



nviron 2013

Ryan Institute, NUI Galway

January 30- February 1, 2013

www.viron2013.org

The 23rd Irish Environmental Researchers' Colloquium (ENVIRON 2013) is organised in a partnership between the Environmental Sciences Research Association of Ireland and the Ryan Institute for Environmental, Marine and Energy Research, National University of Ireland, Galway

Table of Contents

Welcome	3
Sponsors	8
Delegate Information	11
ENVIRON 2013 Programme Outline	15
Biographies:	19
Questions & Answers	20
Keynote Address	23
Invited Speaker	24
Keynote Chairs	25
Workshop & Special Session Contributors	26
Workshops & Special Sessions Information	37
Oral Presentation Schedule	41
Oral Presentation Abstracts	50
Poster Presentation List	150
Poster Presentation Abstracts	153
ESAI Annual Review 2012	206
Index of Presenters	225

Welcome to ENVIRON 2013

Dear ENVIRON Delegate,

Welcome to the 23rd Irish Environmental Researchers' Colloquium, ENVIRON2013, and to NUI Galway. The conference was last hosted in Galway ten years ago in 2003, and we are very pleased to co-host the event again this year in association with the Environmental Sciences Association of Ireland (ESAI).

The theme of this year's conference is *'Environment: From Ecosystem Functioning to Human Health'*. Human health and well-being is achieved and maintained through our interactions with the world around us. Clean air, clean drinking water, safe food, good quality soils, and smart land use are essential elements in achieving good health. We are particularly pleased to welcome our keynote speaker, Mr. Tony Juniper, who is one of the top ten international environmental figures of the last 25 years. His lecture on *'Nature for Health - Opportunities for People and the Environment'* will examine how exposure to good quality green space and the natural environment can improve quality of life. He will highlight the potential economic benefits of working with nature instead of polluting the environment. He will give insights into how nature provides the 'natural services' that keep the economy going, and reveal that these and other services are each year worth about double global GDP. His new book called *'What has Nature ever done for us?'* was launched this month and signed copies are for sale during the conference in the University bookshop.

This year the conference offers four workshops to delegates:

Ecosystems and Health: from Local to Global Issues

Free GIS in Environmental Science: Sourcing Free GIS Data and Using Free GIS Software

ArcGIS in Environmental Science: Skills and Thrills using ArcGIS

Promoting Innovation in Research: Communication, Transfer & Application

We wish to extend a huge big thank you to all the workshop organisers who volunteered and gave up their time for free.

Please join us on board the Irish Naval Service flagship vessel, the LÉ Eithne, on Wednesday evening 30th January between 6.00-8.00pm for an ice-breaker, networking party. The ship is named after Eithne, a tragic heroine and the daughter of the one-eyed Fomorian King, Balor in an early Irish romantic tale. The LÉ Eithne will be moored in Galway Harbour for the duration of ENVIRON2013, and, Lieutenant Commander Alan O'Regan and Dr. Paul Bolger, Chairperson of ESAI will co-host a drinks and finger food reception on board. We would like to extend our gratitude to the Minister for Defence, Mr. Alan Shatter, for granting our request for the attendance of the vessel at the conference.

The main conference activity kicks-off on Wednesday evening 30th January with a Q&A style panel debate on '*Securing Ireland's Energy Future*' from 8.00-10.00pm in the Bailey Allen Hall. Mr. Duncan Stewart, broadcaster and presenter of the RTÉ programme Eco Eye will moderate the debate which will cover a very wide array of topics such as energy efficiency, renewable energy sources, CO₂ emissions, power, heat, transport, fuel imports/energy security, and the creation of energy-related jobs. Members of the six-person panel include Eamon Ryan, Leader of the Green Party and former Minister for Energy, Communications and Natural Resources, Colm deBurca, Manager of Ocean Energy at ESB International, Pat Swords, Engineer and Environmental Campaigner, Brian Barrett, Senior Executive with Galway County Council, Emeritus Professor Phillip Walton, Physicist and member of the Irish pro-nuclear lobby group BENE (Better Environment with Nuclear Energy), and Dr. Eimear Cotter, Senior Manager with EPA's Climate Change and Environmental Research Unit.

In total, we received over 150 abstract submissions and over the course of the Thursday and Friday we will have 99 oral presentations and 50 posters on display. Good luck to all presenters, especially if this is your first conference presentation. There are several oral and poster prizes on offer again this year thanks to the kindness and support of our generous sponsors. So good luck to all our student

presenters! As well as the main conference activity, there are a number of invited speaker sessions. On Thursday afternoon, Prof. Gerard Jennings will deliver a lecture remembering the former Professor of Physics, Tom O'Connor (RIP), who passed away in November 2012. Tom made decades of important contributions to the fields of atmospheric physics, aerosol science, occupational hygiene, and the history of science. Later on Thursday afternoon a workshop on 'Accessing Research Funding' takes place with senior representatives from the Environmental Protection Agency (EPA), the Health Research Board (HRB), Science Foundation Ireland (SFI), Irish Research Council (IRC), Department of Agriculture, Food and Marine (DAFM), and Teagasc who will deliver 20 minute presentations on the best strategies to access funding for your research.

This year, for the first time, the conference will feature the ENVIRON Career Expo and CV workshop. Attendees have the opportunity to meet representatives from NGOs, environmental consultancies, research institutes, and semi-state bodies who are all actively recruiting positions. Please take time to enjoy the photography exhibition in the foyer of the Bailey Allen Hall which features entries received for the ENVIRON 2013 photography competition. Also, the French artist, Francois Gunning, is our ENVIRON artist-in-residence. He is exhibiting 20 of his pieces in the foyer and break-out rooms.

On behalf of the council of the ESAI and the academic organising committee for ENVIRON2013, I would like to thank the generosity of all our sponsors who have made the event possible. Your support and generosity is sincerely appreciated in this time of austerity!

We hope you all enjoy both the academic aspects and the social programme of ENVIRON, and make some new friends during your visit to Galway.

Dr. Martina Prendergast,
ENVIRON2013 Conference Convenor,
On behalf of the ENVIRON2013 Organising Committees

ESAI welcome to ENVIRON 2013 Delegates

On behalf of the Environmental Sciences Association of Ireland (ESAI), the ESAI Council extends you a warm Galway welcome to the 23rd Irish Environmental Researchers colloquium (ENVIRON) at NUI Galway.

It is appropriate that the ENVIRON 2013 colloquium should be held in NUI Galway in EU Year of Air Quality (as 2013 has been designated) as NUI Galway are at the forefront of international research on atmospheric chemistry in no small part due to the Mace Head Atmospheric Research Station which provides data for atmospheric and climate change modelling around the world. We are delighted that Professor Gerard Jennings will be delivering a lecture remembering former Professor of Physics, Tom O'Connor (RIP) who was instrumental in the setting up of the Mace Head Atmospheric Research Station.

One of the strengths of the ENVIRON colloquium is the diversity and breadth of research presented at the parallel sessions. The colloquium allows scientists and engineers to lift their heads from their own research and look beyond their own discipline to what is happening in other areas of environmental research. So we are very pleased to have Mr. Tony Juniper, who has been a leading environmental campaigner for decades, to set the scene for all the research presentations to follow with a keynote lecture on Thursday morning on "Nature for Health - Opportunities for People and the Environment". Also for the first time, the conference will feature the ENVIRON Career Expo and CV workshop. We would encourage all delegates to take the time to meet representatives from NGOs, environmental consultancies, research institutes, and semi-state bodies who are all actively recruiting positions.

The NUI Galway ENVIRON Conference team have put together a wonderfully packed scientific programme for ENVIRON 2013. The ESAI wishes to sincerely thank Dr Martina Prendergast, Mr David Finn and the Ryan Institute/NUI Galway ENVIRON committee for offering to host the ENVIRON and for assembling a very interesting and stimulating scientific programme. We also wish to thank Ms. Sinead Macken for providing administrative support to the event.

We very much look forward to meeting you over the course of the colloquium. Before you leave please drop by the registration desk and to let us know what the highpoints (and lowpoints – not too many we hope!) of the colloquium were for you. Have a great time.

Dr Paul Bolger
ESAI Chairperson

The current ESAI Council members are:

Dr Cara Augustenborg
Mr Alan Berry
Dr Paul Bolger
Dr Shane Colgan
Dr Tom Curran
Ms Aoife Delaney
Dr John Gallagher

Mr Damian Howard
Ms Nuala Murphy
Mr Joe Noonan
Mr Timothy O'Sullivan
Dr Martina Prendergast
Dr PJ Purcell
Mr Kevin Ryan

ENVIRON 2013 ORGANISING COMMITTEES

Conference Convenor

Dr Martina Prendergast, Strategic Development Manager,
Ryan Institute, NUI Galway

Academic Planning Committee

Dr Eoghan Clifford, Department of Civil Engineering, NUI Galway
Dr Gavin Collins, Department of Microbiology, NUI Galway
Prof Martin Cormican, Department of Bacteriology, NUI Galway/HSE
Dr. Frances Lucy, Department of Environmental Science, Sligo IT
Dr Edward Curry, Department of Information Technology, NUI Galway
Dr Michael Gormally, Department of Microbiology, NUI Galway
Dr Marie Coggins, Department of Experimental Physics, NUI Galway
Dr Mark Healy, Department of Civil Engineering, NUI Galway
Prof Mark Johnson, Ryan Institute, NUI Galway
Dr Ronán Kennedy, Department of Law, NUI Galway
Dr Liam Morrison, Department of Earth & Ocean Science, NUI Galway
Dr Maurice Mulcahy, Regional Environmental Health Officer, HSE West
Dr Diarmuid O'Donovan, Director of Public Health HSE West
Dr Brian Quinn, Irish Centre for Environmental Toxicology, Galway-Mayo Institute of
Technology (GMIT)
Dr Maria Tuohy, Department of Biochemistry, NUI Galway
Dr Xinmin Zhan, Department of Civil Engineering, NUI Galway
Mr. Dave Finn, Outreach Assistant, Ryan Institute

Event Management Committee

Nessa Golden, David Clarke, Inga Reich, Sorcha Dolan, Tracy Hynes, James McGrath,
Enda McGrory, Richard Manton, Kate Kilroy, Kelly Fitzhenry, Aoife Joyce,
Aoife Vaughan, Mesa Perry, Jean Hamilton, Wolfgang Helnwein, Lisa McEntee,
Fiona Stapleton, John Staunton

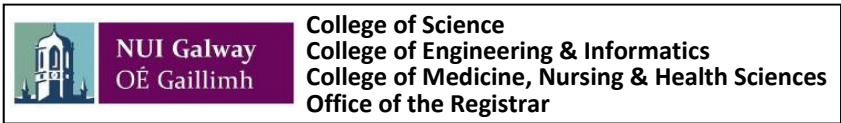
ESAI Council

Ms. Sinead Macken, ESAI Administrator
All members of the ESAI council

A very special thank you in particular to Mr. Dave Finn and Ms. Sinead Macken for their Trojan efforts in the organisation and planning of this year's conference. They were an exceptional team and went above and beyond the call of duty on a daily basis. A very sincere thank you to Dr. Sarah Knight for preparing the entire book of abstracts, and to Ms. Patricia Walsh, for all of her expert advice and assistance with the management of all of the practical aspects of the conference.

