, is used to further investigate and verify the origin and presence of the aerosol layers.

Keywords: radiative forcing, remote sensing, lidar, planetary boundary layer, earlinet

Ecotoxicology

7. Development of a high-intensity, pulsed plasma, gas discharge system for the novel destruction of hazardous chemicals in municipal wastewater and industrial effluent

Michael Broderick[1], Andrew M. Fogarty[1], Neil Rowan[1]

[1]Bioscience Research Institute, Athlone Institute of Technology, Athlone, Co. Westmeath, Ireland.

Corresponding Author Email Address: mbroderick@research.ait.ie

A high-intensity, pulsed plasma, gas-discharge (PPGD) system was developed and optimized for the potential decontamination of wastewater containing hazardous chemicals. The presence of Endocrine Disrupting Chemicals (EDCs) in treated effluent shows that conventional wastewater treatments do not fully remove or destroy these compounds. As the high-intensity, pulsed plasma, gas-discharge system produces multiple short-lived decontaminating properties in the treatment chamber, which includes free radicals, ozone, acoustic shock waves, UV light and pulsed electric fields, it may facilitate the novel removal or destruction of unwanted chemicals in wastewater. In order to investigate the efficacy of the high-intensity, pulsed plasma, gas-discharge system the destruction of phenol in artificially-spiked water samples was examined. High Pressure Liquid Chromatography (HPLC) was used to quantify the concentrations of phenol before and after treatment. The samples were then toxicologically assessed by the microtox® bioassay. The results of this research clearly demonstrated the significant destruction of phenol in treated samples; however, the overall toxicity of the treated samples was significantly increased.

Keywords: phenol, emerging contaminants, endocrine disrupting chemicals, pulsed plasma gas discharge, HPLC, microtox® bioassay, toxicity testing

Ecotoxicology

8. Comparison of quality indices for sediment assessment in Ireland

Tayyaba Bibi[1], Jenny Ronan[2], Robert Hernan[3], Kathleen O'Rourke[3], Brendan McHugh[2], Evin McGovern[2], Michelle Giltrap[1, 4], Gordon Chambers[1], James Wilson[4]

[1]Nanolab, FOCAS Research Institute, Dublin Institute of Technology, Kevin Street, Dublin 8, Ireland.

[2]Marine Institute, Rinville, Oranmore, Co. Galway, Ireland.

[3]Shannon Aquatic Toxicity Laboratory, Shannon town, Co. Clare.

[4]Zoology Department, Trinity College Dublin, Ireland.

Corresponding Author Email Address: tayyabataj2008@gmail.com

Sediment contamination is a major source of ecosystem stress and has received significant attention from the scientific community. Both the Water Framework Directive (WFD) and Marine Strategy Framework Directive (MSFD) require a robust set of tools for biological and chemical monitoring. For the MSFD in particular, causal links between contaminant and effects need to be assessed. Appropriate assessment tools are required in order to make an accurate evaluation. In this study, a range of recommended sediment bioassays and chemical measurements are assessed in a number of potentially impacted and lowly impacted locations around Ireland. Previously, assessment indices have been developed on individual compartments i.e. contaminant levels or biomarker/bioassay responses. A number of assessment indices are applied to chemical and ecotoxicological data from the Seachange project (PBA-ME-07-001) and compared to the Metal Pollution index (MPI), pollution load index (PLI) and Chapman index for chemistry as well as integrated biomarker response (IBR). The benefits and drawbacks of the use of indices and aggregation techniques are discussed. In addition to this, modelling of raw data is investigated to analyse links between contaminant and effects.

Keywords: ecotoxicity, contamination indices, bioassays, sediments, marine environment

Ecotoxicology

9. Ecotoxicogenomics: Validation of a quantitative PCR macroarray for use as a biomarker of exposure to pollutants in flounder

Michelle C. Giltrap[1,2], Michael Leaver[3], Kelly White[4], Adrian Maguire[2], Janina Baršienė[5], James G. Wilson[1], Craig D. Robinson[4]

[1]Zoology Department, Trinity College Dublin, Dublin 2, Ireland.

[2]Nanolab, Focas Institute, Dublin Institute of Technology, Kevin Street, Dublin 8, Ireland.

[3]Institute of Aquaculture, University of Stirling, Stirling, FK9 4LA, UK.

[4]Marine Scotland, Marine Laboratory, 375 Victoria Road, Aberdeen AB11 9DB, UK.

[5]Institute of Ecology of Vilnius University, Akademijos 2, LT-08412 Vilnius, Lithuania.

Corresponding Author Email Address: michelle.giltrap@dit.ie

For many years, there has been increasing concern about effects from the presence of hazardous substances in the marine environment. Chemical and biological effects (BE) monitoring of these pollutants has proven difficult due to low environmental concentrations, variable bioavailability, and the generalised nature of ecological responses to these substances. Biological response techniques (biomarkers) are rapidly increasing in relevance as tools to overcome problems with low chemical analysis detection limits and in linking of organismal responses to contaminant exposure. This study involves the validation of a quantitative PCR macroarray for use as a biomarker of exposure to pollutants in flounder. mRNA extraction and gene expression quantification are performed on flounder samples after exposure to model contaminants and these results are used to validate the macroarray. Model contaminants include 17β-estradiol (E2), 3-methylcholanthrene (3-MC), a commercial mixture of polychlorinated biphenyls (PCB; Arochlor), perfluoroctanoic acid (PFOA) and lindane. Statistical analysis of data from wild-caught flounder is also utilised to link up/down regulated genes to biological effects and contaminant data. The development of gene expression arrays offer the potential to determine changes in multiple relevant genes simultaneously and can infer pathways of toxicity and adverse outcomes in sentinel organisms used for bio-monitoring.

Keywords: ecotoxicogenomics, flounder; PCR macroarray, model contaminants, biological effects, contaminants

Ecotoxicology

10. Assessment of contaminated microplastics using nematodes as environmental indicators

Loriane Mwana-Scoe[1], Thomais Kakouli-Duarte[1], John Cleary[1]

[1]EnviroCore, Department of Science and Health, Institute of Technology Carlow, Kilkenny Road, Carlow, Ireland.

Corresponding Author Email Address: John.Cleary@itcarlow.ie

An urgent worldwide environmental fresh water issue, microplastics (MPs) are generally defined as plastic particles < 5 mm in diameter. The small size of MPs means they evade the filtration systems of waste water treatment plants thus presenting a potential hazard when discharged into marine and fresh water. This is due to the physical effects of ingestion by aquatic organisms, as well as the potential for these materials to leach toxic chemicals such as polychlorinated biphenyl (PCBs) and nonylphenols. There is therefore a need to understand the properties of MPs and their effects in the environment and this is the overall aim of this project. FTIR spectrophotometry was employed to determine the polymer type of the microbeads in commercial cosmetic products. The majority of the MPs recovered in such products are polyethylene. So far, FTIR analysis of microbeads exposed to freshwater samples shows significant changes after 3 weeks due to adsorption of chemicals and/or biofilm formation. Nematodes have such characteristics that enable them to be good bioindicators of environmental change. In this work the microbeads in fresh water are tested on several nematode species (*Caenorhabditis elegans, Heterorhabditis bacteriophora, Steinernema carpocapsae and Steinernema feltiae*) in order to observe their effects on these microinvertebrates. This will involve LD50 toxicity bioassays exposing nematodes to increasing MP concentrations, in 96-well plates, over 24 h, 48 h, 72 h and 96 h. The standardised ISO 10872:2010 protocol will be employed specifically to C. *elegans*, while currently cultures are being synchronised. This work is on-going and findings will aid understanding the effects of MPs on the biotic environment.

Keywords: microplastics, detection, FTIR, toxicity, nematodes, environmental bioindicators

Ecotoxicology

11. Ecotoxicological evaluation of the use of pUV on the aquaculture therapeutant Chloramine-T

Emer O Neill[1], Neil J. Rowan[2], Andrew M. Fogarty[1,2]

[1]Department of Life & Physical Sciences, Athlone Institute of Technology, Dublin Road, Athlone, Co. Westmeath, Ireland.

[2]Bioscience Research Institute, Athlone Institute of Technology, Dublin Road, Athlone, Co. Westmeath, Ireland.

Corresponding Author Email Address: afogarty@ait.ie

Chloramine-T is used in aquaculture to decrease bacterial contamination in recirculating aquaculture systems (RAS) and to increase intensification of fish production and harvesting. Chloramine-T is used at a concentration of 2 - 20 ppm in aquaculture. The licencing of aquaculture effluent discharging into freshwater ecosystem is under active consideration by the Environmental Protection Agency (EPA). This research investigates the use of pulse UV light treatment (pUV) to potentially treat effluent containing Chloramine-T before it is discharged from aquaculture facilities. Toxicity was determined by using a multi-trophic test battery. The *Pseudokirchneriella subcapitata* (alga) and the *Artemia salina* (crustacean) bioassays were used to determine toxicity of Chloramine-T both pre and post pUV treatment. *Artemia salina* yielded LC_{50s} of 672ppm (p = 0.8687) and 611ppm (p = 0.8345) at 24 and 48 hours respectively, pre pUV treatment. Post pUV treatment resulted in LC_{50} values of 373ppm (p = 0.7716) and 275ppm (p = 0.7424) at 24 and 48 hours respectively. For *Pseudokirchneriella subcapitata*, E_rC_{50} values of 2.14ppm (p = 0.8860) and 1.95ppm (p = 0.9613) at 72 and 96 hours respectively were observed pre pUV treatment. Whereas an E_rC_{50} values of 0.78ppm (p = 0.9174) and 0.85ppm (p = 0.9021) at 72 and 96 hours respectively were determined post pUV treatment. These preliminary results suggest that pUV treatment alone may not be the best choice to treat effluent containing Chloramine-T, as its use resulted in increased toxicities.

Keywords: Chloramine-T, Aquaculture, Recirculating Aquaculture Systems, pUV treatment, *Pseudokirchneriella subcapitata, Artemia salina.*

Ecotoxicology

12. Investigation of the variation of environmental toxins in water systems in Clara Bog

Sarah Healion[1], Andrew M. Fogarty[1,2] , Sile O Flaherty[1]

[1]Dept. of Life & Physical Sciences, Athlone Institute of Technology, Dublin Road, Athlone, Co. Westmeath, Ireland.

[2]Bioscience Research Institute, Athlone Institute of Technology, Dublin Road, Athlone, Co. Westmeath, Ireland.

Corresponding Author Email Address: soflaherty@ait.ie

Irish bogs have suffered a lot damage from human activities such as peat extraction and agricultural works which has a major impact on the bog hydrology. Peat extraction is carried out with the use of drainage ditches to cause drying for ease of extraction. When an area of bog has undergone such drying, shrinkage occurs which affects the absorption of water from outside sources such as agricultural run- off, streams and rain. Bogs are known for their acidic and anaerobic nature with these conditions unlikely to support many types of plant growth outside the realm of bryophytes e.g. Sphagnum genus. Despite this fact, abnormal plant growth has been identified in Clara Bog, raising the question of the origin of the supporting factors, which is hypothesised to be caused by external water sources contaminating the bog ecosystem. A battery of physico-chemical tests including pH, alkalinity, conductivity, dissolved solids, suspended solids, colour and the Langlier Index were carried out on water samples from different areas of the bog. Biochemical Oxygen Demand (BOD), Chemical Oxygen Demand (COD), Nitrogen, Phosphorous, Ammonium and trace metal analyses were also performed. The results of this project has yielded interesting results which shows the distribution of environmental toxins with in Clara Bog.

Keywords: Bog, environmental toxins, physico-chemical analyses

Ecotoxicology

13. The phytotoxicity of MCPA on 'green tide' macroalgal species

Edna Curley[1,2], Ricardo Bermejo[1,2], Liam Morrison[1,2]

[1] Irish Seaweed Research Group, Ryan Institute and School of Natural Sciences, National University of Ireland, Galway, Co. Galway, Ireland.

[2] Earth and Ocean Sciences Department, Ryan Institute and School of Natural Sciences, National University of Ireland, Galway, Co. Galway, Ireland.

Corresponding Author Email Address: edna.curley@nuigalway.ie

Numerous water monitoring studies globally have demonstrated the considerable potential for contamination of surface waters by pesticides. The term 'pesticide' encompassing plant protection products (PPP's), biocidal products and certain veterinary medicines. In forestry, agriculture and horticulture, PPP's are used as agents to protect plants from disease, insect pests or weeds and other harmful organisms which are injurious to the health and integrity of the plant. However, in the aquatic ecosystem, pesticides, when present in quantities sufficient to exert their toxic effect, can have a detrimental effect on the health of fish or other aquatic organisms. The phenoxy herbicide, MCPA (2-methyl-4-chlorophenoxyacetic acid), and associated by-products, is widely used in forestry and agricultural production, potentially entering waterbodies through direct application, surface runoff, spray drift and drainage. MCPA, is a post-emergence broad leaf herbicide, functionally similar to naturally occurring plant growth regulators causing malfunctions in growth processes. In a series of laboratory experiments, the vegetative growth and photosynthetic rate of two 'green tide' macroalgal species were examined under a range of MCPA concentrations corresponding to the effective concentration (EC) values, to evaluate the toxicity of MCPA to non-target aquatic plant species.

Keywords: MCPA, green tide, phytotoxicity, macroalgae,

Energy

14. Socio-technical energy transition frameworks for sustainable energy communities

Anitha Sampath[1], John Lohan[1], Gabriel J Costello[1]

[1]Galway Mayo Institute of Technology, Ireland.

Corresponding Author Email Address: anitha.sampath@research.gmit.ie

The Sustainable Energy Authority of Ireland (SEAI) is Ireland's national energy authority with the mission of transforming Ireland into a society based on sustainable energy structures, technologies and practices. One of the main pillars of its thrust to meet this challenging objective is the Sustainable Energy Communities (SEC) Programme. Since 2012, SEAI has been very successful in motivating around 60 communities to participate in the SEC network. However, the challenge of transitioning from a fossil fuel system to a sustainable energy system is not merely a technological problem but a wider societal issue. In this context, the paper provides initial thoughts on developing a framework for socio-technical energy transitions for communities. Energy transition for communities need to include an economic, environmental and social perspectives while retaining the technical component. The various academic frameworks available for energy transitions deal with global or national scale transitions. There is need for academic work situating transitions in a regional and spatial context. In this context, the paper will look at analysing energy transition in the West of Ireland from a sustainable energy community's perspective. The goal of this research is to develop a framework for energy transition for sustainable energy communities in Ireland. This paper will outline the evolution of SECs in Ireland and present initial findings on main social and technical enablers for and barriers to transition into a low carbon energy system for communities in the West of Ireland. The paper will also discuss how these enablers and barriers might be better addressed through a socio-technical approach. This paper will present the results of initial findings from this project and provide the basis for a detailed primary as well as secondary research work on sustainable energy communities in the west of Ireland.

Keywords: sustainable energy communities, renewable energy, energy transitions

Energy

15. Participatory design for building energy retrofit: benefits, barriers and potential Solutions

Paul O'Connor[1], Niall Dunphy[1], Rosemarie Mac Sweeney[1]

[1]Cleaner Production Promotion Unit (CPPU), School of Engineering, University College Cork, Ireland.

Corresponding Author Email Address: poconnor@ucc.ie

In conventional energy retrofit projects, building occupants are typically not involved in the design process to any great extent. Where occupants are acknowledged, they are often seen as simply another variable to take into account or as potentially posing problems for the post-occupancy optimisation of retrofit solutions. As a result, the interventions selected can be either unsuitable for occupants or end up being incorrectly used by them, thus increasing the gap between the energy performance of the building as designed and that actually realised. The H2020-funded NewTREND project intends to address this problem by including building occupants (and users) throughout the course of the design process. Initial research, involving over 50 interviews with construction industry stakeholders from across Europe and participatory workshops with building occupants in Finland, Hungary and Spain, has sought to gain a clearer picture of the current state of play regarding participatory design in the area of energy retrofit, and understand the interests, drivers and motivations of both professional stakeholders and building occupants. This paper will present the initial findings of the research, and suggest how they can help devise novel approaches to help foster occupant and user involvement in retrofit, leading to improved outcomes in terms of both energy efficiency, occupant (and user) satisfaction, and environmental awareness.

Keywords: building energy retrofit, participatory design, building occupants and users, industry stakeholders

Energy

16. High-rate low-temperature anaerobic digestion of municipal wastewater

Darren Mc Hugh[1,2], B. Conall Holohan[1,2], Dermot Hughes[2], Michael Murray[2], Vincent O'Flaherty[1]

[1]Microbiology, School of Natural Sciences, National University of Ireland, Galway, University Road, Galway, Ireland.

[2]NVP Energy, Galway Technology Centre, Mervue Business Park, Mervue, Galway, Ireland.