Thanks to ENVIRON 2013 Sponsors & Exhibitors

Main Sponsors



Theme Sponsor



Prize Sponsors



Cork City Council



Comhairle Cathrach Chorcaí



Soil Science Society of Ireland

Thanks to ENVIRON 2013 Sponsors & Exhibitors

Stand Sponsors



Thanks to ENVIRON 2013 Sponsors & Exhibitors

Careers Expo

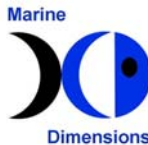
The ESAI is proud to announce the addition of the first annual Environ Career Expo to this year's ENVIRON Conference. Attendees will meet representatives from NGOs, environmental consultancies, research institutes, and semi-state bodies planning to recruit in 2013 to discuss job opportunities; internships; post-doctorate and Ph.D. programmes. Career guidance and CV consultation will also be provided at the event. The Career Expo is open to the general public and is free of charge.

When: Thursday - January 31, 2013 - 13:00-17:00

Where: Bailey Allen Hall Foyer, NUI Galway



Powered by
InterTradeIreland



greencareersireland.com
[environmental jobs and internships in Ireland]





DELEGATE INFORMATION

REGISTRATION

The Environ 2013 Registration Desk will be open in The Bailey Allen Hall at the following times.

Wednesday Jan 30th 09:00am to 6:00pm

Thursday Jan 31st 08:00am to 6:00pm

Friday Feb 1st 08:30am to 9:30am

All enquiries regarding the colloquium (including meals, finance, accommodation and social events) can be made at the Registration Desk.

DELEGATE BADGES

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

LOCATIONS

The Campus Map on the inside cover shows the location of the main rooms being used for the conference. All events are being held in the Bailey Allen Wing with the exception of the GIS Workshops which will take place in the Orbsen Building. The Keynote Address, Poster Sessions and lunches will take place in the Bailey Allen Hall

DELEGATES GIVING ORAL PRESENTATIONS

After registering for the colloquium, delegates giving oral presentations should upload their presentation at the content management desk (located beside the Registration Desk in the Bailey Allen Hall). 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). You will not be able to upload your presentation at the session in which you are presenting. 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 at least 5-10 minutes before the session begins.

POSTERS

The Poster presentation area is the Bailey Allen Hall. When you arrive at the regis-

tration desk, please indicate that you have a poster for presentation and the registrars will direct you to the poster presentation area. Posters can be erected on Weds Jan 30th (12:00pm-6:00pm) or Thurs Jan 31st (8:00 -10:30). **All posters must be in place by 10:30 AM on Thursday January 31st.** Each presenter has been assigned a **unique poster ID number** (please check the abstracts in the Delegate Handbook to find your ID number). Your poster should be mounted on the poster board assigned to your ID. Please do not remove posters until the end of the final poster session on Friday morning. There will be three one hour poster sessions throughout the colloquium; to ensure that colloquium delegates can meet poster presenters, poster presenters should remain by their posters during these sessions to answer any questions. Conference staff will be available to help erect posters.

INTERNET ACCESS

Wireless Access to the NUI Galway network is available in the Bailey Allen Hall and across the campus. To access the network, select NUIGWIFI in your network selection browser and connect. When you open your web browser you will be directed to the NUI Galway server login page. Enter the following username and password

Username: 9876259t

Password: gvaxp2684

Alternatively EDUROAM is also available on campus.

TEA/COFFEE & LUNCH

Teas, Coffees and Lunches will be served in the Bailey Allen Hall during workshop and colloquium conference breaks (please refer to programme). Seating is available in the Bailey Allen Hall and delegates can also avail of seating in The Hub located beside the Bailey Allen Hall.

BANK

A branch of Bank of Ireland is located on the Concourse (check Campus Map) with ATM facilities inside. Alternatively there is an ATM located between the Concourse and the Bailey Allen Wing. There are also ATM facilities at AIB on Newcastle Road, beside Distillery Road and at Ulster Bank on Newcastle Road, opposite UCHG.

PARKING

There is very limited parking space available in NUI Galway. Delegates who drive to the conference are encouraged to use the Park & Ride facility at Dangan (Permits and Timetables will be provided). Delegates can alternatively park in the Pay and Display car park beside the Orbsen Building, where space will be extremely limited. Illegally parked cars will be clamped.

LOCAL TRANSPORT

Galway City Bus runs a number of routes which service NUI Galway; 402-Seacrest; 404- Newcastle 405 – Ragoon. The services start at Eyre Square and drop beside the University. Return journeys can be joined on University Road- beside the University Main Entrance or opposite Cathedral; or Newcastle Road – across from Newcastle Post Office.

Full service details can be found at <http://www.galwaytransport.info/2009/07/city-bus-services.html>.

Taxi Services available include

Galway City Taxis 091 561111

Big O Taxis 091 585858

RESTAURANTS/CAFES/TAKAWAYS AROUND NUI GALWAY

There are several alternative venues on campus that offer snacks and beverages. They can be found in every building on campus. Galway offers numerous choices for off-campus eating. Most of these are located in town. Examples include




* Kai Café & Restaurant, Sea Road; Tel: 091 526003; www.kaiferrestaurant.com

* Rouge Restaurant, 38 Lower Dominic Street; Tel: 091 530681;
www.rougegalway.com

* Ard Bia Restaurant, Long Walk, Spanish Arch; Tel: 091 561114; www.ardbia.com



ENVIRON 2013 PROGRAMME

ENVIRON2013 Programme Wednesday January 30th, 2013		  
9am - 9pm	Registration – Bailey Allen Hall	
WEDNESDAY WORKSHOPS		
10:00 am – 12:30 pm Location: The View	Ecosystems and Health: From Local to Global Issues: Global Workshop Prof. Martin Cormican, Dr. Diarmuid O'Donovan and Team from HSE and NUI Galway	
1:00pm – 2:00pm	Lunch	
2:00pm – 5:00pm Location: The View	Ecosystems and Health: From Local to Global Issues: Local Workshop Prof. Martin Cormican, Dr. Diarmuid O'Donovan and Team from HSE and NUI Galway	
2:00pm – 5:00pm Location: Orbsen Building	GIS Workshop 1: Free GIS in Environmental Science: Sourcing Free GIS Data and Using Free GIS Software Dr. Ronan Hennessy, Ryan Institute NUI Galway	
2:00pm – 5:00pm Location: Bailey Allen Hall	Promoting Innovation in Research: Communication, Transfer and Application Dr. John Gallagher and a team from Trinity College Dublin	
6:00 pm – 8:00pm	Icebreaker Networking Party on board LÉ Eithne at Galway Harbour	
7:30pm – 8:00pm	Wine and Cheese Reception – Bailey Allen Hall	
8:00pm – 10:00pm Location: Bailey Allen Hall	Question and Answers style Panel Debate on Topic 'Securing Ireland's Energy Future', moderated by Mr. Duncan Stewart Panel: <ul style="list-style-type: none"> • Mr. Eamon Ryan, Leader of the Green Party and former Minister for Energy, Communications, & Natural Resources. • Mr. Colm deBurca, Manager of Ocean Energy and Ocean Technologies at ESB International. • Mr. Pat Swords, Chartered Engineer and Environmental Campaigner • Mr. Brian Barrett, Senior Executive with Galway County Council, Chair of the Galway Renewable Energy Enterprise Network (GREEN). • Prof. Phillip Walton. Emeritus Professor of Applied Physics, NUI Galway & Better Environment with Nuclear Energy Group (BENE) • Dr. Eimear Cotter, EPA, Senior Manager, Climate Change and Environmental Research Unit. 	

Thursday, January 31st 2013			
8:00 am – 6 pm	Registration –Bailey Allen Hall		
9:00 am – 9.10am Location: Bailey Allen Hall	Welcome address. Registrar & Deputy President, NUI Galway An Tollamh Nollaig Mac Congáil		
9:10 am – 9:25 am	Opening Remarks – Mr. Duncan Stewart, Broadcaster, and Producer of RTE's EcoEye series		
9:30 am – 10:30 am Location: Bailey Allen Hall	Plenary Session & Keynote Lecture 'Nature for Health - Opportunities for People and the Environment' by Mr. Tony Juniper, Author, Academic and Campaigner		
10:00 am – 1.00pm Location: Orbsen Building	ArcGIS in Environmental Science: Skills and Thrills using ArcGIS for Environmental Research Dr. Ronan Hennessy, Ryan Institute NUI Galway		
10:30 am – 11:30 am	Tea/Coffee and Poster Session 1		
11am Location: Bailey Allen Foyer	Official launch of the Centre for Health from Environment, Ryan Institute, by Mr. Tony Juniper		
11:30 am – 1:00 pm	Session 1 Environment & Health 1	Session 2 Climate Change & Energy 1	Session 3 Biodiversity & Bioresources 1
11:30 am – 1 pm	'Collaborate to Innovate' special session		
1:00 – 2:30 pm	Lunch		
1:30 – 2:30 pm	AGM of the Environmental Sciences Association of Ireland (ESAI)		
2:30 – 3.30pm Location: Bailey Allen Hall	Tribute Lecture - 'A commemoration of the life and work of Prof. Thomas C. (Tom) O'Connor' by Prof. S. Gerard Jennings, Emeritus Professor of Experimental Physics, NUI Galway and Former Director of the Environmental Change Institute, NUI Galway.		
1:00 – 5:00 pm	Career Expo and CV workshop: Bailey Allen Hall Foyer		
2:30 – 4:00 pm	Session 5 Water Quality 1	Session 6 Environmental Management 1	Session 7 Ecosystem Services
3:30 – 6:30 pm	Accessing Research Funding special session		
4:00 – 4:30 pm	Tea/Coffee and Poster Session 2		
4:30 – 6:00 pm	Session 8 Marine & Coastal Processes	Session 9 Environmental Management 1	Session 10 Climate Change & Energy 2
7:30 pm	Drinks Reception: Radisson Blu Hotel.		
8:30 pm	Conference Dinner: Radisson Blu Hotel		

Friday February 1st				
9:30 – 11:00 am	Session 12 Biodiversity & Bioresources 2	Session 13 Environment & Health 3	Session 14 Environmental Management 3	Session 15 Water Quality 2/ Environmental Technologies 1
11:00 – 11:45 am	Tea/Coffee and Poster Session 3			
11:45 – 1:15 pm	Session 16 Environmental Management 4	Session 17 Socioeconomics & Environmental Policy 2	Session 18 Environmental Technologies 2	Session 19 Invited Speakers – Industry and Regulation
1:15 – 2:30 pm	Lunch, Prize Giving & Close of Environ 2013			

The ESAI is proud to announce the addition of the first annual Environ Career Expo to this year's ENVIRON Conference. Attendees will meet representatives from NGOs, environmental consultancies, research institutes, and semi-state bodies planning to recruit in 2013 to discuss job opportunities; internships; post-doctorate and Ph.D. programmes. Career guidance and CV consultation will also be provided at the event. The Career Expo is open to the general public and is free of charge.

When: Thursday - January 31, 2013 - 13:00-17:00

Where: Bailey Allen Hall Foyer, NUI Galway



BIOGRAPHIES:

QUESTIONS AND ANSWERS PANEL

KEYNOTE ADDRESS

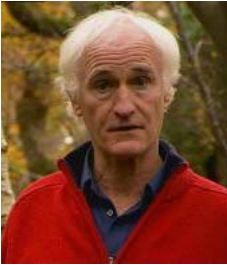
INVITED SPEAKERS

KEYNOTE CHAIRS

WORKSHOP & SPECIAL SESSION CONTRIBUTORS

QUESTIONS & ANSWERS “Securing Ireland’s Energy Future”

Wednesday January 30th, 8:00 - 10:00 pm



Moderator: Mr. Duncan Stewart, Earth Horizon Productions

Duncan is an award-winning architect, a specialist in ecological design and energy as well as being one of Ireland's most liked TV personalities. Duncan has worked for over forty years as an architect and lecturer and consultant in Dublin where he still heads a successful Architectural practice. Duncan's career as a TV personality began in 1991 when he was the host of a brand new type of successful TV series 'Our House'. Since 1997 Duncan has produced many of his own TV series focusing on his passion areas and expertise, design, construction standards and building technology, timber and forestry, environment issues and climate change. Duncan's unique style and screen presence have long since established his popularity with Irish audiences over the past 15 years.



Panel Member: Mr. Eamon Ryan, Green Party

Eamon Ryan is leader of the Green Party/Comhaontas Glas. He was Minister of Communications, Energy and Natural Resources from 2007 - 2011 and a member of the Dail from 2002 - 2011. Prior to entering full time politics he established a cycling holiday touring company and was chairman of the Dublin Cycling Campaign.



Mr. Colm de Búrca, ESB

Colm de Búrca was appointed Manager Safety and Sustainability at ESB in 2012 and is responsible for implementing ESB's Corporate Strategy in safety, sustainability and corporate responsibility. Colm has broad experience of the electricity industry having held operational, regulatory and commercial management roles across power generation, retail supply and the emerging renewables sector within ESB Group over a 20 year period. In his current role he is responsible for the delivery of ESB Group Corporate targets.



Panel Member: Mr. Pat Swords, Principal Process and EH&S Consultant

Pat Swords is a Fellow of the Institution of Chemical Engineers and a Chartered Environmentalist. Since graduation from University College Dublin in 1986 Pat has worked in developing the high technology manufacturing industry in Ireland. His work experience has also included projects in over a dozen other countries throughout Europe and North America. Since 1999 he has worked extensively on EU Technical Aid Projects

in Central and Eastern Europe helping to implement the EU Industrial Pollution Control and Control of Major Accident Hazards legislation.

In his private capacity on a pro bono basis Pat has campaigned for the proper application of EU Environmental Legislation, respecting the principles of environmental assessment, cost-benefit analysis and democratic accountability. The United Nations Economic Commission for Europe’s (UNECE) Aarhus Convention on Access to Information, Public Participation in Decision-Making and Access to Justice in Environmental Matters has a Compliance Committee, which following an investigation of the Irish renewable energy programme initiated by Pat, has ruled that the EU has by-passed the legally binding environmental assessments and public participation in its implementation in the 27 Member States of the 20% renewable energy by 2020 programme. In November 2012, Pat was provided leave by Justice Peart in the High Court in relation to a Judicial Review to quash the Irish Renewable energy programme and its funding arrangements until such time as the legally required environmental assessments and public participation were completed.



Panel Member: Mr. Brian Barrett, Galway County Council

Brian works in the Community, Enterprise and Economic Development Unit of Galway County Council. Over the past 10 years they have been working with communities to increase their participation in policy development and implementation. Brian has a Bachelor of Commerce and a MA in Community Development and is an external lecturer for NUI, Galway in the areas of Rural Development and Community Development. He has been working in the field of rural development for that past 20 years in the Private Sector, NGO sector and in more

recent years with Local Government. He is currently involved in a European Initiative under the Atlantic Area Programme, the Atlantic Power Cluster with Partners in Portugal, Spain, France, Ireland and the UK which aims to maximise the potential of Marine Renewable Energies for the Atlantic Area. In this initiative Galway County Council is leading a work package that progresses the Social Acceptance of Marine Renewable Energies and is piloting measures to increase the awareness and acceptance of Marine Renewable Energies amongst the various stakeholders.

QUESTIONS & ANSWERS “Securing Ireland’s Energy Future”

Wednesday January 30th, 8:00 - 10:00 pm



Panel Member: Prof. Philip Walton, Emeritus Professor of Physics at NUI Galway and member of BENE

Philip Walton received his primary physics and his Ph.D. degrees (1966) from Trinity College Dublin. He then worked for two years in the Department of Clinical Physics and Bioengineering, Western Regional Hospital Board in Scotland. In 1968 he joined the Medical College of Virginia, USA where he became Associate Professor and Chairman of the Radiation Physics Division. In 1978 he took up a new Professorship in Applied Physics at the National University of Ireland, Galway, from which he retired in 2005. He is now Emeritus Professor of Applied Physics at NUI, Galway. He served for seven years on the Board of the Radiological Protection Institute of Ireland. He has served as Radiological Protection Officer both at MCV and NUI, Galway. He is a committee member of BENE (Better Environment with Nuclear Energy), a lobby group urging the consideration of nuclear power for Ireland (www.bene.ie).



Panel Member: Dr. Eimear Cotter, EPA

Eimear Cotter is a Senior Manager in the Environmental Protection Agency. She manages the reporting of national greenhouse gases, air pollutant emissions and projections to the EU and UN. She also has responsibility for managing Ireland’s National Emissions Trading Registry under the EU Emissions Trading Scheme. She holds a Bachelors degree from Trinity College Dublin in Science and a Ph.D in Chemistry from Oxford University.

KEYNOTE ADDRESS “Nature for Health - Opportunities for People and the Environment”

Thursday January 31st, 9:30- 10:30 am



Mr. Tony Juniper, Independent Sustainability Adviser

Tony Juniper is an independent sustainability and environment adviser, including as Special Advisor with the Prince’s Charities International Sustainability Unit and as a Senior Associate with the University of Cambridge Program for Sustainability Leadership. He is a founder member of the Robertsbridge Group that advises international companies. He speaks and writes on many aspects of sustainability and is the author of several books, including the award winning *Parrots of the World*, *Spix’s Macaw* and *How Many Light Bulbs Does It Take To Change A Planet?* He was a co-author of *Harmony*, with HRH The Prince of Wales and Ian Skelly. His new book, *What has Nature ever done for us?* is published in January 2013. He began his career as an ornithologist, working with Birdlife International. From 1990 he worked at Friends of the Earth and was the organisation's executive director from 2003-2008 and was the Vice Chair of Friends of the Earth International from 2000-2008. In these roles Juniper was involved in influencing policy on a wide range of issues both in the UK and internationally, for example on sustainable development, trade, climate change and biodiversity, and in relation to the policies of international institutions, such as the World Bank and Regional Development Banks www.tonyjuniper.com, twitter:@tonyjuniper.com

INVITED SPEAKER “A Commemoration of the Life and Work of Dr. Thomas C. (Tom) O’Connor”

Thursday January 31st, 2:00 pm



Prof. Gerard Jennings, Emeritus Professor, NUI Galway

A native of Ballinasloe, Co. Galway, S. Gerard Jennings (SGJ) obtained a Department of Education (Aiken) Scholarship to University College Galway (UCG), and obtained a 1st class honours B.Sc. degree in Physics in 1965. This was followed by a M.Sc. at UCG under the supervision of Dr. Tom O’Connor. He received a Ph. D. degree in Atmospheric Physics at the University of Manchester in 1971. Following post-doctoral research work at UMIST, University of Durham, and at the Atmospheric Sciences Laboratory in New Mexico, USA, SGJ was appointed as Statutory Lecturer in Experimental Physics at UCG in 1980. He was awarded a D.Sc. from the University of Manchester in 1987.