Corresponding Author Email Address: d.mchugh8@nuigalway.ie

Municipal wastewater (MWW) is conventionally treated using aerobic activated sludge systems, this method is an unsustainable process. It requires large amounts energy input and in turn produces significant volumes of waste sludge requiring further treatment and disposal. The possibility of directly treating the MWW through anaerobic digestion (AD) would be advantageous due to very low waste sludge production coupled with energy (in the form of biogas) recovery. A D has been successfully implemented for MWW in tropical regions, such as Brazil and Columbia, but not yet in temperate regions due to lower ambient temperatures and more dilute wastewaters. In order to implement this technology in temperate regions the system would be required to operate at low temperatures below 20 °C as heating the wastewater would be not be economically feasible. Low-temperature anaerobic digestion (6–15 °C) has already been proven as a viable treatment method for higher strength industrial wastewater, but high-rate anaerobic digestion of low strength wastewaters, such as MWW remains a challenge. This research aims to investigate high-rate low-temperature anaerobic digestion as a viable treatment alternative for treating raw MWW in temperate regions. Additionally, the establishment of a pilot-scale anaerobic treatment system at the Tuam Water Research Facility will test the feasibility of this technology under Irish conditions. Through the evaluation of the microbial community structure and physical properties of the granular biofilms present in the reactors throughout the trial, the underlying, long-term, microbiological stability of the low-temperature anaerobic treatment will be assessed for MWW treatment.

Keywords: low-temperature anaerobic digestion, high-rate, low strength, municipal wastewater

Environment and Human Health

17. A pilot investigation of passive Indoor Nature Exposure (INE) on pain, fatigue & stress in adults with Fibromyalgia (FM)

Patricia Darcy[1], Sinead Conneely[1]

[1]NUI Galway School of Psychology, NUI Galway, Galway, Ireland.

Corresponding Author Email Address: darcypm444@gmail.com

The present research examined the feasibility of passive INE as a health and stress intervention for adults with FM, where 12 FM patients were randomly assigned to either a 4-week INE intervention or wait-list control group. FM is a complex chronic condition characterised by widespread muscoskeletal pain accompanied by chronic fatigue, and impaired physical and cognitive function. Stress is reported to play an exacerbating role in FM, with a growing body of research providing support for Hypothalamus-Pituitary-Adrenal (HPA) dysregulation in FM, as indicated by an abnormal cortisol response. In comparison, exposure to nature has been shown to be restorative, from passive viewing of nature to green exercise and horticultural therapy. Recent research provides support for a possible salutogenic interaction between nature and the HPA axis. While previous research has typically focused on outdoor nature exposure or acute conditions, the present study sought to address a gap in the literature, by applying INE in a clinical population with chronic pain and chronic fatigue. The results showed that a four-week INE intervention, compared with no intervention, resulted in a significant improvement on self-report FM health status (functioning, overall impact and symptom severity), while controlling for nature relatedness. While the mean data showed a trend towards lower scores on fatigue, pain severity, and physiological stress, for the intervention group compared with control, the difference between groups over time was not statistically significant. Additionally, INE was not found to have a significant impact on perceived stress for adults with FM. Passive INE may have therapeutic relevance where FM patients report pain and fatigue that result in a disruption to normal daily routine or inability to partake in physical exercise. The present study may therefore offer some preliminary evidence for the therapeutic relevance of passive INE as a restorative intervention in the self-management of FM.

Keywords: nature based intervention, health, fibromyalgia, stress, pain

Environment and Human Health

18. A big data approach for understanding environmental risk factors for auto-immune disease flare

Brian P. Reddy[1,2], Brett Houlding[2], Lucy Hederman[2], Fumni Akinbola[1], Fumni Balogun[1], Mark Little[1]

[1]Trinity Health Kidney Centre, School of Medicine, Trinity College, Dublin 2, Ireland.

[2]School of Computer Science and Statistics, Trinity College, Dublin 2, Ireland.

Corresponding Author Email Address: reddybr@tcd.ie

ANCA vasculitis is a relapsing and remitting, rare autoimmune disease. 'Flares' of the disease can result in rapid kidney impairment and destruction of other organs, and cannot currently be predicted with accuracy. Treatments to reduce the risk of flares occurring are toxic, and ideally should not be taken unless necessary. Epidemiological data support a strong environmental impact on flare risk, but it has previously proven difficult to identify exactly which environmental components are relevant. We are using an unbiased big data approach, integrating a wide array of unstructured data streams, prospectively attempting to define the 'signature' of the disease's relapse. In addition to clinical data, patients will download a mobile phone app that will record regular exercise and quality of life data. Suspected environmental factors, such as infectious disease rates, weather and pollution, can also be matched with local conditions based upon its GPS data. We have used kriging techniques to generate national maps of daily weather conditions at all points in the country, rather than simply those available at weather stations. These will be matched with patient movements. Similar approaches are applied for pollutants. Kriging has successfully allowed daily mapping of conditions across a 100*100 grid nationally, over a 15-year period; sample results are presented. Known data are also listed. The ultimate goal of this programme is to allow patient-level risk factors to be better identified, allowing benefits and risks of anti-flare treatments to be weighed up. This approach to understanding chronic conditions governed by interaction between patient-level factors and their environment is novel, and could be scaled up. There are a wide variety of environmental data available, from the EPA and Met Éireann in particular. We are particularly keen to discuss other data sources further, alongside relevant modelling approaches, before the next project stage.

Keywords: pollution, weather, environmental risk, modelling, health, vasculitis, autoimmune, disease, flare, kriging

Environment and Human Health

19. Concept thresholds for the introduction of sensory and emotional intelligence into architectural design education

Aoife Hayes[1]

[1]Department of Architecture, CIT, Melbourne Road, Bishopstown, Cork, Ireland.

Corresponding Author Email Address: aoife.hayes@mycit.ie

The 21st century, as a whole, has seen massive developments in smart technologies, environmental strategies and architectural form. The 3D built environment is advancing on a daily basis, but has become a very 2D experience, frontloaded with screened imagery and visual stimuli, which has encouraged a trend of *ocularcentric* dominance. Unfortunately, as a result of this, the human experience is often lost. This disconnect, whereby architecture is borderline art, may be associated with the rapid advancement of visual-representation techniques in architectural design. The prioritisation of the multi-sensorial human experience is not only at threat from this visual predominance, but also environmental concerns and economy seem to hold a greater place on the hierarchy. Research carried out by the WHO established that the majority of people, spend up to 90% of their time inside, and yet this does not reflect the positioning of the human experience within the design process. By continuing to rely on one sensory modality, our built environment is increasingly failing to respond to the sensory and emotional needs of the user. Developing a level of awareness among the architectural design community is essential in order to reposition the human experience throughout the design process. Although there is no immediate solution, education can play a key role in addressing this issue. If the education system begins to supply industry with graduates, who hold an awareness and knowledge for the multi-sensorial human experience, this in turn, will encourage a more human-centred approach in industry. These posters demonstrate the necessary educational concept thresholds, needed to integrate sensory-sensitive course content into architectural education.

Keywords: concept thresholds, education, multi-sensory, human experience

Environment and Human Health

20. What impact does air quality have on short run productivity? Evidence from marathon running performance in Ireland

Elisa Organ[1], Thomas McDermott[1]

[1]Department of Economics, National University of Ireland at University College, Cork, Ireland.

Corresponding Author Email Address: 115224252@umail.ucc.ie

The broader goal of this project is to investigate the causal effects of ambient air pollution exposure on human performance/productivity. This study is the first study in an Irish context to test the relationship between air pollution and Productivity through a means of Marathon finishing times. Measuring the impacts on human well-being and short-term productivity represents a means of quantifying costs imposed on society and the economy by ambient air pollution. In this paper, we estimate the causal effect of ambient air pollution on individuals' productivity by using panel data on athletic performance on the National Marathon Championships of Ireland over the period 2009-2014. Combining this data with hourly/daily information on the concentration of NOx, O3, PM10, PM2.5 and weather conditions from the EPA's Air Quality Monitoring sites in proximity to the National Marathon meets. The results confirm and extend recent evidence on the negative effects of ambient air pollution on short run productivity while controlling for weather conditions as well as fixed effects of athletic individual ability. The impact of air pollution on athletic performance differs by Gender and by Age category, having a greater impact on females and those in the age category of 50 plus. I find significant reductions in performance associated with increased levels of both NOx and Ozone. These results suggest that the effects of these pollutants on the respiratory system involved in aerobic metabolism are present at even relatively low levels of exposure and among groups who would not be considered vulnerable to air pollution. While this measurable effect on Marathon performance is of main interest, it is also an indicative factor of a broad range of costs imposed on society as a result of air pollution. This analysis highlights that economic consequences of environmental pollution are not just limited to the adverse impacts on Human Health. Air quality at moderate levels well below Air Quality standards have been seen to negatively affect the productivity of a selective group of individuals – Marathon Runners a fit and healthy population.

Keywords: ambient air pollution, environment, endurance events, national marathon championships of Ireland, productivity, performance, Ireland

Environmental Policy and Communications

21. An enhancement of environmental awareness by piloting e-learning from nature in outdoor learning ecosystems

Josephine Treacy[1], Marie Walsh[1]

[1]Department of Applied Science, Limerick Institute of Technology, Moylish Park, Limerick, Ireland.

Corresponding Authors Email Addresses: josephine.treacy@lit.ie

Contact with the environment has many benefits including educational, health, cultural and social. Learning through nature has the potential to inspire and enthuse students by providing them with memorable experiences to appreciate the importance of environmental conservation and sustainability. The integration of E-learning from nature and an appreciation of the natural environment can filter outwards to the wider community. This poster will review the different types of learning styles that can benefit from outdoor learning. An overview of the countries geological locations and ecosystems involved in this project will be presented. The importance of the conservation and sustainability of ecosystems in line with the European commission habitats directive and Natura 2000 will be reviewed. This project aids to communicate environmental sustainability at an international level by facilitating a proactive approach to scientific subject learning in a number of European secondary schools. The project partners namely Belgium, Greece, Italy, Lithuania, Portugal, Romania and Ireland, actively promote E-learning from nature with the purpose of enhancing its impact, foster its visibility and ensure its sustainability. This E-learning from nature project in the framework of the Erasmus + programme aims to promote scientific skills and competences.

Keywords: E-learning from nature, environment appreciation

Environmental Socioeconomics

22. Sustainable achievement of an integrated local economy in a sensitive area

John Bartlett[1], Angela Bartlett[2], Catherine McGuinn[2]

[1]Research Office, Institute of Technology, Sligo, Ireland.

[2]School of Business and Social Sciences, Institute of Technology, Sligo, Ireland.

Corresponding Author Email Address: bartlett.john@itsligo.ie

The village of Strandhill in Sligo is situated in an area of outstanding natural beauty on a peninsula that includes a Special Area of Conservation. It has developed, carefully and incrementally, over almost 100 years, a successful local economy, based on tourism, water sports, crafts, culture and services, that is balanced with the requirements of good environmental management and protection. Environmental considerations in the area include erosion, dune protection, sensitive species habitat protection, wastewater management, traffic management, housing development, provision for public recreation and public education/engagement. A number of specific initiatives have been taken to protect and enhance environmental elements. This poster presents the outputs of a case-study of the history of the development of the local economy and of the factors that currently make it effective, successful and sustainable. The study is based on literature/report review and in-depth semi-structured interviews with key stakeholders including business owners, local development associations, planners, development agencies, local residents and visitors.

Keywords: energy, sustainability, community

Environmental Socioeconomics

23. Sustainable energy communities in action

John Bartlett[1], Mel Gavin[1], Leo Murray[1], Paul McNama[1]

[1]Contract Research Unit, Research Office, Institute of Technology, Sligo, Ireland.

Corresponding Author Email Address: bartlett.john@itsligo.ie

A Sustainable Energy Community (SEC) is a community in which everyone works together to develop a sustainable energy system. To do so, they aim as far as possible to be energy efficient, to use renewable energy where feasible and to develop decentralised energy supplies. The Sustainable Energy Authority of Ireland (SEAI) runs a funding programme to support the formation and operation of these communities, and has a further funding programme, Better Energy Communities, that provides capital funding for some projects. IT Sligo, along with our partners Plan Energy Consulting, have been successful in tendering to SEAI to mentor SECs in the border region through a long term partnership with SEAI, and to provide technical support for community based energy projects across the full national SEC network. We are currently supporting 15 SECs, which include all the different energy users in the community including homes, sports clubs, community centres, public sector buildings, churches and businesses. This poster reports on the SEC programme with examples of the process of the formation of particular groups, from proposal, to achievement and operation.

Keywords: energy, sustainability, community

Invasive Species

24. Biological control of the emerging mosquito problem in Britain and Ireland

Ross N. Cuthbert[1], Jaimie T.A. Dick[1], Neil Reid[1], Amanda Callaghan[2]

[1]Institute for Global Food Security, School of Biological Sciences, Queen's University Belfast, Belfast, Northern Ireland.

[2]Environmental and Evolutionary Biology, School of Biological Sciences, University of Reading, Reading, UK.

Corresponding Author Email Address: rcuthbert03@qub.ac.uk

Climate change, the urban 'heat island' effect and wetland expansion schemes are combining to favour the increased proliferation of mosquitoes in Britain and Ireland, leading to greater nuisance biting and a heightened risk of disease transmission. Coupled with this, globalisation and changing domestic water storage practices are increasing the risk of invasive mosquito species becoming established, many of which act as suitable vectors for a range of diseases. Biological control of mosquitoes can be an effective, environmentally sustainable option, particularly as many chemical approaches have unresolved issues relating to resistance and non-target effects. This research will seek to optimise biological control of mosquitoes using native predators. Numerical and functional responses will be applied to derive predatory potential both between and within species. Species combinations will additionally be assessed to reveal the most efficient combinations for mosquito control across habitats. Additional abiotic and biotic contexts will be explicitly integrated into experiments to provide a more empirically representative account of the effectiveness of agents under differing environmental conditions. Furthermore, variations in the predation efficiency within species will be harnessed to facilitate the creation of breeding selection lines that will enhance predatory traits, such as elevated rates of killing through partial prey consumption.

Keywords: biological control, mosquito, total response

Invasive Species

25. On the RIP: using Relative Impact Potential to assess the ecological impacts of invasive species

James W.E. Dickey[1], Jaimie T.A. Dick[1], Ross N. Cuthbert[1]

[1]Institute for Global Food Security, School of Biological Sciences, Queen's University Belfast, MBC, 97 Lisburn Road, Belfast, Northern Ireland, BT9 7BL, UK.

Corresponding Author Email Address: jdickey03@qub.ac.uk

Predicting which non-native species are likely to become invasive, and areas most vulnerable to their arrival, are goals integral to invasion ecology. IAS management has proven difficult in the past, with certain high-profile failures, and as a result, prevention has been deemed the most effective option. IUCN's Aichi Biodiversity Targets and recent EU legislation (Regulation No 1143/2014) are adding impetus for countries to develop evidence-based lists of species deemed likely to impact upon biodiversity or ecosystem services. However, for this to be effective, greater predictive powers are required, as are improved means of quantifying impact. Step forward RIP. This new metric for predicting impact blends (1) the classic Functional Response (FR; consumer per capita effect) and Numerical Response (NR; consumer population response), that is, the Total Response (TR = FR × NR), with; (2) the "Parker-Lonsdale equation", where Impact = Range × Abundance × Effect, to give; (3) RIP = FR × NR_{proxy}. RIP is an invader/native ratio, whereby values >1 predict that invader ecological impact will occur, with larger numbers indicating increasing impact. While FR studies have been used successfully in invasion ecology in recent years, RIP retains the positives offered, while adding crucial benefits, giving a more rounded means of prediction. RIP can take into account low abundance high impact species, as well as high abundance low impact species which would be ignored using FR. Like FR, it allows customisation for context dependencies such as temperature, oxygen, salinity, parasitic infection and multiple predator effects. An overview of the different proxies available for the NR component of the equation will be outlined, and the different study areas for which RIP will readily lend itself will be discussed, showing the metric to be a vital explanatory and predictive tool for scientists, managers, practitioners and legislators.

Keywords: context-dependence, ecological impact, functional response, numerical response, relative impact potential

Invasive Species

26. Impatiens glandulifera: the white vs the purple morph scenario. A phenotypical shift underling an invasiveness change?

Stephanie Coakley[1], Gary Cahill[1], Brian O'Rourke[1], Anne-Marie Enright[1], Carloalberto Petti[1]

[1]EnviroCore, Institute of Technology Carlow, Kilkenny Road, Carlow, Ireland.

Corresponding Author Email Address: Stephanie.Coakley@itcarlow.ie

Impatiens *glandulifera*, or Himalayan balsam, is renowned for the "spectacular invasion" it has generated across Europe. Originally intended as a garden ornamental species, I. *glandulifera* now thrives in ever-expanding territories. As Europe's largest annual, it dominates the aerial environment with ease. An early emergence and a rapid growth rate enables *I. glandulifera* to quickly out-compete native flora. *I. glandulifera* produces up to 2,500 seeds per plant; these seeds are dispersed ballistically, aiding the spread of the species. Impatiens *glandulifera* presents a significant threat to the conservation of biodiversity, particularly in the riparian environments in which it prevalently grows. In County Carlow, there is a large population of *I. glandulifera* in which a rare white morph of the flower dominates. Though white variants of flowers are generally rare, they have been observed to persist in larger numbers within a population where there is an ecological advantage. Could the alteration in pigmentation be associated with a shift in invasive status (i.e. the white morph being more invasive)? Thus, various biological elements correlated with invasiveness are investigated within the population of *I. glandulifera*. The white morph and the purple wildtype are juxtaposed to determine any competitive advantage associated with the change in pigmentation. The UV and Visible spectrum of the flowers of the wildtype and white morph were examined in an attempt to ascertain if one may be more visually compelling to their pollinators. Preliminary studies have shown differences between the two colour variants, particularly in the 200-250 nm region. Attractiveness to pollinators is associated with the reproductive success of a species and *I. glandulifera* is noted to attract pollinators away from native flora.

Keywords: impatiens *glandulifera*, invasive, white morph, phenotype

Marine and Coastal

27. The application of Copernicus satellite-borne remote sensors for monitoring coastal erosion in Ireland

Daithí Maguire[1], Eugene Farrell[1]

[1]School of Geography and Archaeology, National University of Ireland, Galway, Ireland.

Corresponding Author Email Address: d.maguire@nuigalway.ie

Advances in the resolution and availability of imagery data from satellite-borne remote sensors have presented an opportunity to utilise the data for near real-time monitoring of coastal erosion. A feasibility study was carried out to evaluate if synthetic aperture radar (SAR) and multispectral (MS) imagery, freely acquired from the European Space Agency's Copernicus Programme, is of sufficient quality for monitoring coastal erosion. An active coastal erosion study site on the Dingle Peninsula in County Kerry was used to facilitate the evaluation. A series of DEMs, radar images and spectral band images were generated using imagery acquired by the Sentinel-1A and Sentinel-2A satellites during the summer months of 2016. The spatial resolution of the DEMs and images was evaluated by comparing them against a recent DGPS survey of the shoreline position, aerial photography, and a reference DEM generated from the 2001 Shuttle Radar Topography Mission. The temporal resolution of the data was determined by examining the availability of SAR and MS imagery of the study site over an 8-month sample period. The quality of the DEMs generated from the Sentinel-1A SAR imagery was extremely poor due to the effects of temporal decorrelation. Topographical features on the peninsula were mostly unrecognisable in all of the DEMs, and elevations were broadly inconsistent. Shoreline features were recognisable in SAR and MS imagery; however the spatial resolution was not of sufficient quality for coastal erosion monitoring purposes. Overall, imagery from the Sentinel-1 and Sentinel-2 satellites appears to be unsuitable for the planned application. However further evaluation will be carried out on the Sentinel-1 imagery in the next phase of the research using more advanced analysis techniques such as polarimetric interferometry and persistent scatterer interferometry. It is also planned to acquire higher resolution SAR imagery from commercial satellites such as TerraSAR-X and TanDEM-X.

Keywords: synthetic aperture radar, SAR, coastal erosion, interferometry, multispectral

Marine and Coastal

28. Impact of submarine groundwater discharge to coastal inlets on phytoplankton dynamics

Clynton Gregory[1], Rachel Cave[1], Robin Raine[1]

[1]Earth and Ocean Sciences, NUI Galway, University Road, Galway, Co. Galway, Ireland.

Corresponding Author Email Address: c.gregory1@nuigalway.ie

Semi-enclosed coastal inlets are susceptible to fluctuations in forcing variables, in particular nutrient inputs. Variances can result from tidal effects, winds, rainfall, river and groundwater discharges, drainage of agricultural lands and industrially derived or domestic effluents. I n extreme circumstances these can encourage the development of exceptional blooms of microalgae (phytoplankton), which can be harmful to the marine ecosystem, to human health, or lead to eutrophication and consequent loss in water quality. The concept of runoff enriched in nutrients from agriculture, sewage and industrial waste leading to eutrophication is well understood in general terms. However, to date research on coastal waters has concentrated on point sources and/or riverine inputs. Many coastal zones worldwide are influenced by submarine groundwater discharge (SGD) inputs, which are frequently enriched in nutrients. Many such inlets and estuarine zones support shellfish aquaculture, which is adversely affected by Harmful Algal Blooms (HABs). This study is focused on two semi-enclosed bays (Kinvarra and Aughinish) in the south-east corner of Galway Bay, west coast of Ireland. Preliminary studies indicate SGD driven nutrients, circulated within an inner bay retention area, are a source for enhanced primary production which could lead to HABs and ultimately periodic closure of local shellfish aquaculture sites.

Keywords: harmful algal bloom, submarine groundwater discharge

Marine and Coastal

29. Historical water quality data from Galway Bay

R.R. Cave[1], R. Barrett[1], C. Fenton[1], J. Kelly[1], A. McLoughlin[1], J. Murphy[1], J. O'Driscoll[1], P. Togher[1]

[1]Earth and Ocean Sciences, School of Natural Sciences, National University of Ireland Galway, University Road, Galway, Ireland.

Corresponding Author Email Address: Rachel.Cave@nuigalway.ie

In 1972 an oceanographic survey programme was initiated in Galway Bay that collected and analysed seawater samples at monthly intervals from 1972 to 1984. The Oceanography Department at NUI Galway collected and compiled the data into paper reports, which were almost lost forever in a fire in 1996. In 2016, a group of final year Earth & Ocean Sciences students began digitising the data into a database which, when completed, will be made available through the Marine Institute to the science community. This is one of the very few oceanographic data sets from western Irish waters prior to the 1990s when the Marine Institute began its work. These data are being evaluated to see how parameters such as water temperature, salinity, oxygen, chlorophyll and nutrients in Galway Bay waters evolve from month to month over the course of any given year and to see how they differ between years. The data are compared with similar data collected on student training surveys in Galway Bay between 2007-2016. Sea surface temperature (SST) data are also compared with the Malin Head SST dataset, collected twice daily since the 1950s. This rare dataset provides a baseline from the 1970s and 1980s of conditions in Galway Bay which may be of interest to biologists, oceanographers and climate scientists.

Keywords: coastal water quality, long-term dataset, climate change

Marine and Coastal

30. Mechanical testing of degraded plastic marine litter to assess their processing capabilities

Irene Villafañe[1], Colin Keogh[2], Tom Curran[1], Emmanue[l] G. Reynaud[3]

[1]UCD School of Biosystems and Food Engineering, Agriculture & Food Science Centre, Dublin 4, Ireland.

[2]School of Mechanical and Materials, UCD Engineering and Materials Science Centre, Dublin 4, Ireland.

[3]School of Biomolecular and Biomedical Science, UCD Science Centre, Belfield, Dublin 4, Ireland.

Corresponding Author Email Address: irene.villafane@ucdconnect.ie

Due to their increased consumption and high resistance to degradation, plastic materials and their littering is a major environmental concern. In order to reduce this plastic pollution, the Printastic Project aims to reuse, repurpose and recycle those materials using low tech innovative solutions to enable local communities and authorities to process them efficiently and to collect them correctly while limiting further plastic littering. In order to effectively utilise those degraded plastic materials, this work undertook mechanical testing of a selection of common marine waste polymer samples (PET, HDPE/LDPE) to assess their mechanical properties in comparison to reference samples. A number of polymer test samples were produced utilising recycled plastic materials, and subsequently tested for mechanical strength. Control samples were produced from polymer material degraded under laboratory conditions, and tested in parallel. Control and test polymers were analysed for their optical properties, with a view to finding correlations between optically properties and inherent mechanical properties. The main aim of this work is to establish a procedure to evaluate the potential mechanical properties of waste materials utilising visual inspection methods. The results of this study could allow largescale identification of valuable marine waste materials in various environmental contexts.

Keywords: polymer, waste, marine, engineering, mechanical testing, pollution, PET, HDPE, LDPE

Marine and Coastal

31. A new approach to inshore biodiversity monitoring

Rory O'Callaghan[1]

Seasearch Ireland.

Corresponding Author Email Address: Ocallaghan_rory@hotmail.com

Seasearch Ireland is a citizen science initiative to encourage SCUBA divers to document details of species seen during marine dives to help build the knowledge base on the distribution of marine species in Ireland's in-shore waters. To date a total of 46,927 species observations of 1,147 species have been collected from 1,115 site visits. Seasearch Ireland operates on an open-data policy, with the data sets being provided to the National Biodiversity Data Centre, from where they are made publically available. In 2016 Seasearch Ireland undertook the pilot phase of a new initiative to record inshore biodiversity through the use of SCUBA, the National Citizen Science Marine Monitoring Scheme. The objective is to increase the capacity for biological recording within the diving community in Ireland to deliver both quantitative and qualitative data on Irish inshore biodiversity. The pilot phase of the scheme collected data from 51 visits to 11 sites gathering abundance data on a specified list of 96 species or species complexes with recruitment for the roll out of the scheme nationally in 2017 currently underway. By repeatedly surveying of the same site changes in populations of key species and biodiversity generally at inshore sites around the country can be monitored. By liaising with the various state bodies involved in marine monitoring and academic institutions it is hoped to recruit further participants to the scheme and facilitate the collection of more detailed biological records.

Keywords: citizen science, biodiversity, marine, monitoring

Marine and Coastal

32. Incorporating your views into a novel fisheries management system

Debbi Pedreschi[1], Hannes Höffle[2], Sarah Kraak[3], Amos Barkai[4], Keith Farnsworth[2], David Reid[1]

[1]Marine Institute, Rinville, Oranmore, Co. Galway, Ireland.

[2]School of Biological Sciences, Queen's University Belfast, 97 Lisburn Road, Belfast, BT9 7BL, Northern Ireland.

[3]Thünen Institute of Baltic Sea Fisheries, Alter Hafen Süd 2,18069 Rostock, Germany.

[4]Olrac-SPS, Silvermine House, Steenberg Office Park, Tokai, Cape Town, South Africa.

Corresponding Author Email Address: debbi.pedreschi@marine.ie

Real-time Incentives (RTI) management aims to offer a viable alternative to current management systems that can operate on fine spatial and temporal scales whilst incorporating ecosystem management, simplifying implementation and compliance rules, increasing freedom for fishers and incorporating their views. In order to ensure its success, legitimacy, and eventual uptake, a comprehensive management strategy evaluation (MSE) must first be carried out. This process involves the development of scenarios with which to test the system, not just for comparison with current management strategies, but also to simulate the range of potential fisher behaviour, reactions and responses. The project partners are working alongside fishery stakeholders, co-developing methods and management scenarios, and trialling ideas, in a two-way process of development that aims to enable successful implementation through stakeholder engagement and acceptance. The process is open and collaborative, and even in its infancy has already produced some innovative and unexpected results. The aim of this poster is to highlight this work, and to provide information and a contact point for getting involved. To continue this work we need your help.

Keywords: real-time incentives, fisheries management, stakeholder engagement, management strategy evaluation

Nanotechnology and the Environment

33. Potential human exposure to silver nanoparticles from surface water sources

David Shevlin[1], Enda Cummins[1]

[1]UCD School of Biosystems and Food Engineering, University College Dublin, Belfield, Dublin 4, Ireland.

Corresponding Author Email Address: davidshevlin1@gmail.com

Silver nanoparticles (AgNPs) are incorporated in an ever increasing range of commercial and consumer products. Wastewater treatment removal efficiencies may not be adequate for complete removal of nano particles, consequently resulting in fractions of silver nanoparticles being directly released to surface waters through effluent discharges. The fate and behaviour of nanomaterials in surface waters is still surrounded by considerable uncertainty. Surface waters provide ~81.6% of drinking water supplies in Ireland and the presence of persistent nanoparticles my pose a health risk. A framework probabilistic model investigating the fate of AgNPs through the aquatic environment was developed. Preliminary results from the exposure model (assuming an initial hypothetical case study with 0.01 µg/L entering the surface water) indicated sub (µg/ L) levels of nano silver in surface waters, with a mean value of 4.26 E^{-4} µg/ L (90th percentile range 1.19 E^{-4} - 7.71 E^{-4} µg/ L) and 4.21 E^{-4} µg/ L (90th percentile range 1.14 E^{-4} - 7.69 E^{-4} µg/ L) for citrate and PVP coated AgNPs, respectfully for a scenario representing summer environmental conditions. Preliminary results for post treatment drinking water obtained from surface water abstraction for the same season indicated mean values of 4.23 E^{-5} µg/ L (90th percentile range 1.00 E^{-6} - 1.72^{-4} µg/ L) and 4.20 E^{-5} (90th percentile range 1.00 E^{-6} - 1.63 E^{-4} µg/ L) for citrate and PVP coated AgNPs, respectfully. While exposure is low, NP toxicity is still a large unknown with the effects of chronic exposure yet to be determined. While estimated AgNP levels in surface water and exposure and are in the sub µg/ L range, concentrations are expected to increase with further utilization of NPs in an ever-increasing range of products and processes.

Keywords: risk assessment, nanoparticles, drinking water

Nanotechnology and the Environment

34. Development of a lab-on-chip electrochemical immunosensor for detection of Polycyclic Aromatic Hydrocarbons (PAH) in environmental water

Shifa Felemban[1,2], Patricia Vazquez[2], Eric Moore[3]

[1]Tyndall National Institute, Lee Maltings Complex, Dyke Parade, Mardyke, Cork, Ireland.

[2]UCC School of Chemistry, University College Cork, College Rd, Cork, Ireland.

Corresponding Author Email Address: shifa.felemban@tyndall.ie

Polycyclic Aromatic Hydrocarbons (PAHs) refer to a large family of organic compounds consisting of carbon and hydrogen atoms, which present an important threat as environmental pollutants. PAH contamination has been reported to increase cancer risk in humans. It is therefore of great importance to avail of a method to detect them. Current techniques applied for PAH detection in water demand complex analysis, in addition to being time-consuming and no possibility of portability. The work presented here shows a method that integrates immuno-assay techniques and electrochemical techniques to develop a portable and accurate solution for detection of PAH in water. The integration of these techniques can attain the low limits of detection that are required in the analysis of water samples in-situ and in real time. Our integrative approaches take advantage of microfluidic technology, facilitating real-time detection of this family of toxic pollutants. The lab-on-a-chip platform has a three-electrode system that facilitates integrating on-chip electrochemical measurements with immuno-sensing techniques. The application of a lab-on-a-chip platform offers a portable solution that can be used in households, therefore avoiding dependence on costly tools that are presently installed and used in specialized laboratories. In conclusion, this work presents and describes a portable device system for the detection of PAHs in drinking water, with suitable detection limits and real-time results. This is a potential solution for domestic testing that would allow consumers to control the quality of their drinkable water, independently of any specialized laboratory, therefore reducing costs and efficiency in testing

Keywords: Polycyclic Aromatic Hydrocarbons (PAHs), lab-on-chip electrochemical immunosensor, environmental water

Sustainable Land Use and Agriculture

35. A novel association between a STAT1 mutation and carcass conformation in Holstein Friesian dairy cattle

Lyndsey Ratcliffe[1], Francis Kearney[2], Jennifer McClure[2], Matthew McClure[2], Michael P. Mullen[1]

[1]Bioscience Research Institute, Athlone Institute of Technology, Athlone, Co. Westmeath, Ireland.

[2]Irish Cattle Breeding Federation, Bandon, Co. Cork, Ireland.

Corresponding Author Email Address: l.ratclife@research.ait.ie

Signal transducer and activator of transcription (*STAT*) genes encode for a family of proteins involved in pre and post-natal growth and development. In cattle, variants in these genes have been associated with economically important traits including milk production and embryonic survival. The objective of this study was to estimate the effects of polymorphisms in the *STAT1, STAT3* and *STAT5* genes on carcass and health traits in dairy cattle. *STAT* genotypes (n=8) on 10,707 dairy cattle were obtained through the Irish cattle breeding federation (ICBF). Phenotypes for carcass and health traits, also obtained from the ICBF, were expressed as predicted transmitting abilities (PTAs). The association analysis included n = 5747, 3194, 1374, 518 and 360 cows for somatic cell score, carcass weight, cull cow weight, carcass conformation and carcass fat, respectively. Associations between each SNP and PTA were analysed in ASREML using a weighted mixed animal model. A significant association ($P < 0.0001$) between *STAT1* (2697) and carcass conformation was observed with the A allele associated with an increase of 0.93. No association was observed between the remaining seven mutations in *STAT3* and *STAT5* with carcass conformation. No association was observed between any of the *STAT* mutations examined with carcass weight, carcass fat, cull cow weight or somatic cell count. Results suggest a multifaceted role of the *STAT* family in growth and development and the potential for increasing the frequency of this allele in the national herd without negative effects in relation to other carcass traits tested and somatic cell count.

Keywords: genetics, STATs, DNA polymorphism, dairy cattle

Sustainable Land Use and Agriculture

36. No evidence of an association between lethal recessives CVM and Brachyspina and carcass and health traits in Holstein Friesian dairy cattle

Lyndsey Ratcliffe[1], Francis Kearney[2], Jennifer McClure[2], Mathew McClure[2], Michael P. Mullen[1]

[1]Bioscience Research Institute, Athlone Institute of Technology, Athlone, Co. Westmeath, Ireland.

[2]Irish Cattle Breeding Federation, Bandon Co. Cork, Ireland.