SGJ was promoted to a Personal Professorship in 1990. He played an important role, along with colleagues, Tom O’Connor, Aodhagan Roddy and Colin O’Dowd, in the development and progression of the Mace Head Atmospheric Research Station, near Carna, Co. Galway. He has been very successful in obtaining major research funding at both national and international level. He has a strong research publication record over the years and has mentored several Ph.D. and M.Sc. students and researchers in Atmospheric Physics. He served 2 terms as Head of Department of Experimental Physics and was Director of the Environmental Change Institute from 2006-2009.



Prof. Mark J. Costello, Leigh Marine Laboratory, University of Auckland

ENVIRON 2013 Marine & Coastal Processes Chair

Mark is from Naas, in Co. Kildare. He is an Associate Professor at Leigh Marine Laboratory, University of Auckland, New Zealand. Previously he was Executive Director of the Huntsman Marine Science Centre, St Andrews, NB Canada; Founding MD Ecological Consultancy Services Ltd (EcoServe), Dublin; Lecturer in Environmental Sciences, Trinity College, Dublin; Research Fellow in Ecotoxicology of Napier University (Edinburgh) based at the Scottish Office Marine Laboratory Aberdeen; and Royal Irish Academy and Royal Society postdoctoral fellowship at the Marine Biological Association, Plymouth.

Mark founded the *Environmental Sciences Association of Ireland* in 1994, and is the founding Chair of the *World Register of Marine Species*. He is Treasurer and Founder of the *Society for management of electronic biodiversity data*, President of the *International Association for Biological Oceanography*, Vice-Chair *Global Biodiversity Information Facility Science Committee*, and First Chairman of the International Committee of the *Ocean Biogeographic Information System*, the data system of the *Census of Marine Life* until 2008. He has over 100 peer-reviewed publications.



Dr. Eoin O'Neill, UCD

ENVIRON 2013 Socioeconomics & Policy Chair

Dr. Eoin O'Neill is a Lecturer in Environmental Policy in the School of Geography, Planning and Environmental Policy. Eoin has BA (Hons) and MRUP degrees, and completed a PhD in planning and economics in UCD in 2007. His PhD examined the insights offered by spatial economics to national spatial planning policy, and the potential for market-based instruments to influence the location of development.

After graduating with a MRUP degree, he worked as a spatial planner in local authorities in Ireland and the UK in both development management and forward planning. Following the completion of his PhD he went on to work for the UK Environment Agency in 2008/09 in flood risk management where he worked in Thames Region as a technical specialist. Eoin has lectured in Environmental Policy in UCD since September 2009, and has teaching responsibilities for modules in this area, and also ongoing research in his areas of expertise.

Eoin's research interests are broad in scope but centre on the areas of economics and spatial planning, market-based instruments, public policy and governance, regional policy and national spatial planning, and flood risk management.

WORKSHOP: “Ecosystems and Health: From Local to Global Issues”

Wednesday January 30th, 10:00 am to 12:30 pm; 2:00 to 5:00 pm



Prof. Martin Cormican, School of Medicine and Centre for Health from Environment, Ryan Institute, NUI Galway

Martin Cormican is a medical microbiologist who works as Consultant Microbiologist at Galway University Hospitals and Professor of Bacteriology at NUI Galway School of Medicine. He is director of the Ryan Institute Centre for Health from Environment. His research interests include the broad area of health and environment with a specific focus on antimicrobial resistance in clinical and environmental settings and food and water borne infection. He has published more than 100 peer reviewed papers.



Dr. Diarmuid O'Donovan, Director of Public Health, HSE and Centre for Health from Environment, Ryan Institute, NUI Galway

Diarmuid O'Donovan MD MSc FFPHMI DTM&H studied medicine at NUI Galway and public health at the London School of Hygiene & Tropical Medicine. His current post is Director of Public Health (Health Service Executive, West) / Senior Lecturer in Social and Preventive Medicine (National University of Ireland Galway). His work includes public health research, strategic planning, policy and programme design and evaluation. He lived and worked in Africa for seven years.

His research interests include health equity, health information systems, reproductive and child health, communicable disease control, sexually transmitted infections and HIV, and environmental health and sustainable development. Current research projects include monitoring inequities in health in Ireland, using geographic information systems to study water borne infections, investigation of sociocultural aspects of safe motherhood in Zambia, and health research capacity building in Africa.

He is a member of the Irish Aid Technical Advisory Group on the Taoiseach's Initiative on HIV/AIDS and Global Communicable Diseases, and was a founder member and first chair of the Irish Forum for Global Health.

WORKSHOP: “Ecosystems and Health: From Local to Global Issues”

Wednesday January 30th, 10:00 am to 12:30 pm; 2:00 to 5:00 pm



Dr. Akke Vellinga, General Practice, NUI Galway

Akke’s research has been led by methodology and statistics, but always with a strong interest in the applicability and relevance of the research. She has worked as an epidemiologist on a range of subjects including vaccine evaluation and vaccination coverage, asthma and allergies, zoonotic diseases, in various places in Belgium. She moved to Ireland to take up a research post in the NUI Galway in 2005 and joined the Discipline of General Practice in 2008 to work on a project on antimicrobial resistance in the community. Akke has a PhD in Medicine (Epidemiology), a master in Science/Biology, a master in Epidemiology and obtained diplomas in Health Economics and Education.



Dr. Máire Connolly, Adjunct Professor of International Health and Development at NUIG

Dr Máire Connolly is Adjunct Professor of International Health and Development at NUIG and international public health consultant. She graduated in medicine from NUIG, holds a Masters in Public Health from UCD and a Diploma in Tropical Medicine and Hygiene from the London School of Hygiene and Tropical Medicine. She worked as specialist registrar in public health medicine in London. She joined the World Health Organization (WHO) in 1995 working with the Global Tuberculosis Programme and then the Communicable Diseases Cluster. She established the Communicable Diseases in Emergencies Programme in 2001 and was appointed WHO Coordinator of the Disease Control in Emergencies Unit in 2005. In 2007 she was appointed Advisor on Health Security to the WHO Assistant Director General until 2012. Her areas of expertise include communicable diseases, humanitarian response, TB, malaria and outbreak control. Dr. Connolly has worked in over 15 developing countries including Afghanistan, East Timor, Ethiopia, Iran, Iraq, Kosovo, Tanzania and Uganda. She has published two books on TB Control in Refugees and on Communicable Disease Control in Emergencies. In addition, she has published a number of peer reviewed articles in journals such The Lancet and JAMA.

WORKSHOP: “Ecosystems and Health: From Local to Global Issues”

Wednesday January 30th, 10:00 am to 12:30 pm; 2:00 to 5:00 pm



**Dr. Martina Prendergast, Strategic Development Manager,
Ryan Institute, NUI Galway**

Martina Prendergast is the Strategic Development Manager of the Ryan Institute at NUI Galway with responsibilities for the academic and technical development of the Institute. Her duties include strategic planning and policy, raising research funding, research management, input to teaching and learning programmes, and outreach and communication. Prior to her role in the Ryan Institute she worked as a post-doctoral fellow and lecturer in the Department of Microbiology, NUI Galway. Her research interests include the spread of infectious disease in contaminated food and water and vaccine development. She has authored over 20 international peer-reviewed articles, several book chapters, hundreds of academic reports, and contributed to numerous Irish government-commissioned reports on the development of Environment-related policy. She is a member of the council of the Environmental Sciences Association of Ireland (ESAI). She has two children under the age of three and lives with her husband and sons in Kilcolgan, Co. Galway.



**Dr. Maurice Mulcahy, Chief Environmental Health Officer,
HSE West**

Dr Mulcahy, is the Chief Environmental Health Officer responsible for the strategic direction of Environmental Health Services in the nine counties of Health Service Executive West Region. He has vast experience as a regulator in the Environmental Health field, including food safety, occupational safety, environmental protection, cosmetic product safety and tobacco control. He is a former Chairperson of the Environmental Health Officers Association (Ireland) and the Board of ASH Ireland. . Maurice is a lead for numerous research initiatives including the DEMOCOPHES pilot human bio-monitoring study.

He was a recipient of the UK Chartered Institute of Environmental Health (CIEH), Presidents Award in 2004, for his outstanding contribution to and excellence in the field of Environmental Health. In 2007 he was awarded the inaugural Tom Power Medal by the Office of Tobacco Control, for his commitment, leadership and vision in defeating the tobacco epidemic in Ireland. He holds an MSc in Occupational Safety from the Robens Institute, University of Surrey and was awarded a PhD by NUI Galway in 2010 for his research investigating the Environmental Health perspectives of tobacco control, with a particular focus on the Irish smoking ban. He is a Board member of the Research Institute for a Tobacco Free Society and recently has been appointed as an adjunct lecturer with the Centre for Health from Environment (CHfE), Ryan Institute, NUI Galway.

WORKSHOPS: “Free GIS in Environmental Science” & “ArcGIS in Environmental Science”

Wednesday January 30th, 2:00 to 5:00 pm; Thursday January 31st, 10:00 to 1:00 pm



**Dr. Ronan Hennessy, Senior Technician, GIS Centre,
Ryan Institute, NUI Galway**

Ronan Hennessy is the Senior Technician in Geographical Information Systems (GIS) at NUI Galway’s Ryan Institute for Environmental, Marine and Energy research. Ronan also lectures at NUI Galway’s Department of Earth and Ocean Science, where he was awarded a PhD in 2009.

Ronan has many years of research experience in the field of GIS, photogrammetry and geo-visualisation. In 2011, Ronan was invited to present his research on Google Earth at Google Headquarters in California. He has presented his research throughout Ireland, the UK, USA, and Scandinavia.

In 2011, as Geopark Geologist with the Burren & Cliffs of Moher Geopark, Ronan helped to secure the designation of the Burren as a UNESCO-supported Global Geopark.

Ronan has a keen interest in the geological and railway heritage, and recently completed a Heritage Council-funded project to publish an animated timeline map of the history of the Irish railway network in Google Earth.