Corresponding Author Email: l.ratclife@research.ait.ie

The frequency of genes with lethal effects on embryo survival is economically important in livestock production. The maintenance of such deleterious mutations in cattle populations is partly due to the intense selection for milk yield in dairy cattle in recent decades. The elimination from or management of such mutations in the national breeding herd is a desirable objective; however, estimation of the potential pleiotropic effects on other traits of economic importance would ascertain if strategic matings of carrier animals would be advantageous. Therefore, the objective of the current study was to estimate the effects of two such lethal recessives, CVM and Brachyspina, on carcass and health related traits in Irish dairy cattle. CVM and Brachyspina SNP genotypes on 10,707 dairy cows were obtained through the Irish Cattle Breeding Federation (ICBF). Phenotypes for carcass and health traits, also obtained from the ICBF, were expressed as predicted transmitting abilities (PTAs). Associations between each SNP and PTA was analysed in ASREML using a weighted mixed animal model. No associations ($P > 0.05$) between CVM and Brachyspina and either somatic cell score ($n = 5747$), carcass weight ($n = 3194$), cull cow weight ($n = 1374$), carcass conformation ($n = 518$) and carcass fat ($n = 360$) were observed in the sample set tested. No evidence was obtained to support maintenance or strategic matings for carrier animals suggesting that elimination of carriers of either CVM or Brachyspina would not reduce the genetic merit of the national herd in relation to carcass and health related traits.

Keywords: lethal mutations, pleiotropy, dairy cattle, genetics

Sustainable Land Use and Agriculture

37. A mechanistic evaluation of sub-surface carbon fluxes in forested peatlands

Stephen Barry[1,2], Alan Gilmer[1,2], John Cassidy[1,3], Eugene McGovern[1,2], Vivienne Byers[1,4]

[1]Environmental Sustainability & Health Institute, Dublin Institute of Technology, Greenway Hub, Grangegorman, Dublin, D07 H6K8, Ireland.

[2]College of Engineering & Built Environment, Dublin Institute of Technology, Bolton Street, Dublin 1, Ireland.

[3]School of Chemical & Pharmaceutical Sciences, Dublin Institute of Technology, Kevin Street, Dublin 2, Ireland.

[4]School of Management, Dublin Institute of Technology, Aungier Street, Dublin 2, Ireland.

Corresponding Author E-mail Address: d15125851@mydit.ie

Peatlands cover approximately 11,757 km^2 of Ireland and represent a major carbon store – of this nearly half 4,350 km^2 is represented by upland blanket peatlands. Carbon losses from this ecosystem type are recognised as having significant consequences for Ireland's carbon store and the associated impacts on climate change. Although carbon fluxes are recognised as occurring throughout the peat profile National Emission inventories typically rely on Net Ecosystem Exchange (NEE) which tends to reflect surface fluxes while lateral diffusion, macrophyte conduction and advection from the lower peat profiles are not explicitly referenced in the calculations. In addition, system knowledge and data regarding advective sub-surface carbon migration and fluvial carbon evasion processes are incomplete. This study proposes to explore the nature of sub-surface CO_2 fluxes in forested peatland sites in Co Wicklow. This will involve the characterisation of the environmental setting including, rainfall and water table level determinations as well as the measurement of free phase CO_2 evasion. The relationship between precipitation and the CO_2 "pulse effect" where large sporadic CO_2 emissions occur over several minutes will be evaluated. This existence of water table related thresholds or tipping points within the system will be monitored. The outputs of this study will be a mechanistic based assessment of sub-surface CO_2 dynamics within Irish forested blanket peatland systems. This will provide a direct input in peatland carbon flux determinations and facilitate the optimisation of land-use carbon sequestration capacity as required under the IPCC Good Practice Guidelines. It will also add to our knowledge and understanding of the sensitivity of this ecosystem type to the effects of climate change, environmental system stress and land-use adaptation.

Keywords: peatlands, carbon, greenhouse gas emissions, land-use

Sustainable Land Use and Agriculture

38. Characterisation of proteins obtained by different extraction methods from a grassland topsoil

Matthias Waibel[1], Clelton Santos[2], Eric Paterson[3], Barry Thornton[3], Fiona Brennan[4], Florence Abram[1], Maria Tuohy[2]

[1]National University of Ireland, Galway, Discipline of Microbiology, University Road, Galway, Ireland.

[2]National University of Ireland, Galway, Discipline of Biochemistry, University Road, Galway, Ireland.

[3]The James Hutton Institute, Craigiebuckler, Aberdeen, Scotland.

[4]Teagasc, Environmental Research Centre Johnstown Castle, Wexford, Ireland.

Corresponding Author Email address: m.waibel1@nuigalway.ie

For informing on sustainable land use and grassland productivity practices, elucidating the mechanisms of soil N mineralisation can be a contribution to defining soil-specific N fertilization rates and thereby mitigating deleterious N losses. P reviously, the decomposition of soil organic matter (SOM) and associated mobilization of N has been correlated to soil enzyme activity. The aim of the study was to develop and assess methods to extract proteins from soil. Sodium pyrophosphate (Na-PPi), potassium sulfate, and buffers that employ strong detergents and denaturants were employed with the aim of enriching for different soil protein pools. The following methods were applied: SOM/humus was characterised by spectrophotometric absorbance measurement (colour ratio). To quantify protein concentration the Lowry method with TCA-DOC, and to assess electrophoretic patterns of the proteinaceous soil extracts, 1-D SDS-PAGE with Coomassie, and Silver stain were employed. Preliminary results indicate that total protein concentration with alkaline pH was higher than with neutral pH, possibly indicating that extraction of OM and proteins were associated. Total protein concentration in the retentate increased with ultrafiltration. Furthermore, results indicate that the colour ratio is useful for determining the degree of humification of OM fractions, extraction buffer effect, and the efficacy of sample clean up. For example, the colour ratio of the retentate fraction (supposedly protein and humic matter fraction) was reduced by ultrafiltration and increased from a low value when subjected to sample clean up with the TCA-DOC method, possibly indicating that the retentate is cleaned of strongly humified compounds. Differences in electrophoretic pattern were observed between ultrafiltration fractions but as a function of pH, while the retentate fraction (of most interest) exhibited a proteinaceous smear indicated by Coomassie and silver staining. Our study showed that there is significant potential for further process development and investigations of soil proteins.

Keywords: soil, proteins, grassland productivity, extraction, biochemical characterisation

Sustainable Land Use and Agriculture

39. Unconjugated linoleic acid and its role in fatal equine haemorrhaging

Catriona Kielty[1], Carmel Kealey[1], Damien Brady[1], Ursula Fogarty[2]

[1]Bioscience Research Institute, Athlone Institute of Technology, Dublin Road, Athlone, Co. Westmeath, Ireland.

[2]Irish Equine Centre, Johnstown, Naas, Co. Kildare, Ireland.

Corresponding Author Email Address: c.kielty@research.ait.ie

In recent years, the Irish Equine Centre (IEC) has observed an increase in cases of a fatal, idiopathic, haemorrhagic condition affecting horses. Through collaboration with the IEC, Athlone Institute of Technology have carried out studies that have identified unconjugated linoleic acid (ULA), an essential fatty acid, as a causative factor in this fatal condition. It has been hypothesised, that the recent increase in the use of impure glycerol, obtained as a by-product of biodiesel production, in animal feedstuffs, may interfere with unconjugated linoleic acid at a molecular level. Using the epithelial cell line, HepG2, and the endothelial cell line, HUVEC, the cytotoxicity of varying concentrations of ULA (2 mM to 10 mM) as well as impure glycerol have been assessed using the colorimetric resazurin assay as an endpoint. Cell viability was also assessed after exposure to a combination of the two compounds in order to determine the cytotoxicity of such an amalgam. Significant cell inhibition ($P = 0.0001$) was observed in HepG2 cells treated with ULA alone when cells were compared to a positive growth control. However, cells exposed to lower concentrations of a combination of both ULA and impure glycerol (2 mM and 2.5% respectively) showed a hormetic response with 79.2% more proliferation occurring during this treatment than in the positive growth control. High concentrations of ULA inhibit cell proliferation, while specific concentrations of a combination of ULA and impure glycerol have a synergistic effect, which could indicate an inflammatory response. Future work will include the identification of inflammatory biomarkers associated with coagulopathies, in order to elucidate the mechanism of action of ULA.

Keywords: unconjugated linoleic acid (ULA), animal feed grade (AFG), glycerol, biodiesel production

Sustainable Land Use and Agriculture

40. Pulsed light inactivation of the bumble bee Trypanosome parasite *Crithidia bombi*

John Naughton[1], Erin Jo Tiedeken[1,2], Mary Garvey[3], Jane C. Stout[4], Neil J. Rowan[1]

[1]Bioscience Research Institute, Athlone Institute of Technology, Ireland.

[2]National Biodiversity Data Centre, Waterford, Ireland.

[3]Department of Life Sciences, Institute of Technology Sligo, Ireland Department of Life Sciences, Institute of Technology Sligo, Ireland.

[4]Discipline of Botany, School of Natural Sciences, Trinity College Dublin, Ireland.

Corresponding Author Email Address: nrowan@ait.ie

The anthropogenic movement of managed bees has led to the introduction and global spread of parasites with significant adverse effects on the health of both managed and wild species. This constitutes the first study to report on the use of high-intensity pulsed light (PL) for the novel inactivation of the complex Trypanosome parasite *Crithidia bombi*, a major pest of wild and managed bees. Through initial PL range-finding studies we identified a putative effective UV dose of 12.96 µJ/cm2 for C. *bombi* treatment using surrogate Bacillus endospores and oocysts from the waterborne protozoan *Cryptosporidium parvum*. Unlike bacteria that are readily cultured under laboratory conditions, disinfection of C. *parvum* required of use of in vitro cell culture-qPCR infectivity assays. To confirm this dose as appropriate for treatment of Crithidia bombi, we used the Buff-tailed bumble bee (Bombus terrestris) as an animal infectivity model. C. *bombi* was collected from the faeces of wild B. terrestris queens and used to inoculate 30 commercially-supplied workers (B. *terrestris audux*) in order to obtain a colony-specific C. bombi inoculum. This was used for subsequent tests on 60 randomly-selected unparasitised workers, which were divided evenly and fed either PL-treated or untreated (control) C. *bombi* inoculant. Of the 28 surviving workers fed with pooled C. *bombi* untreated inoculum, 25 exhibited infection as confirmed by detection of the parasite in faecal samples after 9 days, where the remaining two did not excrete faeces. Twenty eight of 30 (93%) workers fed PL-treated C. *bombi* at 12.96 µJ/cm^2 under similar test conditions were uninfected after the same time period (the remaining two workers did not produce faeces for testing). Thus, we demonstrated for the first time, that PL is potentially a reliable and efficient technology for the non-thermal inactivation of C. *bombi* for the pollination industry.

Keywords: bumble bee, *Bombus terrestris audux, Crithidia bombi* parasite, pulsed light, disinfection, pollination industry

Sustainable Land Use and Agriculture

41. Plant growth promotion potential of novel bacterium Ensifer adhaerens OV14

Wojciech Nowak[1], Ann-Marie Enright[1], Guiomar Garcia-Cabellos[1], David Ryan[1]

[1]EnviroCore, Department of Science and Health, Dargan Centre, Institute of Technology Carlow, Kilkenny Road, Carlow, Co. Carlow, Ireland.

Corresponding Author Email Address: Ann-Marie.Enright@itcarlow.ie

The extensive use of chemical fertilizers in modern agricultural practice is an expensive, wasteful and environmentally damaging approach. As such, there is a drive towards more effective and environmentally friendly alternatives. One potential technology is the use of biological fertilizer instead of/ combined with reduced levels of chemical fertilizers. A number of bacteria have been described which possess traits that can promote plant growth and development, including species of Rhizobia, Bacillus, and Pseudomonas (Saharan & Nehra, 2011). Recently, while screening for plant transforming bacteria, researchers in Teagasc, Oak Park, Carlow discovered a novel bacterium Ensifer adhaerens OV14 (Wendt et *al.,* 2011). *Ensifer adhaerens* OV14 is closely related to *Sinorhizobia* species, known plant symbionts (Rudder et al., 2014). During preliminary investigations into the characteristics of this strain plant growth promotion (PGP) effects were observed (Ewen Mullins, Teagasc, personal communication, 2015). Various other strains of the bacterium were found to possess similar traits (Tak et al., 2016; Wang et al., 2016; Yutani et al., 2011; Zhou et al., 2012). The current research aims to investigate the PGP potential of OV14 and examine its host range in a variety of commercial crops. The proposed methodology includes; bioinformatic analysis of the OV14 genome targeting PGP genes; in-vitro analysis to test PGP phenotypes as well as quantitative analysis of OV14 growth products; assessment of OV14 PGP effect and ability to mitigate environmental stress on plant growth using greenhouse based plant trails; quantitative reverse transcription PCR analysis of PGP gene expression during these plant trails. The preliminary bioinformatic screening focused on PGP genes involved in facilitation of nutrient acquisition, production of plant hormone effector molecules and phyto-pathogen antagonism and initial *in-vitro* results are described here.

Keywords: plant growth promotion, bio-fertilizer, *Ensifer adhaerens* OV14

Sustainable Land Use and Agriculture

42. An investigation into a sustainable eco-friendly practice for the mining of lithium

Laurence Kavanagh[1], Jerome Keohane[2], Guiomar Garcia Cabellos[1], Andrew Lloyd[1], John Cleary[1]

[1]EnviroCore, Department of Science and Health, IT Carlow, Kilkenny road, Co, Carlow, Ireland.

[2]EngCore, Department of Built Environment, IT Carlow, Kilkenny road, Co, Carlow, Ireland.

Corresponding Author Email Address: Laurence.Kavanagh2@itcarlow.ie

Phytomining, a concept first introduced in the 1970's involves the use of plants in the mining process. Certain species of plants have the ability to take up large amounts of metals into their tissue without apparent harm. This ability can be used to accumulate high concentrations of a target metal. After a suitable period of time the plants are harvested and incinerated and the target metal is extracted from the ashes. In some cases the incineration is harnessed to produce energy. In this study plants were grown in different concentrations of lithium in a nutrient solution. The goal being to determine if any plant species is an effective lithium accumulator at high enough levels to justify phytomining as an economic method for concentrating the metal. Our interest in lithium comes from the fact that a large deposit of lithium has been discovered in the South East of Ireland. The mine tailings from the exploitation of this resource would be an ideal substrate onto which lithium accumulator plants could be planted. Five species from known metal hyperaccumulator families (*Solanaceae, Asteraceas, Brassicaceae and Lamiacea*) were chosen in an initial trial (n = 50 plants) to assess their ability to accumulate lithium. From this initial trial two plant species tomato *Solanum lycopersicum* and cabbage *Brassica oleracea* were selected to be up scaled to larger trials (n = 100 plants). The lithium content in the plants roots, shoots, leaves and fruits was determined by Flame Emission Spectroscopy (FES) using sodium and potassium concentrations as controls.

Keywords: hyperaccumulator plants, phytomining, pot trials.

Sustainable Land Use and Agriculture

43. Wheat seed germination response to novel agar/ι-carrageenan blended hydrogel coating under drought stress

Maya Hotta[1,2], James Kennedy[1,3], Clement Higginbotham[1], Noreen Morris[1,2]

[1]Materials Research Institute, Athlone Institute of Technology, Dublin Road, Athlone, Co. Westmeath, Ireland.

[2]Department of Life and Physical Sciences, Athlone Institute of Technology, Dublin Road, Athlone, Co. Westmeath, Ireland.

[3]Mazars, Harcourt Road, Dublin 2, Ireland.

Corresponding Author Email Address: nmorris@ait.ie

Future climate scenario in 2050 is predicted to rise in atmospheric temperature and increase the intensity and frequency of drought. Much research has been carried out to mitigate drought stress and improve crop productivity by searching drought tolerant species and developing seed coating polymers. This study compares germination performances of Durum wheat seeds (*Triticum durum Desf.*) and Bread wheat seeds (*Triticum aestivum L.*) with novel agar/ι-carrageenan blended hydrogel seed coatings in drought simulated conditions. The germination percentage, germination speed, shoot length, seed vigour index, and dry mass were analysed as growth rate indices and compared at a significant ($P < 0.05$) difference according to Tukey's post hoc test. Seeds were coated with natural agar/ι-carrageenan blend (**AC16**) hydrogel and monitored their growth in a greenhouse (Carlow IT). Results confirmed that the natural polymer coating was capable of increasing germination speed of both Durum wheat seeds by 3.1 % and Bread wheat seeds by 7.7 % relative to uncoated seeds. This study also showed that the hydrogel coating was more effective for Durum wheat variety over the Bread wheat variety in terms of germination percentage, shoot length, seed vigour, and biomass. This novel ι-carrageenan based hydrogel blend has the potential to work as an environmentally friendly seed coating agent to enhance seedling development under drought stress. It is anticipated that this work will be extended to incorporating plant protectants and coating different seed varieties to promote seed growth with minimum environmental impact under less than ideal growth conditions.

Keywords: drought stress, durum wheat (*Triticum durum Desf.*), bread wheat (*Triticum aestivum L*), ι-carrageenan, hydrogel seed coating, sustainable agriculture

Sustainable Land Use and Agriculture

44. POLLIVAL: assessing market and non-market values of pollination services in Ireland

James T. Murphy**1**, Jane C. Stout*1,2*

[1]Botany Department, School of Natural Sciences, Trinity College Dublin, Dublin 2, Ireland.

[2]Trinity Centre for Biodiversity Research, Trinity College Dublin, Dublin 2, Ireland.

Corresponding Author Email Address: murphj64@tcd.ie

Assessing and evaluating natural capital and ecosystem services which flow from it are key national environmental research priorities (for various organisations including the EPA, National Biodiversity Plan, Irish Forum on Natural Capital, All-Ireland Pollinator Plan), enabling integration of natural capital into decision-making processes and the sustainable use of natural resources. The POLLIVAL project, funded by the EPA, will develop national capacity in evaluation of ecosystem services using pollination as a case study. By integrating market and non-market values, assessing current status and identifying drivers of future change, the project will develop a model system to enable evaluation of other forms of natural capital for decision-making and planning processes. The objectives of the project are: 1. To identify best practice to evaluate the current market values of pollination services in Ireland. 2. To develop methods to assess non-market values. 3. To integrate the implications of land use change (driven by various processes including environmental change, policy change and consumer behaviour) on the value of pollination services in Ireland. The project will integrate approaches from natural, social and economic sciences and will involve consultation with experts and integration of expert knowledge, data-gathering (from a range of sources, including collection of novel ecological data sets), development of methods, and modelling of future scenarios.

Keywords: pollination, ecosystem services, natural capital, bio-economics

Sustainable Transport

45. Sodium bicarbonate reduces density of HDPE which can result in cost savings in automotive applications

Zhi Cao[1], Luke M. Geever[1], Ian Major[1], John G. Lyons[1], Alan Murphy[1], Clement. L. Higginbotham[1], Declan. M. Devine[1]

[1]Centre for Industrial Services and Design (CISD) East Campus Research Hub, Athlone Institute of Technology, Athlone, Co. Westmeath, Ireland.

[1]Materials Research Institute, Athlone Institute of technology, Dublin road, Athlone, Co. Westmeath, N37 F6D7, Ireland.

Corresponding Author Email Address: ddevine@ait.ie

A decrease in fuel consumption and CO2 emissions has been a topic of extreme importance in the automotive industry for the past 20 years. Among the possible technical solutions, the reduction of the weight of the vehicle seems to be one of the most promising. It is possible that this can be achieved by the use of lightweight polymeric foams. However, specific types of polymeric foams, obtained from specific base materials with unique characteristics have not yet been intensively investigated and the effect of their incorporation is not yet well known. This research investigated the development of lightweight and cost effective high-density polyethylene foams. These materials were obtained by hot melt extruding high-density polyethylene [Marlex® HXM 50100: an extrusion blow moulding grade HDPE] with a non-toxic chemical foaming agent (sodium bicarbonate $NaHCO_3$). The resultant foams were assessed using scanning electron microscopy (SEM), foam void fraction, density measurements, long-term water uptake analysis, tensile properties, puncture properties and material costing. The effects of various $NaHCO_3$ loadings on the essential physical and mechanical properties of polymeric foams (namely HDPE [Marlex® HXM 50100] foam) were examined. It was observed that the addition of $NaHCO_3$ into HDPE significantly influenced its mechanical properties and long-term water absorption profiles, but reduced the resulting density and raw material cost, highlighting the potential use of this material for automotive applications.

Keywords: sodium bicarbonate, high-density polyethylene, cost effective, lightweight

Sustainable Transport

46. Travel mode of choice and neighbourhood satisfaction in the greater Dublin area

Ahlam AlAnbouri[1], Lorraine D' Arcy[1], Audery Martin[1], Niall Holmes[1]

[1]Dublin Institute of Technology, Bolton Street, Dublin 1, Ireland.

Corresponding Author Email Address: ahlama@motc.gov.com

Neighbourhoods can differ both structurally and socio-economically and the variety in these neighbourhood attributes, and residents' perceptions of these attributes, are considered to be factors influencing choice of travel mode. Modal choice is a contributing factor to environmental emissions, public health concerns, transport infrastructure investment and car ownership. Due to the complexity of potential influencers the relationships between these factors is difficult to determine. The aim of this research is to investigate the role of factors including resident's satisfaction with their neighbourhoods, travel modal availability and the neighbourhood structure in their modal choice. A GIS model has been developed with layers of statistical information including cross-sectional data for 16 neighbourhoods (n = 1064) from the Cleaner, Greener, Leaner Study with other relevant data from different sources. This paper outlines the methodology being undertaken to investigate the role of the actual neighbourhood structure and perceptions of neighbourhood environments using GIS and multi-level statistical analysis on determinants of behaviour to inform predictions of behaviour for the Greater Dublin Area.

Keywords: mode choice, neighbourhood satisfaction, GIS model

Waste Management

47. An introduction to sustainable sludge management in Ireland

Juan Vinagre-Sendino[1,2], Thomas P. Curran[1], Seamus Crickley[2]

[1]UCD School of Biosystems and Food Engineering, University College Dublin, Belfield, Dublin 4, Ireland.

[2]WEW Engineering Ltd., Consulting Engineers. 39B Hebron Business Park, Hebron Road, Kilkenny, Ireland.

Corresponding Author Email Address: juan.vinagre-sendino@ucdconnect.ie

Sludge is a by-product of domestic and industrial wastewater processes. It contains valuable nutrients, organic substances and important properties that can have commercial benefit. For example, the calorific value of sewage sludge is around 8,300 J/g which easily meets cement industry requirements (6,250 J/g) for? Therefore, sludge, once it has been well stabilised and converted to a biosolid, could contribute to a reduction in fossil fuel consumption currently associated with cement production. Since the dumping of wastewater sludge into waterbodies was prohibited under the Urban Wastewater Directive, its application to land has become the most common alternative. In 2014 in Ireland, over 98% of wastewater sludge was re-used for agricultural purposes. However, there are many constraints to land application of sludge. There are closed periods for sludge spreading during the winter months due to the implementation of the Nitrates Directive. In addition S.I. 31 (2014) does not permit land application of sludge at certain times. Moreover, the combined effects of a rising population with increased land production, caused by the expansion of the agri-food sector with the Foodwise 2025 Strategy, will result in additional sludge generation andfurther pressure to find sustainable strategies for sludge management. The aim of this work is to perform a preliminary quantification and classification analysis of the sludge currently applied to land by the agri-food industry in Ireland. This information will be used to assess the long-term capacity of the land for waste material management such as nutrient limits, distance from sources (and economic aspects including Geographical Information System (GIS) analysis) and locations according to EPA licences). This study will evaluate alternatives and different strategies to land disposal of sludge.

Keywords: wastewater, sludge, land application

Waste Management

48. Eco- MixPlas – Mixed plastics waste as a valuable resource

Michael J. Hopkins[1], Luke M. Geever[1], Crevan O'Donnell[1]

[1]Applied Polymer Technologies, Athlone Institute of Technology, Dublin Road, Athlone, Co. Westmeath, Ireland.

Corresponding Author Email Address: mhopkins@ait.ie

Applied Polymer technologies (APT) is currently designing and developing innovative additives and processes for the cost effective recycling of Mixed Plastics Waste, enabling it to be used in high value product applications. Labelled Eco-Mixplas, this project focuses on the development of novel recycled polymeric materials from various waste streams, via innovative polymer processing techniques. AIT tailors each stream for individual applications. Currently the Mixed Plastics Waste stream accounts for approximately 25% of all plastic waste collected and sorted in Europe. Thousands of tonnes of this material is exported (mainly to China) or landfilled, as it cannot presently be recycled cost effectively into new products. This results in meagre financial returns particularly considering the cost of collecting and initial sorting of such material. As the Mixed Plastics Waste stream consists of several different types of plastics - it is not cost effective to further separate/sort this waste stream into individual plastic types. Moreover these mixed plastics do not mix well together, separating like oil and water when melt processed, which greatly restricts the potential applications for this material. One method currently been explored by APT, is the development of various compatibilisers which are incorporated into the melt of the mixed plastic waste in order to, effectively create a polymer with one destined phase. These novel compatibilisers will act as binding agents, enabling the mixed plastics materials to be cost effectively combined together via melt processing, which will allow for the development of high value new products from this old plastics waste. This innovation will provide the basis for the development of a pipeline of novel polymer blends (combinations of several different polymer types) from the Mixed Plastics Waste stream. This revolutionary new technology provides an economically attractive route to recycling plastic materials and will transform Mixed Plastics Waste into a valuable resource. The platform technologies developed will initially be targeted at high volume applications in the multitrillion euro building and construction sector or as a possible matrix material for thermoplastic composites systems. To date in-house trials have created a material which supersedes current recycled grades of polymer material on the market. In light of this, a batch has been created for large scale production runs which will see the team utilise a full scale extrusion line of a number of days to create hundreds of meters of a specific profile which will be used as a demonstrator part in licencing talks with various Irish recycling companies.

Keywords: mixed plastics waste, innovative, waste stream, binding agents, development, revolutionary

Water Quality and Resources

49. Optimising a duckweed-controlled wastewater treatment system for perch-trout aquaculture

Wagner S.S. Hernandes[1], Alan Gilmer[1], John Cassidy[2], Vivienne Byers[3]

[1]Environmental Sustainability and Health Institute, Dublin Institute of Technology, Ireland.

[2]School of Chemical and Pharmaceutical Sciences, Dublin Institute of Technology, Ireland.

[3]School of Management, Dublin Institute of Technology, Ireland.

Corresponding Author Email Address: d16126313@mydit.ie

Aquaculture relies heavily on the control of water quality to achieve maximum production rates as it generates a continuous load of effluent from decaying fish feed and faeces. Various wastewater treatment systems, including mechanical solids removal and nitrification, have been employed to manage water quality in these settings. Arising from this requirement, the development of a nature-based system is proposed to secure water quality parameters deemed optimal for freshwater fish production. Waste treatment will be achieved with an integrated pond system, comprised of a smaller stocking pond and a larger pond where treatment of wastewater takes place. This arrangement is referred to as a split-pond production system. The proposed system will combine the intensive production of perch and trout with plant-mediated wastewater quality control and resource management. Duckweed (Lemnaceae), as a fast-growing macrophyte, has long been successfully incorporated into wastewater treatment systems across the globe. The present study will explore the role of native Irish duckweed species in controlling water quality under local climatic conditions, thereby contributing to our understanding of the use of a duckweed-controlled system in the optimisation of aquacultural output. This will involve utilising the natural processes of these plants and their rapid growth rates to uptake and metabolise nutrients from wastewater through biomass accumulation. Initial work will entail the formulation of a suitable mixture of duckweed species, based on their ability to produce biomass in wastewater and promote desirable changes to water quality parameters under laboratory conditions. The defined duckweed phytosociological community can then be assessed on site.

Keywords: water quality, biomass, freshwater aquaculture

Water Quality and Resources

50. Integrated constructed wetlands: performance and analysis

Leaine Hall[1], David Woodward[1], Rodney McDermott[1], Alan Strong[1]

[1]Ulster University, Jordanstown, Shore Road, Newtownabbey, Co. Antrim, BT37 0QB, Northern Ireland.

Corresponding Author Email Address: hall-l9@email.ulster.ac.uk

Over the last 40 years, research on constructed wetlands for various types of wastewater treatments has expanded and enhanced understanding of the processes and interactions involved. However, there still remains a number of unknowns on the design principles and performance appraisals of Integrated Constructed Wetlands (ICW) and their potential as sustainable alternatives to traditional wastewater treatment works. In order to fully evaluate ICWs, a deeper understanding of their performance and analysis for the treatment of domestic wastewater must be developed. This study aims to develop an understanding of the performance of ICW's in order to aid in the decision making process for future provisions of ICWs for the treatment of domestic wastewater in Northern Ireland. A full scale, 5 pond ICW system was designed by VESI Environmental and implemented by Northern Ireland Water as a pilot study to assess their appropriateness as an alternative approach to traditional wastewater treatment works in Northern Ireland and a Test Rig was then designed to test the key variables that impact treatment performance as identified through literature review and stakeholder engagement. Samples were taken on a weekly basis from each pond to monitor water quality for contaminants such as BOD, COD, NH_3, Nitrates, Nitrites, Total Nitrogen and Phosphorus. After the first year of testing the results have been beneficial in developing a deeper understanding of the overall performance of an ICW as a method of treating domestic wastewater, having identified and confirmed trends in ICW performance over time and area, identified relationships between contaminants, highlighted connections between design variables and performance and illustrated a need for more appropriate Design Framework.

Keywords: integrated constructed wetlands, sustainable, wastewater treatment, design framework

Water Quality and Resources

51. Assessing the impact of cattle access to watercourses in stream faecal contamination

Patrícia Oliveira Antunes[1], Eleanor Jennings[1], Daire Ó hUallacháin[2], Noelle Dunne[2], Lyubov Bragina[1], Mary Kelly-Quinn[3], Matt O'Sullivan[3]

[1]Centre for Freshwaters and Environmental Studies, Dundalk Institute of Technology, Dublin Road, Dundalk, Co. Louth, Ireland.

[2]Teagasc, Johnstown Castle Research Centre, Wexford, Ireland.

[3]School of Biology and Environmental Science, Freshwater Ecology Research Group, University College Dublin, Dublin, Ireland.

Corresponding Author Email Address: patricia.antunes@dkit.ie

Faecal contamination of waters is a major cause of waterborne infections worldwide. Although human faecal contamination is usually regarded as most concerning, faecal contamination associated with pastoral agriculture has received increasing attention due to zoonotic pathogens that are naturally found associated with ruminant animals. Faecal contamination is a major cause of water impairment in countries such as the US and New Zealand; in Ireland, the last water quality monitoring programme completed by the Environmental Protection Agency (EPA) reported that 51% of groundwaters were impacted by faecal contamination, and about 35% of the designated shellfish areas were non-compliant with guide values for faecal organisms' concentrations. This study is part of the COSAINT project - Cattle exclusion from watercourses: environmental and socio-economic implications (EPA funded under the Research Programme 2014-2020), which aims to assess environmental, ecological and socio-economic of cattle access to watercourses and of existing and potential exclusion measures. In this research, the levels of faecal indicator bacteria (*Escherichia coli*) in sediments of five farmland streams were investigated to determine whether areas where cattle had access to streams could act as hotspots for faecal contamination of sediments and overlying stream waters. Sediment samples were collected upstream and at cattle access points during early summer (June) and autumn (October) 2016. In general, the numbers of *E. coli* in sediments at the cattle access points in samples collected during early summer were substantially higher (*i.e.* two to three orders of magnitude) than those observed upstream of these sites, whereas the levels observed during autumn were generally lower than those in June and the difference between the upstream sites and the sediments at the access sites was less pronounced. These results indicate that cattle access to watercourses can result in increased faecal contamination at access sites.

Keywords: water quality, faecal indicator bacteria, *E. coli,* agriculture, agri-environmental policy

Water Quality and Resources

52. A quick and routine analysis of polar pesticides in water by suppressed ion chromatography and mass spectrometry

Gemma Ellison[5], Katerina Boušová[1], Astrid Kurz[2], Cees Bruggink[3], Michal Godula Jonathan Beck[4]

[1]Thermo Fisher Scientific, Special Solutions Center, Dreieich, Germany.

[2]Hochschule für Technik und Wirtschaft Aalen, Aalen, Germany.

[3]Thermo Fisher Scientific, Special Solutions Center, Breda, The Netherlands.

[4]Thermo Fisher Scientific, San Jose, CA, USA.

[5]Thermo Fisher Scientific, Hemel Hempstead, UK.

Corresponding Author Email Address: gemma.ellison@thermofisher.com

Polar pesticides analysis in water and foods has become very hot topic in the past couple of years. A famous representative of this group is a broad-spectrum systematic herbicide glyphosate and its metabolite AMPA. Glyphosate was discovered more than 40 years ago and has become very popular due to its low toxicity in comparison with other herbicides. It is used to kill weeds competing with crops and in the parks and roadsides. But, in March 2015 the World Health Organization´s (WHO) International Agency for Research on Cancer classified glyphosate as a probable carcinogen[a]. However in November 2015, the European Food Safety Authority (EFSA) concluded glyphosate unlikely to cause cancer[b]. There is a big demand to increase the number of tested water and food samples and monitor the presence of these contaminants carefully. Because of the chemical properties it is not possible to analyse these compounds with the conventional C18 column. Typically the laboratories use the methods that include derivatisation step or special chromatographic columns like the porous graphitic carbon (PGC) based Hypercarb. With both approaches varying method robustness and unreliable results are often reported by routine laboratories. Here we demonstrate the analysis of polar pesticides with an Ion Chromatograph coupled to a triple quadrupole mass spectrometer. A new, rapid method for the direct analysis of polar pesticides in water.

[a] http://www.iarc.fr/en/media-centre/iarcnews/pdf/MonographVolume112.pdf

[b] https://www.efsa.europa.eu/sites/default/files/4302_glyphosate_complementary.pdf

[c]The European Drinking Water Directive 98/83/EC.

Keywords: ion chromatography, pesticide analysis, glyphosate, AMPA, EU Water Directive, drinking water

Water Quality and Resources

53. Emerging organic contaminants arising in rural environments-investigations in karst and fractured bedrock aquifers

Damien Mooney[1, 2], Martin Danaher[2], Karl Richards[3], Laurence Gill[4], Per Erik Mellander[3], Catherine Coxon[1]

[1]Geology Department, School of Natural Sciences, Trinity College Dublin, Ireland.

[2]Food Safety Department, Teagasc Food Research Centre, Ashtown, Dublin 15, Ireland.

[3]Environment, Soils and Land-Use Department, Environment Research Centre, Teagasc, Johnstown Castle, Wexford, Ireland.

[4]Department of Civil, Structural and Environmental Engineering, Trinity College Dublin, Ireland.