As well as publishing many science-press articles and academic papers, Ronan has co-published two books: *Stone, Water: A Geology Trip through the Burren*, and *Galway’s Living Landscapes: Part 1 Eskers*.

WORKSHOP: “Promoting Innovation in Research: Communication, Transfer & Application”

Wednesday January 30th, 2:00 to 5:00 pm



John Gallagher, Research Officer, School of Environment, Natural Resources & Geography at Bangor University

John Gallagher is a Research Officer in the School of Environment, Natural Resources & Geography at Bangor University. He previously work as a PhD researcher in Trinity College Dublin and a past engineering graduate from Trinity and Queen's University Belfast. His research interests include innovation in research and research communication; LCA of renewable energy sources; air pollution controls; and domestic wastewater treatment systems. John has also worked for various consultancies and local authorities and has been involved in an extensive range of engineering projects; from road construction to landfill design and leachate management, design of civic amenity sites and DBO (design, build and operate) contracts for water supply network upgrades. He has also recently completed a Postgraduate Certificate in Innovation and Entrepreneurhip and is one of the first graduates from the TCD-UCD Innovation Academy programme, which promotes the development of social and commercial enterprises from postgraduate research.



Dr. Paul Bolger, Environmental Research Institute (ERI), UCC
‘Activities at the Environmental Research Institute, UCC’

Dr. Paul Bolger is manager of the Environmental Research Institute at University College Cork. He graduated from The Queen’s University of Belfast with a PhD in Chemistry in 1999 and completed a MBA from the Open University in 2006. Previously he carried out post-doctoral research on cleaner production processes for the metal industry at the U.S. Environmental Protection Agency, Cincinnati and also worked as wastewater R&D manager in Bord na Móna Environmental Ltd. He is currently Chairperson of the Environmental Sciences Association of Ireland.



Dr. Martina Prendergast, Ryan Institute, NUI Galway
‘The Ryan Institute – Open for Business’

Martina Prendergast is the Strategic Development Manager of the Ryan Institute at NUI Galway with responsibilities for the academic and technical development of the Institute. Her duties include strategic planning and policy, raising research funding, research management, input to teaching and learning programmes, and outreach and communication. Prior to her role in the Ryan Institute she worked as a post-doctoral fellow and lecturer in the Department of Microbiology, NUI Galway. Her research interests include the spread of infectious disease in contaminated food and water and vaccine development. She has authored over 20 international peer-reviewed articles, several book chapters, hundreds of academic reports, and contributed to numerous Irish government-commissioned reports on the development of Environment-related policy. She is a member of the council of the Environmental Sciences Association of Ireland (ESAI). She has two children under the age of three and lives with her husband and sons in Kilcolgan, Co. Galway.



Dr Raquel Cabral Harper, UCD Earth Institute

‘UCD Earth Institute: Science Informing Policy’

Dr Raquel Cabral Harper graduated from the Lisbon Technical University with a ME (Forestry) and received her PhD degree in Tree Physiology from University College Dublin. She then joined the Forest Ecosystems Research Group in UCD where she worked on GHG emissions in Irish peatlands, as well as day-to-day group management. From 2006, she managed the PRTL 2-funded UCD Urban Institute where she was instrumental in securing many European and nationally-funded projects including the PhD Programme in Earth and Natural Sciences (57 PhDs) funded under PRTL 5. She also coordinated two very successful lecture series aimed at stakeholders and industry: “Meeting the Challenges of Climate Change” and “Transforming Ireland”.

Dr Cabral Harper currently leads the Research Management Team at UCD Earth Institute. The Institute is a PRTL 5 funded centre for environment and energy resources research of a scale capable of leading Ireland’s response to climate change and the global energy resources crisis. She works with close to 80 UCD PIs spread across 9 UCD Schools to implement the Institute’s Research Strategy. She has significant experience in research concept development among multidisciplinary teams and the ability to get the best out of disparate intellectual and personal talents.



Dr. Brian Donlon, EPA

“EPA Research Programme - Informing Policy, Identifying Pressures & Developing Solutions”

Dr. Brian Donlon is based in the EPA Cork office in the Climate Change & Environmental Research Unit. Brian has a BSc in Biotechnology (DCU), PhD in Microbiology (UCG). He worked for 2 years in Wageningen, Netherlands researching and developing methods for the biological treatment (anaerobic, aerobic) of textile and chemical industry wastewaters. He also worked for UCG (6 years) as PhD student and Post-Doc researcher on treatment of industrial (distillery and pharmaceutical) and agricultural wastewaters primarily using anaerobic treatment methods. He joined the EPA in Feb 1996 and worked in Waste and IPC licensing and enforcement until Feb 2005. Since March 2005 he has been research manager of the EPA Research programme. Brian is the National Delegate for the European Commission’s FP7 Environment programme and is an Executive Board member of the EC-funded Water Joint Programming initiative.



Dr. Gemma Irvine, Irish Research Council

“Irish Research Council Funding Opportunities”

Dr Gemma Irvine is currently co-ordinating the merger of the new Irish Research Council. Prior to this, she was a Manager in the Higher Education Authority (HEA), coordinating the assessment and implementation of HEA funded research programmes, in particular, the ‘Programme for Research in Third Level Institutions (PRTL)’ and the development of research policy.

Dr Irvine completed her Masters and PhD in Neuroscience in New Zealand. Science communication is important to Dr Irvine who has published and presented her research internationally, mentored and lectured undergraduate and post-graduate students and been active in organising ‘Hands on Summer Science Camps’ for school students to stimulate their interest in Science.

Dr Irvine moved to Ireland to take up a SFI Research Fellow position in the Department of Pharmacology and Therapeutics at Trinity College Dublin, investigating the molecular mechanisms underlying Alzheimer’s Disease. Dr Irvine was also awarded an IRCSET Postdoctoral Fellowship to use Human EEG to investigate Alzheimer’s. Dr Irvine was a founding member of the Trinity Research Staff Association and worked on the development of careers for researchers.

Dr Irvine has a keen interest in the business and commercialisation side of research, completing several Business Administration papers via distance learning from Manchester Business School.



Dr. Maura Hiney, Health Research Board (HRB)

“Understanding the HRB strategic approach to funding research”

Dr Maura Hiney is Head of Policy, Evaluation and External Relations at the HRB. Her unit hosts the EU Framework Programme National Delegate and National Contact Points for Health, the National Focal Point for the EU Public Health Programme, as well as providing evaluation and policy expertise for the HRB.

From 1988-2000 Maura worked as a researcher at NUI Galway, as well as managing a commercial diagnostics service for the Aquaculture Industry. She has published over 30 peer-reviewed papers and 3 book chapters, has acted as a resource expert for NACA and the FAO, and has held a number of international roles including Meeting Secretary and Vice-President of the European Association of Fish Pathologists (EAFP). From 2000-2007 Maura was Head of Research Support Services at NUI Galway, which included development of research funding opportunities and research-relevant policies for the university, participation in strategic direction setting and the preparation of large strategic proposals.

Maura has a particular interest in issues of research integrity (RI) in health research. She has chaired a working group of the ESF Forum on RI, organised and participated in two national seminars on RI, is a member of the recently formed National Committee on Research Integrity, and has acted as rapporteur/expert for the Global Research Council and Science Europe initiatives on RI.



Dr. Roisin Chesire, Science Foundation Ireland

“Accessing funding from Science Foundation Ireland”

Dr Chesire is a scientific programme manager in Science Foundation Ireland. Science Foundation Ireland (SFI) is the national foundation for research in Ireland. SFI invests in academic researchers and research teams who are most likely to generate new knowledge, leading edge technologies and competitive enterprises in the fields of science and engineering underpinning three areas: Biotechnology,

Information & Communications Technology (ICT) and Sustainable Energy & Energy Efficient Technologies (Energy).

Dr Chesire holds a BSc in Physics and a PhD from Queen’s University, Belfast. Her PhD research involved the optimisation of commercial plasma systems used for semiconductor processing. Following a postdoctoral position in Queen’s, she joined Andor Technology, manufacturer of detectors for low light imaging and spectroscopy applications. Dr Chesire worked in the United States for Andor’s USA distributor, Oriel Instruments, in a business development role, where she worked with customers both in industry and academia.

Returning to Ireland, Dr Chesire worked in Optronics Ireland in Dublin City University, (DCU) where she investigated potential commercial applications of optical sensors. She then left Optronics to join Scientific Systems, producer of plasma diagnostic equipment. Before joining SFI in 2008, Dr Chesire worked as product manager with XSil Ltd, manufacturer of laser processing equipment for the semiconductor industry.



Mr. Bart Bonsall, Technology Centre for Biorefining & Bioenergy
‘Developments and Issues in the Irish Bioenergy and Biorefining Sector’

Since July 2010 Mr. Bonsall has been the Technology Leader for the Irish Technology Centre for Biorefining and Bioenergy, responsible for evaluating and developing biorefining and bioenergy projects relevant to the Irish market. Mr. Bonsall is responsible for developing a programme to coordinate and expand the relevant research activities of a number of the Irish Universities, with a

particular focus on bringing bio-based products and technologies to market. Mr. Bonsall has worked with researchers at several Irish Universities to evaluate and develop biological pathways for processing biodegradable wastes and agri residuals into bioenergy sources, biochemicals and biodegradable plastics, integrating various pretreatment technologies with advanced thermo enzymatic hydrolysis and adaptations of mixed culture anaerobic digestion technologies.

Mr. Bonsall has been actively involved in organising and authoring funding applications under various EU funding programmes and is currently actively involved in several Inter-Reg programmes investigating process commercialisation in the bio-sector.

Prior to employment with the Technology Centre Mr. Bonsall worked as the Operations Director at Biodiesel Production Ireland, Ltd., an Irish company organised to produce biodiesel fuel in a joint venture with one of the major transport fuel distributors in Ireland. Mr Bonsall has been involved in the design of state-of-the-art biodiesel production facilities and has spent a number of years investigating the various sources of vegetable oils suitable for conversion into biodiesel fuels. Mr. Bonsall is a graduate of the University of Illinois.