Corresponding Author Email Address: damien.mooney@icrag-centre.org or mooneyd2@tcd.ie

Emerging Organic Contaminants (EOCs) are chemicals that have not been included in national or international monitoring programmes or in existing environmental quality regulations, but are being continually introduced into the environment by anthropogenic activities. In Ireland, due to increased pressures on the food production system, veterinary drugs and crop protection agents have become a critical component in animal husbandry and crop cultivation respectively. This has led to these agro-chemicals being considered as primary emerging contaminants of concern. The administration and application of such substances, can potentially lead to their occurrence in groundwater. This project, which forms part of the groundwater spoke of the Irish Centre for Research in Applied Geosciences (iCRAG), aims to examine the occurrence of three groups of agro-chemicals in Irish groundwater, with a particular focus on occurrence in karst and fractured bedrock aquifers. This project will specifically focus on three groups of agro-chemicals commonly used in Irish agriculture; the anthelmintics, anti-coccidials and pyrethroid insecticides. Solid Phase Extraction (SPE) in combination with Ultra High Performance Liquid Chromatography tandem Mass Spectrometry (UHPLC-MS/MS) is currently considered the most powerful technique for the quantitative determination of such substances in complex matrices in the field of veterinary residue analysis. To date, a multi-residue SPE method has been developed for the extraction and confirmatory determination of thirty-six anthelmintic compounds in water by UHPLC-MS/MS. This method was applied to environmental water samples by means of a pilot sampling programme where high risk sites were targeted in terms of source and pathway factors. Up to five different anthelmintics were detected in four of fifty-two (8%) groundwater samples and four of twenty (20%) surface waters analysed from 43 different sampling points. Detections were of the order of 1 – 31 ng L^{-1}. The work carried out as part of this project will help to assess whether or not anti-parasitic drugs are an issue in Irish groundwater. It will also contribute to broadening the knowledge and understanding of occurrence and fate (mobility and behaviour) in the environment.

This publication/presentation has emanated from research supported in part by a research grant from Science Foundation of Ireland (SFI) under Grant Number 13/RC/2092 and is co-funded under the European Regional Development Fund and by iCRAG industry partners.

Keywords: emerging organic contaminant, groundwater, karst, veterinary and crop protection agents

Water Quality and Resources

54. Comparison of different meteorological forcing data for in the GOTM Lake Physical Model

Tadhg Moore[1], Eleanor Jennings[1], Elvira de Eyto[2]

[1]Dundalk Institute of Technology, Dublin Road, Dundalk, Co. Louth, Ireland.

[2]Marine Institute Catchment Research Facility, Furnace, Newport, Co. Mayo, Ireland.

Corresponding Author Email Address: tadhg.moore@dkit.ie

Dynamic water quality models are dependent on the physical lake model. The GOTM (General Ocean Turbulence Model) physical lake model requires high quality and high resolution meteorological data to increase the accuracy of this model. The PROGNOS project aims to develop a predictive water quality model. This model takes data in near real time from high frequency monitoring buoys and runs the water quality model using weather forecast data and outputs water quality information. The focus is to predict Dissolved Organic Carbon (DOC) and algal blooms. The model is dependent on its input. There are 3 different meteorological data sets available; European Centre for Medium-Range Weather Forecasts, Weather Station on the raft and Weather Station on the shore. The aim of this project is to compare the difference in the lake physical model output from each of the different data sets. This comparison will highlight the benefits of which meteorological data set is best for use in the lake physical model and improve the model accuracy.

Keywords: modelling, DOC, high frequency data, environmental monitoring

Water Quality and Resources

55. Filling in the gaps: resolving the organic carbon budget of a humic, oligotrophic lake in the west of Ireland

Brian C. Doyle[1,2], Elvira de Eyto[1], Eleanor Jennings[2]

[1]Marine Institute, Furnace, Newport, Co Mayo, Ireland.

[2]Centre for Freshwater and Environmental Studies, Dundalk Institute of Technology, Dundalk, Co. Louth, Ireland.

Corresponding Author Email Address: brian.doyle@marine.ie

Future climate scenarios for Ireland predict warmer temperatures and significant changes to seasonal precipitation patterns as a result of global climate change (Sweeney and Fealy, 2002). Such changes are likely to alter the quantity and composition of allochthonous organic carbon (OC) entering aquatic ecosystems. It has been estimated that between 13% and 17% of Irish land area is peatland, containing a soil carbon stock of between 53% and 62% of the national total (Wellock et al., 2011): this vast stock of carbon is important for current and future carbon cycling and particularly vulnerable to climate change (Ise et al., 2008; Kiely et al., 2010). Lakes play a significant role in making, storing and mineralising OC and are important to regional and global carbon budgets (Hanson et al., 2014), also allochthonous carbon is the main source of carbon fuelling all trophic levels in many freshwater systems, particularly in catchments dominated by peatland. Understanding and quantifying carbon cycling processes in peatland lakes provides important insights into OC transportation, storage and transformation mechanisms. For this project a complete OC budget for Lough Feeagh (in the Marine Institute's intensively instrumented Burrishoole catchement) is proposed and includes: major allocthonous inputs from surface water, groundwater, and atmospheric deposition; losses due to outflow, sediment burial and also autochothanous primary production and ecosystem respiration. This study intends to build on the considerable progress that has already been made (Jennings et al., 2010; Fealy et al., 2014; Ryder et al. 2012; 2014; Sparber, 2013) and 'fill in the gaps' to resolve the organic carbon budget for Lough Feeagh.

Keywords: organic carbon, allochthonous, lake, budget

Water Quality and Resources

56. Risk based water management framework – developing a water standards landscape for the Irish pharmaceutical sector

Shane Merritt[1], Niamh Power[1], Ken Stockil[2], Joe Harrington[1]

[1]Department of Civil, Structural and Environmental Engineering, Cork Institute of Technology, Ireland.

[2]Central Solutions Ltd, Innovation Works, National Technology Park, Limerick, Ireland.

Corresponding Author Email Address: shane.merritt@mycit.ie or joe.harrington@cit.ie

In 2016 the World Economic Forum highlighted that over the next decade the possibility of impending water shortages are one of the top 5 risks in terms of overall global impact, on an equal footing with issues like climate change. As the world's population is set to grow to over 8 billion by 2030 overall demand for clean water is expected to rise dramatically leading to an increased strain on supply. Large industry water users such as the pharmaceutical sector are one example of intensive consumers of fresh water. Water is a critical pharmaceutical utility and considered the "life blood" of most sites due to the variety of its onsite applications (*e.g., potable, process, cleaning, heating, cooling*). Contamination has the potential to result in plant shutdowns and product recalls and this risk constitutes a key challenge for sites thereby forcing them to adopt a "quality" specific view of their water management practices. Due to high quality control it is common for issues like performance to take a secondary role which means that sites may lack the knowhow or the initiative to improve their water systems. To address this problem a detailed understanding of the current practices and standards is needed to determine how much support is available from high level policy makers to address this problem in the pharmaceutical sector. The aim of the project is to determine what current legislation, standards and guidelines are applied for water management purposes. This will provide clarity on what current management techniques are used to meet current best practice in Ireland. This will then be used to determine if the current water standards landscape is deficient in areas promoting water efficient management practice.

Keywords: risk-based water management framework, pharmaceutical sector, landscape, water standards, best practice

Water Quality and Resources

57. Modelling the effect of environmental factors on the survival of antibiotic resistant Escherichia coli in surface water ecosystems

Eithne O'Flaherty[1], Enda Cummins[1]

[1]UCD School of Biosystems and Food Engineering, University College Dublin, Belfield, Dublin 4, Ireland.

Corresponding Author Email Address: eithne.o-flaherty@ucdconnect.ie

Antibiotic resistant bacteria (ARB) are prevalent in surface water ecosystems and research shows the presence of ARB in streams, rivers, lakes and beaches around the world. When a bacterial infection is resistant to antibiotics this can make it very difficult to treat, and in extreme cases can lead to death. The role of surface water ecosystems and environmental factors on the survival of ARB is not fully understood. Evaluating the effect of environmental factors (*e.g. temperature, solar radiation, light extinction coefficient, salinity, and depth of water*) on the survival of ARB in surface water ecosystems is a critical part of understanding this process. In this study an environmental model is presented for AR *Escherichia coli (E. coli)* in surface water based on Mancini's equation for environmental influences. Data was collected from scientific literature on the environmental factors representing winter, spring, summer and autumn conditions. Seasonal variations on the survival characteristics of AR *E. coli* are presented. Environmental conditions in the winter were seen to be more favourable for survival. The model presented represents an accumulation of existing knowledge regarding environmental influences on ARB. The study is an important step to gain an insight into the survival characteristics of ARB in the environment, where information can be used to inform risk assessment models to help predict ARB levels and resultant environmental and human health risks.

Keywords: risk assessment, antibiotic resistant bacteria, environmental factors

Water Quality and Resources

58. Uisce Aille – Development of a focussed integrated catchment management toolkit for use in secondary schools encompassing outdoor environmental education and GIS mapping

Grainne Barron[1], Tiernan Henry[1], Gesche Kindermann[2]

[1]Department of Earth and Ocean Sciences, National University of Ireland, Galway, University Road, Co. Galway, Ireland.

[2]Applied Ecology Unit, Centre for Environmental Science, National University of Ireland, Galway, University Road, Co. Galway, Ireland.

Corresponding Author Email Address: g.barron1@nuigalway.ie

In Ireland, a substantial amount of our rivers, lakes and groundwater systems are at risk of pollution both now and in the future. While the role of public engagement in catchment management is becoming increasingly recognised in academic, governmental and social spheres, it is only just beginning to be fully implemented and realised in Ireland. A key gap identified by the 2014 EPA Research Report – Towards Integrated Water Management (TIMe) is a lack of Integrated Catchment Management (ICM) focussed primary or secondary school initiatives. Having reviewed best practice in ICM, Environmental Education (EE) and strategies for community engagement and place based learning, this overall project aims to help inform the foundation of ICM by utilising a Participatory Action Research (PAR) approach that allows for the fostering of an ICM curriculum that combines local knowledge, EE and outdoor field skills with the use of QGIS skills in the classroom. The Uisce Aille project, which is supported by the Burren GeoparkLIFE program, will result in an educational toolkit that will enable educators to explore an alternative approach to local stakeholder engagement: i.e. train the trainers, to engage the students, so that they can share the message with their local community. Ultimately the program devised will align itself with the execution of the EU Water Framework Directive (WFD) within Ireland: it is participatory, it is educational, it is emancipatory, it is based in and of a community, and the outcomes will be replicable and transferable across the Burren Geopark and the Irish secondary school sector.

Keywords: environmental education, place based learning, educational toolkit, integrated catchment management, water resource management, GIS, WFD

Water Quality and Resources

59. Blanket bog streams: Where does the water come from?

Sorcha Cahill[1], Katie Woodhouse[1], David Carlisle[1], Raymond Flynn[1]

[1]School of Natural and Built Environment, Queen's University Belfast, Northern Ireland.

Corresponding Author Email Address: scahill04@qub.ac.uk

Despite their widespread occurrence, the hydrology and hydrogeology of Irish upland blanket bogs remains poorly understood. One view bogs considers them as sponges that gradually release water to streams to maintain baseflow. On the other hand, the high groundwater levels in peat are viewed as limiting its capacity to accept recharge. A survey of three streams, discharging into the Killylane Reservoir, Co. Antrim from surrounding peat-covered areas, aimed to evaluate the sources of baseflow. Field observations corroborated geological and subsoils maps, showing that peat soils overlay basalt bedrock. Water quality surveying completed in summer 2016, through longitudinal channel specific electrical conductance (SEC) measurements, showed that water from the three streams had SECs consistently in excess of 300 uS/cm. Lower SECs and elevated colour levels, typically observed in peatland waters, suggested that although groundwater from peat contributes to stream flow, the proportion provided during baseflow was minor; this is consistent with low hydraulic conductivities typically encountered in peats adjacent to natural and artificial surface drainage. By contrast, the more elevated SECs observed in stream water reflected higher levels of mineralisation, typical of those encountered in waters as a result of contact with inorganic subsoils and bedrock. Survey findings suggest that a significant proportion of groundwater in peat discharges to depth where it becomes more mineralised. The proposed hypothesis is consistent with higher hydraulic conductivities and storage observed in peat away from drainage features and helps to reconcile conflicting flow and hydrochemical data through this alternative flow path. At the same time findings further underscore the importance of undrained peatlands as sources of baseflow, delivered to streams via permeable substrate deposits.

Keywords: blanket bogs, peatlands, water quality surveying

ESAI Annual Review 2016

ESAI Chairpersons Address from Dr. Frances Lucy

The ESAI has been involved in a number of activities over the past year since Environ 2016, both in terms of events and planning for the future. The highlights are as follows:

- Environ 2016 - 26th Irish Environmental Researchers Colloquium hosted by University of Limerick, March 24th -26th
- ESAI Postgraduate Researcher of the Year Award
- ESAI Grassroots Workshop competition
- 'Where there is No Engineer' design initiative - DTC Research Group in DIT now has ESAI as a partner

We had a large attendance at Environ 2016 and this is reported separately. I would like to acknowledge Dr Ronan Courtney, Dr. Audrey O'Grady and Dr. Ken Byrne and their team for hosting Environ 2016 at UL. The colloquium in Limerick was a big success and extremely well organised. The theme for Environ 2016 was 'Ecosystem Services for a Sustainable Future'.

Thanks to Dr Liam McCarton and Dr Niamh Power for co-ordinating the "ESAI Postgraduate Researcher of the Year Award". The applications from postgraduates were evaluated according to the criteria: [1] Scientific excellence and originality;[2] Impact (economic/environmental/societal) and;[3] Dissemination (conferences, outreach, media). Congratulations to the winner Christopher Finnegan, a PhD student in the third year of his research in enviroCORE, the Centre of Research and Enterprise in the Institute of Technology Carlow. Christopher's project is entitled "Bioremediation of tributyltin (TBT) in Irish marine sediments: microbial screening and process optimisation". Please come along to his see Christopher present his research at the ESAI AGM on Tuesday April 11th at 5.30pm.

One of our major initiatives in the past two year is to reach out to colleges more than we have done in the past. As part of this, we are fortunate to have an ESAI Liaison in each college. These staff members act as a contact point for ESAI activities and information flow. We are also offering free membership to all undergraduates in relevant courses in each college. The list of third level environmental education programmes on our web site has been updated as part of this process. We hope that this approach will facilitate more sustainable engagement with students and in particular will raise awareness and stimulate interest in environmental research. We have been encouraged by the growing number of non-research based students (e.g. taught Masters) attending Environ over the past few years and we would anticipate that this trend may extend further to undergraduate students through this process.

Another recent development is that we are reviewing our aims and objectives at the core of the ESAI. It is healthy that we should question how we serve our members and our ability to do things better or differently. Perhaps the focus needs to be moved more explicitly to a research agenda as many of our members are involved in this area. Furthermore our membership is also quite diverse in terms of discipline, which is a great strength of the organisation. We are depending on the voluntary efforts of our members, so we must be cognisant of what is possible to achieve effectively. As always, we welcome your input. Remember to keep in touch with ESAI through social media on Twitter, Facebook and LinkedIn. We produce a bi-annual newsletter [mail chimp] to keep you up to date with our activities and your participation in ESAI. The ESAI listserver continues to be very effective in terms of spreading news on events and jobs to our network.

A key ESAI meeting was held in June 2016 to decide on future strategy. We would like to be the association of choice for environmental researchers on the island of Ireland. We also aim to provide the best networking opportunities for environmental science research. This year the ESAI committed to developing a Governance Code for the ESAI and will be developing this during 2017. This will be reporting on in next year's report.

The Grassroots Workshop Support Scheme was established in 2016 to assist researchers, particularly postgrads and postdocs at hosting specialist workshops. We are grateful to the EPA for providing funds for four workshops in 2016-2017, which have been administered by the ESAI. The workshops have been very successful in terms of research and outreach for citizen science. Since Environ 2016 we have had two winners in this scheme, David Kelleghan [UCD]: 'Nitrogenous pollutants in the atmosphere' workshop and Gill Weyman [UCC]: 'Ladybirds and Citizen Science' workshop. The aim is to continue this scheme in 2017.

"Where there is no Engineer" is a design initiative funded by Irish Aid and delivered in partnership with DIT, Concern Worldwide, Engineers Ireland, Engineers without Borders Ireland and ESAI. ESAI Researchers who think their work may have an application within a developing country are invited to enter the competition. Research is grouped under six global themes; Climate Resilient Infrastructure, Self Supply Water and Sanitation,Health,Energy Systems, Food Security, Applying Big Data in the Community. This year's competition will focus on Nepal, working with the communities affected by both long term development problems and the recent devastating earthquake. Selected entrants will be invited to participate in the National Finals where they get the opportunity to pitch their research in a dragons den style format. The winning team will be awarded a "Davies Travel Scholarship" to travel to Nepal to work with Concern and EWB. Four research concepts will also be selected for funding under our "Arup Trust Innovation Award". This will fund researchers who need to further testing to develop their concept to a practical stage. This is an opportunity for researchers to bring their research into a practical real world environment. Anyone interested to apply can discuss further at the environ conference or email liam.mccarton@dit.ie for more information.

On the ESAI Council front, we are actively seeking new members for the council to get involved in a range of new and existing activities. This is a great experience for both early stage [PhD and Post Doc] and more mature researchers and also research supervisors. Please attend the ESAI AGM on April 11th at 5.30pm if you wish to become involved.

Environ 2017 Athlone Institute of Technology

On behalf of the ESAI, I wish to say a sincere thanks to members of the Council who are stepping down from their roles including Emer Cosgrove [Honorary Treasurer], Mark Nolan [Communications], Dr. Noreen Layden, Dr Ronan Courtney, and Dr. Yvonne Lang [Early Stage Researcher representative]. I would also like to thank my predecessor Dr. Tom Curran for his leadership as chair of the ESAI council from 2014-2016 and also for his continued guidance.

The Council wish to thank ESAI administrator, Sinead Macken, for her excellent trojan work, dedication and support over the past year with all our diverse activities.
Best wishes to all for research in the year ahead.

Dr Frances Lucy is Head of Department of Environmental Science at IT Sligo. She has been on ESAI Council since 2013 and was the convenor at the 2015 ENVIRON in IT Sligo.

ESAI Goals and Objectives 2016

The ESAI (Environmental Science Association of Ireland), founded in 1995, as a not for profit organisation. The membership is drawn from all sectors and disciplines, ranging from biology and ecology to engineering, hydrology and management and from professors to amateur naturalists. The goals and objectives of the organisation are to:

- Provide a forum to facilitate exchange of specialist information and advice amongst environmental researchers, policy makers, environmental management practitioners and other stakeholders, within Ireland and elsewhere.
- Promote a fuller awareness of the role that higher-level education institutions may make in finding solutions for the urgent environmental problems confronting contemporary society.
- Provide a forum for networking amongst environmental researchers both at national and international scales.
- Facilitate an annual conference aimed at providing postgraduate and other researchers with an opportunity to learn about each other's work, and for postgraduates to present and publish papers within a supportive community.
- Promote high professional standards amongst environmental researchers and professionals.
- To ensure a platform for science-based research on the environment in Ireland.
- Provide a Code of Ethics for Environmental Professionals in Ireland through its membership.
- To maintain growth in the membership base.

Lough Gill: photo Frances Lucy

Membership

Make the most of your Membership

Benefits of Membership

By becoming a member of ESAI, you will also have access to:

- Discounted rates at Environ, the annual Irish Environmental Researchers Colloquium, one of the major activities of the Association. It is now one of the largest national scientific meetings in Ireland attracting over 300 delegates each year.
- Discounted rates for selected workshops, seminars, further education courses and conferences.
- Access to ESAI listserver
- Eligibility to apply for ESAI Postgraduate Researcher of the Year Award
- Eligibility to apply for ESAI Grassroots Workshop Funding
- Learn from others and absorb best practice
- Raise the profile of you and your business
- Stimulate new business opportunities
- Innovate and commercialise new products and services

Raise your Profile

- Members of ESAI will receive free-of-charge E-Newsletters, Environews.
- Sponsorship opportunities

Keeping you informed

The ESAI website (www.esaiweb.org) is kept up to date with the latest news from the association about our upcoming events, competitions and funding opportunities.

We circulate a quarterly newsletter summarising our work throughout the year. We also coordinate an email Listserver, which facilitates a community of over 2,300 subscribers to exchange information about environmental events and career opportunities in Ireland. To sign up to these services, please visit our website.

We are also very active on a number of social media platforms including Facebook, Twitter and LinkedIn.

http://twitter.com/esai_environ

http://www.facebook.com/esaiweb

http://www.linkedin.com/in/esaiweb

Contact Details

ESAI Chairperson
Dr Frances Lucy, Dept. of Environmental Science, Institute of Technology Sligo, Ash Lane, Sligo

Email: Chairperson@esaiweb.org Tel: +353 (071) 9155284
Website: www.esaiweb.org

ESAI Administrator

Ms Sinead Macken, Stonehaven, Moy Road, Kinvara, Co. Galway.

Email: administrator@esaiweb.org Tel: +353 (0) 86 8071498
Website: www.esaiweb.org

2016 Events

Date	Event
Jan 1st	**ESAI Grassroots Workshop Support Scheme Rolling Call**
February 2nd	**ESAI Winner Leave No Trace Competition - Sarah McInerney** One Day Workshop Outdoor Awareness Training, Dublin
February 29th	**ESAI Grassroots Workshop Support Scheme Rolling Call**
March 22nd - 24th 2016	**Annual Conference** Environ 2016 co-hosted by University of Limerick 26th Annual Irish Environmental Researchers Colloquium, University of Limerick, Limerick
March 22nd	**Workshop @ Environ 2016** 14:00-17:00 R: Facilitating reproducible statistical analysis in the Environmental Sciences University of Limerick
March 22nd	**Workshop @ Environ 2016** 14:00-17:00 Maximising and Assessing Research Impact University of Limerick
March 22nd	**Workshop @ Environ 2016** 14:00-17:00 The UL Green Campus Journey University of Limerick
March 23rd	**Launch** ESAI Postgraduate Researcher of the Year Award Launch
March 23rd	**ESAI AGM** 17:40-18:10, University of Limerick All members welcome
March 24th	**ESAI Student Competition Prize Giving Ceremony**
April 21st	**Conference** Water Ireland Conference & Exhibition 2016 15% Discount for ESAI Members
April 30th	**ESAI Grassroots Workshop Support Scheme Rolling Call**
August	**ESAI Environews Summer Edition available online** www.esaiweb.org
August 31st	**ESAI Postgraduate Researcher of the Year Competition Winner Announced** Christopher Finnegan - IT Carlow
August 31st	**ESAI Grassroots Workshop Support Scheme Rolling Call**
Sept 1st	**Free Membership for Undergraduate Members Roll Out**
October 31st	**ESAI Grassroots Workshop Support Scheme Rolling Call**
November	**ESAI Environews Winter Edition available online** www.esaiweb.org
December 31st	**ESAI Grassroots Workshop Support Scheme Rolling Call**

Environ 2016

The 26th Irish Environmental Researchers' Colloquium, ENVIRON 2016, was held at University of Limerick, from Tuesday to Thursday 22nd-24th March, 2016.

The ENVIRON colloquium is the longest running and largest annual gathering of environmental researchers in Ireland, with over 270 delegates attending this year. The event continues to provide a platform for postgraduate students and postdoctoral researchers to exchange information on their most up-to-date findings with a large and diverse audience made up of academics, industry members and policy makers.

The theme of this year's colloquium **'Ecosystem Services for a Sustainable Future'** stimulated consideration of how current research informs this theme and the development of sustainable policies for future generations.

The University of Limerick previously hosted the 7th and 14th ENVIRON in 1997 and 2004 respectively and the Department of Life Sciences, Faculty of Science and Engineering were very pleased to welcome the colloquium back to Limerick in 2016. 2015 saw the launch of the The Bernal Project, a €52 million strategic investment in research excellence, at the University of Limerick. The role of environmental sciences in the collaborative and cross-disciplinary teaching and research in Environment, Engineering and Energy are important foci of this new project and will continue the long standing record UL has established in these disciplines including Faculty representation in the UN Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services (IPBES).

The University of Limerick was named 'University of the Year 2015' in the Sunday Times Good University Guide. Other recent achievements include the University receiving the prestigious Athena SWAN Institution award. This recognises and celebrates good practice in recruiting, retaining and promoting women in STEMM (science, technology, engineering, mathematics and medicine) in higher education. UL is a recent recipient of the internationally recognised Green Flag by An Taisce's Green-Campus programme. This is an international environmental education and award scheme that promotes long term, whole college action for the environment. Significant initiatives and advances in the areas of Energy Conservation, Biodiversity and Travel and Transport have been incorporated into campus life.

Environ 2017 Athlone Institute of Technology

The conference began on Tuesday 22nd March, 2015 with three education and training workshops on offer to delegates: 'Facilitating reproducible statistical analysis in the Environmental Sciences' (Dr Coilin Minto, GMIT), 'Maximising and Assessing Research Impact' (Dr Fintan Bracken, UL) and The UL Green Campus Journey (UL Green Campus Committee in conjunction with Leave No Trace). All workshops were well attended and the feedback was very positive from those that engaged with them.

Environ 2016 opened on the evening of 22nd March with a public lecture by author and journalist Paddy Woodworth entitled 'Pricing the Planet: The economic and environmental benefits of accounting for natural capital and ecosystem services'. This talk was well attended with interest from not only to environmental science researchers but also members of the public and other stakeholders.

The colloquium was formally opened on the morning of Wednesday 23rd February by Professor Don Barry, President of UL followed by four keynote speakers from academia and industry: Prof John O'Halloran (University College Cork), Ms Katy Tsesmelis (Manager of the International Aluminium Institute), Prof Dave Goulson (University of Sussex) and Mr Michael Fennell (Rusal Aughinish). This stimulated discussion on the need to enhance and sustain ecosystem services which striving to maintain socio-economic progress.

Four concurrent sessions were held on Wednesday and Thursday morning. Theses session spanned 11 environmental topic areas, with a total of 92 oral presentations including a new theme in the Environ series, Novel applications in sustainability and research innovation. There were also 62 posters on display, covering a spectrum of sessions displayed alongside a wide range of exhibitors from environmental agencies, organisations and suppliers. On the Wednesday night, the social event was held in the Clarion Hotel with over 180 delegates in attendance.

Environ 2017 Athlone Institute of Technology

The conference closed on Thursday with a prize giving ceremony awarding €1750 of sponsored prizes to six delegates for excellence in presenting in their field. Student Competition: Six awards for excellence in presentation: ESAI Best Overall Oral Presentation went to Daryl Gunning, UCC for his talk entitle 'Commercial and experimental scale IMTA research'. ESAI Best Overall Poster Presentation was awarded to Paul Buckley, UCC with his poster entitled 'Sources of particulate matter in small rural towns in Ireland'. Best Water Based Presentation was presented to Derek Higgins, University of Limerick, for his a talk 'Use of constructed wetlands to treat alakaline leachates'. Best Waste and Resource Management Presentation was given to Tom Wallace, UCD, for his talk 'Review of fat, oil and grease (fog) waste utilisation trends'. Best Soils Presentation went to Israel Ikoyi, University of Limerick for his talk 'Influence of different rates of inorganic phosphorus fertilizer on soil biological properties in a soil-biota system'. Finally Best Biodiversity Presentation went to Tara Dirilgen, UCD for her presentation entitled 'What controls the abundance and diversity of soil animals? - a manipulation study using mesocosms in a controlled laboratory setting'.

A post event survey filled in by 27%of attendees indicated very high levels of satisfaction with the event. Again ENVIRON2016, proved to be a great opportunity for the 270 delegates to network with fellow researchers, and with industry, agencies and policy makers. We hope this continues to inspire them to think 'outside the box', to explore global research trends and technologies in search of a cross disciplinary vision.

Many thanks to all involved at University of Limerick, including the postgraduates, organising committee, IT Services, building office and administration. We are extremely grateful for the continued sponsorship of Environ by all sponsors, but especially by the EPA whose support is invaluable.

ESAI INCOME AND EXPENDITURE ACCOUNT

ESAI INCOME AND EXPENDITURE ACCOUNT		
For the year ended 31 December 2016		
	€	€
Opening balance as 01/01/16		6,175.80
Income		
Membership	3,043.46	
Environ 2015 - Delegate Fee	110.00	
Environ 2016 - Delegate Fee	26,845.00	
Sponsorship	18,600.00	
Environ 2016 Prizes	1,500.00	
Environ 2017 Sponsorship	3,350.00	
IPS Repayment	660.00	
Total Income	**54,108.46**	
Expenditure		
Environ 2016 (inc prizes)	31,183.82	
Environ 2017	2,459.82	
Environ 2016 Refunds	1,175.00	

Website	1,589.49	
Administration	6,989.00	
Travel	473.13	
Postage/Stationary	26.16	
Bank Charges (inc. Merchant banking)	1,767.15	
Insurance	1,002.87	
Workshop Grassroots	900.00	
Governance	150.00	
Postgrad Prize	500.00	
Accountancy	196.80	
Total Expenditure	**48,413.24**	
Excess Income over Expenditure		5,695.22
Closing Balance per Bank @ 31/12/16		**11,871.02**
***The balance includes the**		
Biodiversity Workshop 2000 surplus of €1,982.56		

Chairperson	**Regular Members**
Dr Frances Lucy	
Email: chairperson@esaiweb.org	Dr Noreen Layden
Honorary Secretary	Dr Thomas Curran
Dr Kevin Ryan	
Email: secretary@esaiweb.org	Dr Dorothy Stewart
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Email: treasurer@esaiweb.org	Dr Niamh Power
Communications Officer	Mr Liam McCarton
Mr Mark Nolan	
Email: communications@esaiweb.org	
Editor	**Membership Officer**
Dr Yvonne Lang	c/o Ms Sinead Macken / Administrator
Email: lang.yvonne@itsligo.ie	Email: administrator@esaiweb.org
Early Stage Researcher Representative	**Webmaster**
Dr Yvonne Lang	c/o Dr Adrian Corcoran / Attik Designs
Email: lang.yvonne@itsligo.ie	Email: webmaster@esaiweb.org
Conference Coordinator 2018	
Dr Joe Harrington	
Email: joe.harrington@cit.ie	
Conference Coordinator 2017	
Dr Andy Fogarty	
Email: conference@esaiweb.org	
Conference Coordinator 2016	
Dr Ronan Courtney	
Email: ronan.courtney@ul.ie	

Environ 2017

Athlone Institute of Technology

April 10th -12th 2017

Putting the Eco in the Economy
27th Irish Environmental Research Colloquium

Biographies

Workshop Sessions

A: Clara Bog Field Trip

Dr Sile O'Flaherty

Dr Sile O'Flaherty has been a lecturer in the Faculty of Science and Health since 2007. She has been actively involved for the past ten years in education and development of educational programmes at AIT. She is the coordinator of the BSc (Hons) in Bioveterinary degree programme. Her expertise is in Terrestrial Ecology, Land Use and Land Management. She was instrumental in the development of the new four year ab initio BSc (Hons) degree programme in Microbiology which will be starting in September 2017.

Previously she was a senior researcher in the area of Microbial Molecular Ecology at Rothamsted Research (UK), previously known as the Rothamsted Experimental Station which is one of the oldest agricultural research institutions in the world.

B: Maximising and Assessing Research Impact

Dr Fintan Bracken

Dr. Fintan Bracken currently works in the University of Limerick as the Research Services and Bibliometrics Librarian. In this role, Fintan is responsible for providing services to researchers in many aspects of the research process including reference management, publication strategy, bibliometrics, open access and maximising research impact. Prior to joining UL in October 2013, Fintan worked for IRIS Electronic Information Services Ltd. which manages IReL, the Irish Research eLibrary. He has also previously worked in the Marine Institute's research library. Before he completed his MLIS in 2011, Fintan worked in environmental consultancy. He conducted and published research on bird biodiversity in various farmland, woodland and peatland habitats during his PhD and post-doctoral studies in University College Dublin. His current research interests include usability studies and bibliometrics.

C: Where Next? Career Opportunities after Completing a PhD

Mr Patrick Barrett

Agricultural Inspector – Horizon 2020, National Contact Point, Societal Challenge 2

Department of Agriculture, Food & Marine

Mr Patrick Barrett works as an Agricultural Inspector with the Department of Agriculture, Food & Marine (2006-ongoing). He currently is part of the DAFM Research, Food & Codex Division and is the Horizon 2020 National Contact Point for Societal Challenge 2. He is a member of the States Representative Group for the Biobased Industries Joint Undertaking. He previously worked in the DAFM Pesticides Division. He was previously posted in Brussels on secondment to the EU Commission working in DG Environment working in the Natural Capital Directorate on their Agriculture, Forest & Soils unit (2013-2015).

He also previously completed a posting to the EU Commission in the DG Environment Chemicals unit (2010-12) working in relation to REACH and Biocides legislation. Initially, he worked as a Research & Development Scientist for Tridelta Developments.

Alice Wemaere

Dr Alice Wemaere Research Manager - Horizon 2020, National Contact Point, Societal Challenge 5

Environmental Protection Agency

Dr Alice Wemaere has a BSc. and MSc. in Chemical Engineering and a MSc in Environmental Sciences. She holds a PhD looking at Lake eutrophication and GIS modelling of nutrient loadings from a catchment into surface waters. Alice has been working with the EPA Research programme since 2004. Up to recently, she was responsible for the EPA Water Research Pillar and, in the past, has managed the EPA Research Publications and website. Since December 2016,Alice is now the EPA Research Manager, with responsibility for the full EPA Research Programme. She is the National Contact Point for the Water JPI and Horizon2020 Societal Challenge 5 (Climate Action, Environment, Resource Efficiency & Raw Materials) and since 2017 has also become the NationalDelegate for Societal Challenge 5.

Dr Fergus Mc Auliffe

Dr Fergus Mc Auliffe is Education, Public Engagement and Communications Manager at the Irish Centre for Research in Applied Geosciences (iCRAG).He manages all of iCRAG's communications, education and public engagement activities. He holds a PhD in environmental science from University College Cork. Alongside his research experience, Fergus also has a wide range of experience in science communication, through winning FameLab International in 2013, delivering workshops and conference talks on science communication around Europe, and is currently a presenter on "The Science Squad/10 Things to Know About" on RTE1 television. As part of his role, Fergus works closely with the Public Perception and Understanding of geoscience platform in ICRAG.