Mr. Tim Folan, Environmental Officer, Thermo King Ireland Limited

‘Best practice in Environmental Management in a Multi National Corporation’



Mr. Ben Wrafter, Chair, Atlantic Ocean Energy Alliance
‘Activities of the Atlantic Ocean Energy Alliance (AOEA)’

Ben Wrafter is the founder and Chairman of the Atlantic Ocean Energy Alliance (AOEA). Founded in 2011 the AOEA is an alliance of individuals, companies, institutes and representative bodies with an interest in Ocean Energy.

Ben is CEO of Sea Power Ltd, a progressive marine R&D and engineering company involved in the development of a wave energy device.

Ben has a degree in industrial engineering from UCG (NUIG). He worked with Thermo King and Byrne Mech. Ltd. and started Impulse Engineering Ltd. in 1983, a major supplier to the Multi National industry in Ireland, Europe and the U.S, which he owned and managed until selling it in 2000. Ben was CEO of Haptica Ltd, a medical device company, from 2002-2005.



Dr. Maurice Mulcahy, Chief Environmental Health Officer, HSE West

‘Human biomonitoring for Europe and Ireland: turning exposure assessment inside/out’

Dr Mulcahy, is the Chief Environmental Health Officer responsible for the strategic direction of Environmental Health Services in the nine counties of Health Service Executive West Region. He has vast experience as a regulator in the Environmental Health field, including food safety, occupational safety, environmental protection, cosmetic product safety and tobacco control. He is a former Chairperson of the Environmental Health Officers Association (Ireland) and the Board of ASH Ireland. . Maurice is a lead for numerous research initiatives including the DEMOCOPHES pilot human bio-monitoring study.

He was a recipient of the UK Chartered Institute of Environmental Health (CIEH), Presidents Award in 2004, for his outstanding contribution to and excellence in the field of Environmental Health. In 2007 he was awarded the inaugural Tom Power Medal by the Office of Tobacco Control, for his commitment, leadership and vision in defeating the tobacco epidemic in Ireland. He holds an MSc in Occupational Safety from the Robens Institute, University of Surrey and was awarded a PhD by NUI Galway in 2010 for his research investigating the Environmental Health perspectives of tobacco control, with a particular focus on the Irish smoking ban. He is a Board member of the Research Institute for a Tobacco Free Society and recently has been appointed as an adjunct lecturer with the Centre for Health from Environment (CHfE), Ryan Institute, NUI Galway.



WORKSHOPS AND SPECIAL SESSIONS

WORKSHOP: “Ecosystems and Health: From Local to Global Issues”

Wednesday January 30th, 10:00 am to 12:30 pm; 2:00 to 5:00 pm

John Snow:

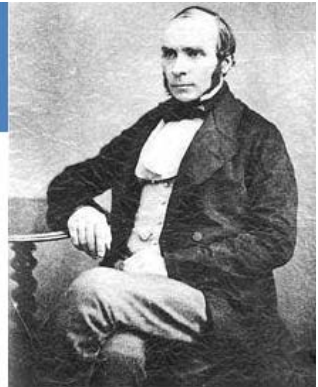
Investigating Outbreaks –Then and Now

Weds Jan 30th 2013, 10am-5pm

Bailey Allen Hall, NUI Galway

To mark the bicentenary of the birth of John Snow who is regarded as one of the founders of modern epidemiology, a workshop will focus on the multi-disciplinary response to water contamination issues.

A tabletop exercise will examine the investigation of a cholera outbreak in London in 1854, and Haiti in 2010, and the cryptosporidiosis outbreak in Galway in 2007.



Prof Martin Cormican NUIG/GUH, Dr Maire Connolly WHO/NUIG, Dr Maurice Mulcahy HSE, Dr Akke Vellinga NUIG, Dr Martina Prendergast NUIG, Dr Diarmuid O'Donovan NUIG/HSE

By the end of this session participants should:

- **Have an awareness of the broader environmental & social determinants of Health and identify ecosystem approaches**
- **Be familiar with data collection methods and sources of data**
- **Be able to describe an epidemic curve**
- **Recognise the values of mapping and Geographic Information Systems(GIS)**
- **Understand the health impacts of a sudden-onset natural disaster**
- **Be aware of the humanitarian response activities essential to protect the health of populations effected by emergencies**
- **Understand the roles of different agencies in the management of an outbreak**
- **Understand the principles of detection and control, and the outbreak of infectious disease**

WORKSHOPS: “Free GIS in Environmental Science” & “ArcGIS in Environmental Science

Wednesday January 30th, 2:00 - 5:00 pm & Thursday January 31st, 10 am - 1:00 pm

GIS workshops for Environ2013 @ GIS Centre Ryan Institute

2 half-day introductory GIS workshops will be delivered during the Environ2013 Colloquium. The two workshops are designed so that participants can take either or both workshops (i.e. the content of both workshops is independent)

Wed 30th January: 2pm -5pm (Workshop 1)

Thurs 31st January: 10am-1pm (Workshop 2)

Workshop 1: Free GIS in Environmental Science: Sourcing Free GIS Data and Using Free GIS Software

This workshop will enable participants to source and acquire freely available GIS data for environmental research. Data sourced from Irish and global GIS data providers will be examined, in addition to free WMS services. A variety of datasets will be examined, including soil, water quality, Water Framework Directive data, CORINE, historic mines, Census population data, bedrock, karst, groundwater, offshore wells, SACs, sites and monuments, elevation, and bathymetry data. Participants will be introduced to examples of free and open source GIS software, and how free data can be displayed, analysed and presented using free GIS software.

This workshop is suitable for students and researchers who are interested in learning to use free GIS software. Free and open source GIS software enables users to have access to their GIS software at home, in the office, in the field and into the future, as it is not restricted by user licences. This is especially beneficial to students and researchers interested in pursuing consultancy work.

Participants are invited to use their own notebooks/laptops for this session. However, it is advised that participants have installed the latest version of the free open source GIS software being used in the workshop prior to attending the workshop. Details on the software will be provided in January 2013.

Workshop 2: ArcGIS in Environmental Science: Skills and Thrills using ArcGIS for Environmental Research

This workshop will provide participants with the necessary skills to display, edit and analyse spatial and environmental data in ArcGIS - one of the world's most widely used GIS software applications. The workshop enable participants to create their own data and maps, import and display GPS data, import and accurately georeference historic/scanned maps, and create finished, annotated map displays for reports, posters and presentations. On completion, participants will have acquired valuable skills to introduce essential digital mapping skills and geographic visualisation techniques into their research.

This workshop is suitable for students and researchers who are interested in gaining an introduction or refresher in using ArcGIS software.

Collaborate to Innovate

Thursday 31st January. 11.30am-1.00pm.

'The Ryan Institute – Open for Business'

Dr. Martina Prendergast, Strategic Development Manager, Ryan Institute, NUIG

'Activities at the Environmental Research Institute, UCC'

Dr. Paul Bolger, Manager, Environmental Research Institute, UCC.

'UCD Earth Institute: Science Informing Policy'

Dr. Raquel Cabral Harper, Research Manager, UCD Earth Institute, UCD

Assessing Research Funding

Thursday 31st January. 3.30-6.30pm.

Presentations by

- **Dr. Brian Donlon**, Head of Research Programmes, Environmental Protection Agency (EPA).
- **Dr. Maura Hiney**, Head of Policy, Evaluation and External Relations, Health Research Board (HRB).
- **Dr. Roisin Cheshire**, Scientific Programme Manager, Programmes, Enterprise and International Affairs Directorate, Science Foundation Ireland.
- **Tom McDonald**, Forestry Inspector, Research and CODEX Division, Government Department of Agriculture, Food and Marine.
- **Dr. Gemma Irvine**, Irish Research Council.
- Speaker tbc from Teagasc.

Industry and Regulation (Session 19)

Friday 1st February. 11.45am – 1.15pm.

'Human biomonitoring for Europe and Ireland: turning exposure assessment inside/out'

Dr. Maurice Mulcahy, Chief Environmental Health Officer, HSE West

'Developments and Issues in the Irish Bioenergy and Biorefining Sector'

Dr. Bart Bonsall, Technology Leader, Centre for Biorefining and Bioenergy

'Best practice in Environmental Management in a Multi National Corporation'

Mr. Tim Folan, Environmental Officer, Thermo King Ireland Limited

'Activities of the Atlantic Ocean Energy Alliance (AOEA)'

Mr. Ben Wrafter, Chair, Atlantic Ocean Energy Alliance



ORAL PRESENTATION SCHEDULE

Thursday, January 31st (11.30 – 1.00pm) Oral Presentations (Sessions 1-4)			
Session 1 Environment & Health	Session 2 Climate Change & Energy	Session 3 Biodiversity & Bioresources	Session 4 Socioeconomics & Environmental Policy
Opening Chair Address	Opening Chair Address	Opening Chair Address	Opening Chair Address
Training neural networks for estimating minute ventilation and lung deposited air pollution dose in cyclist commuters, given information on personal exposure, physical exertion, cycling style, road topography and meteorology Marguerite Nyhan (TCD)	The effect of laboratory analysis on the design of a community digester. Eoin Allen (UCC)	Artificial coastal defences: enhancing biodiversity using sensitive design Louise Firth (NUIG)	Trialling of a method for sustainability analysis in a local authority Travis O'Doherty (UL)
Preliminary findings of the Cleaner, Greener, Leaner (CGL) Study on the influence of the neighbourhood environment on walking and transport behaviours Lorraine Fitzsimons D'Arcy (DCU)	Anaerobic digestion of restaurant food waste and an evaluation of hydrolysis of protein, carbohydrates, lipid and cellulose fractions Corine Nzeteu (NUIG)	The Kerry Slug: How should we manage a protected species in commercial conifer plantations? Inga Reich (NUIG)	Incorporating coastal risk within coastal planning, a practical decision making approach James Massey (RPS)