Dr. Martina Prendergast

Dr. Martina Prendergast is a Research Support Officer working in the Research Office in the University of Limerick since December 2016. From 2010 to 2016 she was the Strategic Development Manager of the Ryan Institute for Environment, Marine and Energy research at NUI Galway. Her duties there included strategic planning and policy, securing research funding, research management, input to teaching and learning programmes, and outreach and communication. Prior to her role in the Ryan Institute, she held the position of Development Manager of the Environmental Change Institute at NUI Galway (2002-2010). Before that, she worked as a Health Research Board Postdoctoral Fellow and as a lecturer in the Department of Microbiology, NUI Galway. She has authored over 20 international peer-reviewed articles, several book chapters, hundreds of academic reports, and contributed to Irish government-commissioned reports on the development of Environment-related policy. She is the University of Limerick's representative on the EPA's National Advisory Group for Horizon 202

Keynote Speaker

Minister Denis Naughten, Department of Communications, Climate Action & Environment

Denis Naughten TD was elected to Dáil Éireann in 1997 and served as Fine Gael's Spokesperson on Youth Affairs, School Transport and Adult Education until 2000. He then commenced his role as the Party's Deputy Spokesperson on Public Enterprise until 2002. Minister Naughten has also served as opposition spokesperson on Agriculture and Food and on Immigration issues during his tenure as a member of the Fine Gael Party until 2011. He is now an Independent member of Dáil Éireann. A food scientist by profession, Minister Naughten was appointed a senior Government Minister, representing the Roscommon-Galway constituency, on May 6th 2016.

Q&A Panel Debate Speakers / Chair

Chairman: Mr. Ciaran Mullooly

Ciaran Mullooly is RTE Midlands Correspondent and a former winner of the AT Cross National Media Awards and Medical Journalist Of The Year Award. He has worked in journalism for 25 years , training as a reporter in the Longford Leader , Cavan Leader and Shannonside Radio. His first TV role was as a reporter with the Rural Affairs Magazine show 'Ear To The Ground' on RTE 1.

Ciaran is best known for his award winning coverage of the flooding crisis of 2015/2016 where his TV and radio broadcasts on some of those worst affected by the floods brought the story of the trauma and the family upheaval into the homes of thousands of people on RTE television and radio. The story of the family funerals on Saints Island, Newtowncashel in county Longford in the midst of the flooding crisis have been watched by two million people online here and around the world. Ciaran also works as a volunteer in community development in the midlands for more than thirty years.

During that period he has shared a vision with several community groups for improving the quality of life and developing new facilities in Longford, Roscommon and Westmeath. He has worked with Lough Ree Angling Hub, Roscommon Lions Club, Ballyleague & Lanesborough Area Mens Shed, Rathcline GAA Club, Ballyleague Village Renewal & Tidy Towns, Longford County Tourism Committee ,Lough Ree Bay Tennis Club and Athlone Lions Club.

Minister Séan Canney,
(Minister of State with responsibility for OPW and Flood Relief)

Minister of State with responsibility for the Office of Public Works and Flood Relief

Political Background:
County Councillor: 2004 – 2016
TD: Feb 2016 – to date (Elected for constituency of Galway East)
Appointed **Minister of State** in May 2016
Department of Public Expenditure and Reform with responsibility for the Office of Public Works and Flood Relief

Education and Professional Qualifications:
Chartered Quantity Surveyor
Fellow of Chartered Institute of Building
Associate Chartered Institute of Arbitration

Mr. Tom Browne, ESB

Tom Browne is the Asset Assurance and Engineering Manager with ESB Generation. He is a Chartered Engineer with over 30 experience in ESB, with a background in power station operation. Over the last number of years Tom has represented ESB on various groups looking at flood management. He represents ESB on the Lower Lee Flood Relief Scheme project in Cork and has more recently assisted the work of the Shannon Flood Risk State Agency Co-ordination Working Group set up by the Government last year.

Dr. Ciaran Byrne, CEO Inland Fisheries Ireland

Dr Ciaran Byrne was appointed as Chief Executive Officer of Inland Fisheries Ireland (IFI) on July 1st 2010 following the amalgamation of the Central and Regional Fisheries Boards. Prior to this appointment he held the roles of Director of Research and Chief Executive Officer of the Central Fisheries Board. Ciaran graduated with a primary degree in Zoology from Trinity College Dublin in 1996 and followed this up with a PhD in fisheries parasitology. He is also a chartered management accountant and has spent a number of years working in private industry as an accountant. In June 2014, he was appointed Chairperson of the North Eastern Atlantic Commission (NEAC) within the North Atlantic Salmon Conservation Organisation (NASCO). As Chief Executive Officer of Inland Fisheries Ireland Dr Byrne has a key influence in much of the freshwater fisheries research and development work carried out in the country today and is leading the strategic change in IFI in challenging times.

Ms Sinéad O'Brien, Sustainable Water Network (SWAN)

Sinead holds an Honours degree in Zoology from University College Cork and has been Co-ordinator of the Sustainable Water Network (SWAN) for 12 years. SWAN is an umbrella network of 26 of Ireland's leading environmental organisations - national and regional - working collaboratively to protect and enhance Ireland's natural water resources through participation in the implementation of the Water Framework Directive (WFD), the Floods Directive and a wide range of other water-related policy and legislation. Sinead represents the Irish Environmental Network on the National Rural Water Services Committee and represents SWAN on the Irish Water Stakeholder Forum. She has extensive experience of water policy analysis at national and EU level and has a particular interest in public participation in integrated water management.

Sinead is a keen kayaker and this has given her an ideal vantage point from which to view the beauty but also the pollution of the Ireland's rivers and sea over the past decade.

PUBLICATIONS

Irvine, Kenneth and O'Brien, Sinead (2009). Progress on stakeholder participation in the implementation of the Water Framework Directive in the Republic of Ireland. Biology and Environment: Proceedings of the Royal Irish Academy 109B, 365–76.

Mr. Éanna Rowe, Waterways Ireland

Éanna Rowe Regional Manager for the West with Waterways Ireland and leading a multi disciplinary team in the management, maintenance and development of the Shannon Navigation Éanna is also a member of the Senior Management Team in Waterways Ireland.

Éanna is also a Director of Leave no Trace Ireland, member of the National Trails Advisory Committee and Co-Chair of the Lakelands initiative.

Previously Head of Marketing and Communications with Waterways Ireland Éanna was responsible for the formulation, development and implementation of the various strategies, policies and programmes from a Marketing, Research, Communications, Product Development and Visitor Services perspective.

Éanna previously worked in a number of roles and grades within the Department of Arts, Heritage and the Gaeltacht, including Private Secretary to the Minister, Irish Language Policy and Press Office.
A graduate of the Institute of Public Administration and of Athlone Institute of Technology Éanna hols a Degree in Public Management and a fist class honours MBA

Mr. Michael Silke, IFA Spokesperson

Michael has been a member of IFA for the past thirty years and has served in many roles including Galway county chairman, Connaught vice president and chairman of the IFA flood project committee. He has lived all his life on the Shannon callows and is intimately acquainted with flooding of the Shannon. He is a keen fisherman and throughout his life has been very involved in protecting wildlife on the Shannon callows especially the corncrake which unfortunately has disappeared from the Shannon callows in the past three years largely due to continual summer flooding. Michael's knowledge of the unique hydrological and ecological nature of the Shannon is encyclopaedic.

Keynote Chairpersons

Catherine Coxon

Catherine Coxon is an Associate Professor in Environmental Sciences in TCD, based in the Trinity Centre for the Environment / Geology Department, School of Natural Sciences. She carries out research on groundwater quality and water resource management. Her interests include: rural groundwater quality issues, particularly nitrate and synthetic organic compounds; karst hydrogeology and karst groundwater protection; phosphorus loss to surface waters by different hydrological pathways; groundwater – surface water interactions and groundwater dependent ecosystems. She has 30 years' research experience in this area, with over 100 publications. Much of her research is carried out in collaboration with Teagasc, the Environmental Protection Agency and Geological Survey Ireland. She recently co-edited with Dr. Caroline Wynne a special issue of Biology and Environment, Proceedings of the Royal Irish Academy, on "Advances in water research: evidence-based contributions to management and policy in Ireland under the Water Framework Directive", which forms the basis of one of the Environ 2017 paper sessions.

David Dodd

David Dodd - Technical Scientific Policy Advisor – Department of Communications, Climate Action and Environment

David is an environmental scientist with nearly 20 years professional experience in the environmental area. He worked in consultancy from 1998 to 2004 working on a variety of environmental projects undertaking air quality and noise assessments and contaminated land and groundwater projects. He spent 10 years with the Environmental Protection Agency (EPA) in Wexford and Dublin in waste prevention, hazardous waste and environmental research and is currently a scientific technical policy advisor with the Department of Communications, Climate Action and Environment (DCCAE) in particular in the area of air quality and noise . He holds qualifications from Trinity College Dublin, University of Ulster, IT Sligo and most recently undertook a Masters Degree in Science Communication with DCU. David is currently working on the

development of Ireland's First National Clean Air Strategy which looks at the sources of air pollutants from across sectors and the plans and programmes to reduce these emissions.

Jaimie Dick

Jaimie Dick is Professor of Invasion Ecology at Queen's University Belfast and Director of Queen's Marine Laboratory in Portaferry. Jaimie is former Director of Research and Director of the *Quercus* Biodiversity and Conservation Centre. Jaimie was Senior Investigator on Invasive Species Ireland and currently PI on several invasions projects with eg EPA, IFI, WWI, British Council and NSERC. Jaimie's interets are in the science and managmenent of the impacts of invasive species in freshwater, marine and terrestrial settings. In particular, Jaimie applies individual, population and commumity concepts to undersanding and predicting the ecological impacts of invasive species. Jaimie has given several recent invitation/keynote talks in China, Argentina, Canada, South Africa, Australia and across Europe. His PhD students are currenlty involved in fish, invertebrate and plant invasions across the globe and Jaimie engages BSc/MSc students in such ventures with lectures, fieldcourses and projects. Jaimie has published over 160 papers in the area and likes beer.

Jenny McElwain

Professor Jenny McElwain's research interfaces between geological and biological sciences and is mainly focused on exploring macroecological and evolutionary responses of plants to long term climatic and atmospheric change.

Professor McElwain is particularly interested in understanding and documenting plant community responses in the plant fossil record to changes in atmospheric carbon dioxide concentration. Intervals of past global change can serve as import analogs with which we can improve our predictions of how broad-scale ecological interactions and plant communities may respond to future carbon dioxide-induced global warming. She has been working extensively on documenting plant community responses across mass extinction boundaries in the fossil record, including the Triassic-Jurassic mass extinction event (200 million years ago) when over 50% of invertebrate fauna went extinct and the Cenomanian-Turonian oceanic

anoxoic event, which was an interval of major climatic and atmospheric upheaval in the Cretaceous period around 90 million years ago. Much of her research has also focused on developing tools with which we can reconstruct past environmental changes, including the concentration of atmospheric carbon dioxide in ancient atmospheres and paleoelevation (the elevation of past land surfaces) using fossil plants.

Martin Cormican

Martin Cormican, MB, BCh, BAO and MD, is Chair of Bacteriology, and Director of the Centre for Health from Environment at the National University of Ireland Galway; Consultant Microbiologist at Galway University Hospitals, Director of the National Salmonella Shigella and Listeria Reference Laboratory and Director of the National Carbapenemase Producing Enterobacteriaceae Reference Laboratory. Martin has over 20 years' experience of research on antimicrobial resistance and water borne organisms of public health concern.

David Tobin

David Tobin, Planning and Sustainability Manager with Lagan Cement.

David is a graduate of Environmental Science from both Coventry University and University of Bath, with primary interests in contaminated land, air pollution control, waste recovery and renewable energy. He has worked primarily in environmental management roles in heavy industry since 1996, with experience of large scale timber processing, food and the cement manufacturing industries. He has worked with Lagan Cement since 2006 and since that time has mainly focused on alternative fuel procurement, environmental licensing and the planning aspects associated with the use of waste derived fuels at Lagan Cement.

He has been a pioneer in driving the sourcing, planning, licensing, development and use of alternative and waste derived fuels in Ireland. David also chairs the alternative fuels sub-group of the Cement Manufacturers association of Ireland. David retains a keen interest in scientific research.

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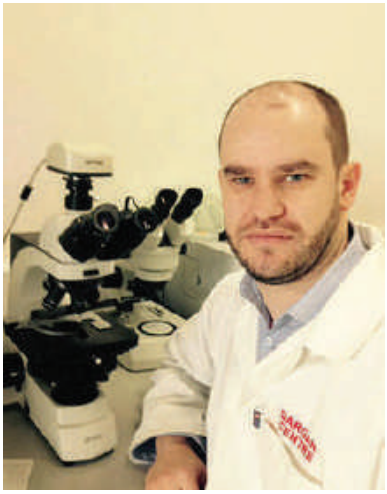
Dr Ciaran Kelly

Dr Ciaran Kelly – Manager of the Office of Research and Development (ORD) at the Marine Institute.

Ciaran is a marine scientist with over 20 years professional experience from running surveys at sea to modelling population dynamics and managing research calls. For over 15 years Ciaran worked for the Fisheries and Ecosystem Advisory Services section at the Marine Institute where he led teams conducting pelagic fisheries resource assessments and producing advice and support for fisheries management. Currently Ciaran is the manager of the ORD, part of the Policy Innovation and Research Services section (PIRS) at the Marine Institute; which in conjunction with the CEO and the MI directors develops strategic programs and determines funding opportunities. Annually the ORD supports competitive funding initiatives and funded projects to the value of €8.5 million. Ciaran is currently involved with the development of a new National Marine Research and Innovation strategy which is due to be launched at SeaFest in 2017.

ESAI Postgraduate of the Year Winner



Christopher Finnegan

Christopher Finnegan, completed an BSc (Hons) in Environmental science in 2014 and also received a degree in Analytical and Forensic science in 2013 from Carlow IT. Christopher, is currently a doctoral student at IT Carlow's enviroCORE research centre were his work focuses on the bioremediation of tributyltin (TBT) in Irish marine sediments. Christopher's research interests includes a diversity of topics: phytoremediation, bioremediation and gas chromatography analyses. Specifically the use of micro-organisms to remove or degrade environmental pollutants. He instructs in both Bio and Analytical science subjects and is also involved in a number of undergraduate research projects. His academic achievements to date include winner of ESAI researcher of the year 2016, winner of best student oral presentation at ISEH conference 2016 and the publication of his first paper in the International Journal of Environmental Bioremediation & Biodegradation titled "Gas Chromatographic Approach to Evaluate the Efficacy of Organotin Degrading Microbes".

Environ 2017

AN APPROVED EVENT FOR CONTINOUS PROFESSIONAL DEVELOPMENT

Engineers Ireland
cpd APPROVED EVENT

CIWM
Supported by CIWM 2017
Helping to inspire excellence in resource management since 1898

CIWEM Chartered Institution of Water and Environmental Management
Republic of Ireland Branch

CIEEM Chartered Institute of Ecology and Environmental Management

ESAI Student Competition 2017

ESAI Student Competition 2017

The ESAI will be judging all student oral and poster presentations for consideration in this years student competition. Winners are also invited to submit an article on their research project to the ESAI newsletter Environews and to their prize sponsors. Along with their certificate and award each winner will receive a one year subscription to the journal Biology and Environment published by the Royal Irish Academy. Results will be announced at the prize giving ceremony on Wednesday 12th April at 13.30pm.

The prizes and categories this year are:

- ESAI Best Oral Presentation (€500) sponsored by Environmental Sciences Association of Ireland (ESAI)
- ESAI Best Poster Presentation (€250) sponsored by Environmental Sciences Association of Ireland
- Best Air Quality Presentation (€250) sponsored by Department of Communications, Climate Action and Environment
- Best Soils Presentation (€250) sponsored by Soil Sciences Society of Ireland
- Best Waste and Resource Management Presentation (€250 and 2017 CIWM Student Membership) sponsored by the Chartered Institution of Wastes Management (CIWM)
- Best Water Related Presentation (€250) sponsored by the Chartered Institution for Water and Environmental Management (CIWEM)
- Best Biodiversity Related Presentation (€250) sponsored by the Chartered Institution for Ecology and Environmental Management (CIEEM)
- Richard Fitzgerald Poster Prize for Best Aquatic Environment Presentation (€250) sponsored by AquaTT

Dr. Richard D. Fitzgerald

Richard was an exemplary fisheries zoologist. He was an excellent researcher and a gifted and inspiring lecturer. A UCC graduate [BSc and PhD], Richard was involved research and development in Aquaculture for almost 30 years in a variety of roles and posts in UCC, AquaTT and NUIG. He was also extremely interested in natural freshwater and marine fish populations, with a rare and extensive knowledge in both aquatic environments developed over the span of his career. He published over thirty peer reviewed publications, which are widely cited. Until the end of 2015, he was Research Co-ordinator and manager of the NUIG aquaculture research lab at Carna. Richard was blessed with an insatiable curiosity about all research, particularly in the aquatic environment and the highlight of his annual visit to Environ was the poster sessions. His rule of thumb for all his students and employees was that they could go to any relevant conference as long as they produced a poster! Richard sadly passed away on December 5th 2016. Thank you to AquaTT for sponsoring the Richard FitzGerald prize for best poster in Aquatic Environment.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