<p>A spatial approach for the epidemiology of antimicrobial resistance in <i>E. coli</i> causing urinary tract infections in the community Sandra Galvin (NUIG)</p>	<p>An Investigation into the Degradation of Beachcast Seaweed Brian Carpenter (Dundalk IT)</p>	<p>Integrating soil characteristics, land management and soil microbial communities Andrea Richter (UCD, Teagasc)</p>	<p>Visioning for more Sustainable Food Consumption in Ireland: Challenges and Opportunities Jessica Pape (TCD)</p>
<p>Longitudinal study of environmental contamination with antimicrobial resistant organisms in a newly built nursing home Catherine Ludden (NUIG)</p>	<p>Evaluation of building fabric retrofit options for achieving sustainable domestic building operation. Jamie Reynolds (TCD)</p>	<p>The potential of Microalgae as “Healthy” Foods Freddy Guiheneuf (NUIG)</p>	<p>Patterns and drivers of seafood mislabelling in European markets Amanda Brechon (UCD)</p>
<p>An assessment of the development and spread of antibiotic resistance as a result of biocidal and antibiotic use in the natural environment. Aideen Dowling (UL)</p>	<p>Comparison of the application of four standardised methodologies for the quantification of lifecycle greenhouse gas emission implications of building retrofits Niall Dunphy (UCC)</p>	<p>Searching for markers of local climate adaptation in the genome of <i>Bombus terrestris</i> populations originating from a variety of habitats Samuel Moran (IT Carlow)</p>	<p>Using discrete choice methods to calculate generic values for water Geraldine Murphy (EPA)</p>
<p>Detection of Low Level Contamination of Water with Shiga-Toxigenic <i>E. coli</i> Siobhan Kavanagh (NUIG)</p>	<p>Sustainable Retrofit Appraisal (SRA) of energy efficiency options: a project approach for low carbon buildings John Morrissey (UCC)</p>	<p>How well does the Irish Natura 2000 network encompass the occurrences of threatened and protected plant species? Aidan Walsh (Teagasc)</p>	<p>Uphill Struggle or Plain Sailing? Connecting Transport Policy and Human Health Henrike Rau (NUIG)</p>

Thursday 31 st January (2:30pm – 4.00 pm) Oral Presentations (Sessions 5-7)		
Session 5 Water Quality	Session 6 Environmental Management	Session 7 Ecosystem Services
<p>Opening Chair Address Dr. Frances Lucy, Ecologist, Dept. of Environmental Science, IT Sligo</p>	<p>Opening Chair Address</p>	<p>Opening Chair Address Dr. Stephen Hynes, Lecturer and Director of Social and Economic Marine Research Unit (SEMRU), NUI Galway</p>
<p>Landscape complexity and sediment flux: is landscape organisation preventing excessive sediment losses from agricultural land? Sophie Sherriff (Teagasc)</p>	<p>Anaerobic Digestion of Perennial Rye Grass Aoiffe Vaughan (NUIG)</p>	<p>Identification of grassland management and land-use change using high resolution spatial databases Jesko Zimmermann (TCD)</p>
<p>The Fate of pathogens and nutrients in on- site wastewater effluent disposal systems Kate Kilroy (NUIG)</p>	<p>Vegetative composition of aquatic buffer zones in Irish plantation forests Cormac McConigley (UCD)</p>	<p>The biology and behaviour of Tetanocera elata (Diptera: Sciomyzidae), potential biological control agent of pestiferous slugs Tracy Hynes (NUIG)</p>
<p>Next generation autonomous chemical sensors for environmental monitoring Deirdre Cogan (DCU)</p>	<p>Utilising a biomonitor, Deroceras reticulatum (Mollusca, Gastropoda), to investigate metal contamination on wetlands infilled with Construction and Demolition (C&D) waste John Staunton (NUIG)</p>	<p>The relationship between species interactions and multifunctionality in grasslands. Laura Kirwan (WIT)</p>

<p>An assessment of the spatial and seasonal distribution of microbiological contamination in groundwater derived potable water supplies. Jean O'Dwyer (UL)</p>	<p>Microbial structure and function during anaerobic digestion of food waste Paul McAteer (NUIG)</p>	<p>Multifunctionality and the grassland biodiversity-ecosystem functioning relationship. Aine Dooley (NUIM)</p>
<p>An interdisciplinary approach to engagement with, and conservation of, campus trees Richard Manton (NUIG)</p>	<p>Public Perceptions of the Irish Marine Environment Stephen Hynes (NUIG)</p>	
<p>Thursday January 31st (4.30-6.00 pm) Oral Presentations (Sessions 8-11)</p>		
<p>Session 8 Marine & Coastal Processes</p>	<p>Session 9 Environmental Management</p>	<p>Session 10 Climate Change & Energy</p>
<p>Opening Chair Address The Validity of Integrating UK Hydrological Catchments into Irish Pooling Groups David Forde (CIT)</p>	<p>Opening Chair Address Vegetation monitoring of farmland in west Mayo: Potential use for identification of extent and quality of High Nature Value farmland in North-West Ireland Pamela Boyle (IT Sligo)</p>	<p>Opening Chair Address Seabird interactions with a novel tidal energy conversion device, the Scotrenewables SR250 Jean Hamilton (UCC)</p>
<p>Understanding the dynamics of maërl debris beach systems Zoe Elliott (NUIG)</p>	<p>National Study on Environmental Waste Enforcement: Issues, Best Practices and Technologies Aidan McDermott (NUIM)</p>	<p>Analysing the Carbon Impact Factors of OSB from Irish Forests Desmond Dolan (NUIG)</p>
		<p>Opening Chair Address You are where and when you eat: seasonal and spatial variability in edible seaweed bioactives Matthias Schmid (NUIG)</p>
		<p>Child Car Seats: a habitat for dust mites and reservoir for harmful allergens? David Clarke (NUIG)</p>

<p>Transformative Marine Stakeholders: Moving from a Marine, Fisheries and Coastal Management Centric View to a Societal Marine Ecosystem Perspective</p> <p>Michelle Devaney (NUIG)</p>	<p>Assessment of zinc and cadmium distribution in plant tissues using a complementary micro-PIXE, EXAFS and laser-ablation-ICP-MS approach</p> <p>Stanley Lutts (Universite Catholique de Louvain)</p>	<p>Transboundary Air Pollution Measurements in Ireland from 2005 to 2010</p> <p>Michael Geever (NUIG)</p>	<p>Revitalizing European environmental health law and policy: can adaptive regulation help?</p> <p>William Onzivu (University of Bradford)</p>
<p>Molecular Microbial Ecology of Ammonia Oxidation in Coastal Bay Sediments</p> <p>Aoife Duff (NUIG)</p>	<p>The Identification of High Nature Value (HNV) farmland in the north-west of Ireland: How Important are Terrestrial Invertebrates?</p> <p>Margaret Hayes (NUIG)</p>	<p>Estimation of deforestation in Ireland 2000 – 2012; a comparison of assessment methods</p> <p>John Devaney (UCC)</p>	<p>Salmonella enterica can readily form a biofilm in the environment and is highly resistant to eradication with chemical disinfectants</p> <p>Mary Corcoran (NUIG)</p>
<p>Nepheloid layers along the North-East Atlantic continental margin Case study: The Whittard Canyon System</p> <p>Annette Wilson (NUIG)</p>	<p>Remote sensing of slurry spread on grasslands with exposed soil</p> <p>Ross Donnelly-Swift (UCD)</p>	<p>The interaction of a large scale sea-water pumped hydro energy storage plant, proposed electrical interconnectors and large scale wind farms with the Irish Energy system</p> <p>Fionain McCarthy (CIT)</p>	<p>Decadal trends of atmospheric pollution at Mace Head, Ireland and over Europe</p> <p>Darius Ceburnis (NUIG)</p>
		<p>Metaproteomics: Grass Anaerobic Digestion</p> <p>Aoife Joyce (NUIG)</p>	<p>Eco-driving policy & Technology: Benefits, Limitations & Future Research</p> <p>Md Sanjul Alam (TCD)</p>

Friday, February 1 st (9.30-11.00am) Oral Presentations (Sessions 12-15)			
Session 12 Biodiversity & Bioresources	Session 13 Environment & Health	Session 14 Environmental Management	Session 15 Water Quality/ Environmental Technologies
The effect of irrigation with wastewaters on the abundance of earthworms, springtails and mites in established Short Rotation Coppice (SRC) willow James Feighan (IT Sligo)	Development of a Computational Model to Evaluate Personal Exposure to Particulate Matter in Indoor Microenvironments. James McGrath (NUIG)	An examination of the potential vectors and pathways of spread for <i>Corbicula fluminea</i> in Ireland Rory Sheehan (IT Sligo)	Pathogen Detection and Quantification in Drinking Water Cathy Abberton (NUIG)
Climate and species identities affect the composition of four-species grassland mixtures over three years and across 23 sites. Caroline Brophy (NUIM)	Promoting active travel in cities: the role of permeability Richard Manton (NUIG)	Chemical amendment of pig slurry prevents P loss in runoff – but don't forget to examine gaseous emissions! Cornelius O' Flynn (NUIG)	Alternative Infiltration Systems for Disposal of Domestic Wastewater in Low Permeability Subsoils Mary Keegan (TCD)
The relationship between stormwater pollution and rocky shore assemblages. Chloe Kinsella (UCD)	A new geochemical atlas of European agricultural soils Patrick O'Connor	A growing problem & #61485; invasive species distribution modelling of <i>Rhododendron ponticum</i> and the implications for conservation Paul Egan (TCD)	Assessment of the Impact of Traditional Septic Tank Soakaway Systems on Water Quality in Ireland Mary Keegan (TCD)

Modelling pollen dispersal and reproductive success of invasive <i>Spartina anglica</i> (Common Cordgrass) in mud flat environment James Murphy (NUIG)	Dose and Personal Exposure to Air Pollution in Office Workers in Dublin, Ireland: Measurements, Analysis & Policy Implications. Aonghus McNabola (TCD)	Attitudes to recycling in Limerick, Ireland- Knowledge Action Gap Susan Byrne (UL)	Developing an advanced marine cyber-infrastructure to support technology development and marine environmental monitoring through SmartBay - Irelands National test facility for Marine Technology. Paul Gaughan (Smartbay IE)
An integrated approach to conserving specific Annex I habitats in the Burren, Co. Clare Sarah Anne O'Loughlin Irwin (NUIG)	Designing building facades to reduce environmental noise Oliver Kinnane (TCD)	Assessment of alternative effluent disposal options for single houses in low permeability subsoil settings based on economical and environmental sustainability Donata Dubber (TCD)	Novel Sorbents for Temperature Swing Adsorption of Carbon Dioxide David Madden (UL)
Species and population diversity of Maerl-forming corallines (Corallinales: Rhodophyta) Jazmin de Jesus Hernandez-Kantun (NUIG)	A GIS model for personal exposure to PM10 for Dublin commuters Francesco Pilla (TCD)	Materials efficiency in building construction; systematic appraisal of business ecosystems for construction projects Rosemarie MacSweeney(UCC)	Review of a five year study on pharmaceuticals in the Irish aquatic environment Brian Quinn (GMIT)
Friday, February 1 st (11.45-1.15pm) Oral Presentations (Sessions 16-18)			
Session 16 Environmental Management	Session 17 Socioeconomics & Environmental Policy	Session 18 Environmental Technologies	
Life Cycle Energy & Environmental Balance of Micro-Hydro Turbines in the Water Industry: An Ireland-Wales Context John Gallagher (Bangor University)	Estimating the value of achieving good environmental status in Irish marine waters Daniel Norton (NUIG)	Zero-discharge willow wetlands for on-site domestic wastewater treatment in Ireland Fergus Mc Auliffe (UCC)	

<p>What role did fire play in the Irish uplands, from the early Holocene to the present day, and how should fire be best managed in the future? Donna Hawthorne (TCD)</p>	<p>Social, economic and environmental sustainability in important fisheries areas in Northern Ireland: An industry perspective Lynn Gilmore (Seafish)</p>	<p>Potable Water Distribution Network Model for Quality and Operations Management Anne-Marie Brady (LIT)</p>
<p>Considerations for Nitrate Source Determination in Environmental Forensics Studies Cecilia Fenech (DCU)</p>	<p>Applying multi-disciplinary walkability criteria to area selection for the Cleaner, Greener, Leaner (CGL) study Lorraine Fitzsimons D'Arcy (DCU)</p>	<p>Optimisation of a novel Horizontal Flow Biofilm Reactor (HFBR) for the removal of nuisance gases Colm Kennelly (NUIG)</p>
<p>The visual evaluation of soil structure under arable and pasture management Mohammad Sadegh Askari (UCD)</p>	<p>The development of Key Performance Indicators for the Effectiveness of Strategic Environmental Assessment in Ireland Nicola Dwyer (UL)</p>	<p>Microarrays for monitoring a toxic bloom of <i>Alexandrium minutum</i> in the North Channel of Cork Harbour Gary McCoy (NUIG)</p>
<p>Zebra mussel control using Zequanox® in an Irish waterway Sara Meehan (IT Sligo)</p>		<p>Measurement and modelling of oxygen transfer and hydraulics in a novel passive aeration biofilm system Noelle Jones (NUIG)</p>
		<p>Real time control and remote monitoring of small scale wastewater treatment plants Shane Fox (NUIG)</p>



ORAL PRESENTATION ABSTRACTS
(Listed in Session Order)

Training neural networks for estimating minute ventilation and lung deposited air pollution dose in cyclist commuters, given information on personal exposure, physical exertion, cycling style, road topography and meteorology

Marguerite Nyhan, Bruce Misstear, Aonghus McNabola

Civil, Structural & Environmental Engineering Department, Trinity College Dublin, Ireland

Corresponding Author Email: mnyhan@tcd.ie

Keywords: air pollution, commuting, cyclists, respiratory tract modelling, neural networks

The adverse health effects of traffic-related air pollution have become a great concern in recent years. Cyclists experience higher inhaled doses and subsequent lung deposition of air pollution when commuting per unit time relative to other, less active, commuter groups such as bus, train and car passengers. This is due to their elevated minute ventilation levels and respiration frequencies. This study compares measured and modelled ventilation rates in cyclists which could be used as input to a numerical model of the human respiratory tract for predicting lung deposited doses of air pollution. Sixty volunteers were recruited to cycle a 7.5km route in Dublin city centre. Ventilation parameters and heart rate were measured continuously while cycling using a portable cardiopulmonary testing system. Cycling speed, style and road topography were quantitatively assessed from data collected from a GPS device. Meteorological variables were recorded using a micro-weather station mounted on subjects' bicycles. Personal particulate matter exposure was logged using an ambulatory monitor. A feed forward neural network was designed and implemented to assess the non-linear relationship between training vectors related to cycling effort, instantaneous road speed, road gradient, meteorological parameters and a target vector of measured minute ventilation. Linear regression of the outputs of modelled minute ventilation and the corresponding targets of measured minute ventilation yielded a Pearson's correlation coefficient of 90.4%. The correlation coefficient for the training phase was determined to be 91.8%. The validation and testing phases had correlation coefficients of 85.8% and 90.7% respectively. Neural networks were found to be a viable function approximation method for predicting ventilation rates in cyclists given information on cycling style, road topography and meteorology. This will have applications in determining lung deposited air pollution doses using highly variable real-time environmental data, heart rate measurements and GPS data acquired from wireless devices.

Applying multi-disciplinary walkability criteria to area selection for the Cleaner, Greener, Leaner (CGL) study

Lorraine Fitzsimons D'Arcy¹, Kevin Leyden², Catherine Woods¹

¹*School of Health and Human Performance, Dublin City University, Ireland*

²*Whitaker Institute for Innovation and Social Change; and Centre for Health from Environment, National University of Ireland, Galway, Ireland*

Corresponding Author Email: lfitzsimonsdca@gmail.com

Keywords: walkability, geographic information systems, deprivation, site selection

The Cleaner, Greener, Leaner study investigates the relationship between neighbourhood walking, human health and transport carbon emissions. Neighbourhood features that contribute to walkability (pedestrian friendliness) are diverse and depend on the physical and social attributes of an area. The purpose of this study was to identify examples of high or low walkable areas for further examination as part of the CGL study. International walkability research favours macro-scale objective geographic information systems (GIS) information when identifying study areas. However, limitations with available GIS information and unrepresentative neighbourhood boundaries on GIS datasets meant additional methods for site selection had to be established. A multi-disciplinary focus group study, made up of planners, designers, engineers, public representatives and public health professionals (N=5 focus groups, 26 participants) was used to generate walkability criteria with macro (city level), meso (neighbourhood level) and micro (street level) considerations. They also gave a list of potential study sites. Of the original 171 valid area selections, 20 areas grouped under four categories: high walkable deprived, high walkable not deprived, low walkable deprived or low walkable not deprived were included in the final CGL study. These were selected based on the developed criteria, the examples given and checked with GIS, audit and ground truthing to determine their validity. Only 2 sites selected by focus group participants as high walkable met the inclusion criteria for a deprived neighbourhood. This could potentially reflect a bias within participants or how social characteristics influence the perceptual walkability of an area. An investigation of the role of high and low walkable environments on resident's behaviours and health can be used to inform future planning, transport, public health and neighbourhood design policies.

A spatial approach for the epidemiology of antimicrobial resistance in *E. coli* causing urinary tract infections in the community.

Sandra Galvin^{1,2}, Niall Bergin¹, Ronan Hennessy³, Belinda Hanahoe⁴, Akke Vellinga^{1,2,5}

¹*Discipline of General Practice, School of Medicine, NUI Galway*

²*Centre for Health from Environment, Ryan Institute, NUI Galway*

³*GIS Centre, Ryan Institute, NUI Galway*

⁴*Department of Microbiology, University Hospital Galway,*

⁵*Discipline of Bacteriology, School of Medicine, NUI Galway*

Corresponding author e-mail address: Sandra.galvin@nuigalway.ie

Keywords: Geographical information systems, mapping, spatial analysis, antibiotic resistance profiles.

Background: The use of antimicrobials has been increasing steadily over the past six decades, resulting in wide dissemination of resistant pathogenic bacteria. Antimicrobial resistance (AMR) was once considered predominantly an issue for the clinical setting; however resistant bacterial pathogens are now a major issue with community acquired infections. Urinary tract infections (UTIs) are the second most common infection in general practice and microbiological results from urine samples serve as an indicator of antimicrobial resistance in the community. To explore the possibility of a geographical pattern in the occurrence of AMR, the antimicrobial resistance of *E. coli* from UTIs in the community was mapped.

Methods: All adult patients consulting with a suspected UTI in 22 general practices in the West of Ireland over a 9 month study period were requested to supply a urine sample. Patients were enrolled by means of an opt-out methodology. All urine samples with laboratory confirmed *E.coli* were included (n=752) and antimicrobial susceptibility testing was performed. Patient addresses were geocoded and antimicrobial susceptibility zone diameters for trimethoprim and ciprofloxacin were mapped against patient addresses using ArcGIS software. A series of maps detailing antibiotic resistance patterns in the west of Ireland were generated.

Results: The spatial data demonstrated a trend toward higher resistance in urban centres. Some rural areas also showed high levels of resistant *E. coli* which might be related to the presence of a nursing home.

Conclusion: Our study is the first example of a visual geographical analysis of antimicrobial resistance in *E. coli* from UTIs in the community in Ireland. The application of geo-mapping antimicrobial resistance patterns of pathogenic bacteria over geographic areas provides information on geographical spread of AMR and may help explaining patterns in the occurrence and spread of AMR.

Longitudinal Study of Environmental Contamination with Antimicrobial Resistant Organisms in a Newly Built Nursing Home

Catherine Ludden^{1,4}, Martin Cormican^{1,2,4}, Bernie Austin³, Dearbháile Morris^{1,4},

¹*Antimicrobial Resistance and Microbial Ecology (ARME) Group, School of Medicine, National University of Ireland, Galway.*

²*Department of Medical Microbiology, Galway University Hospital, Galway, Ireland*

³*St. Brendans Home, Galway, Ireland*

⁴*Centre for Health from Environment, Ryan Institute for Environmental, Marine and Energy Research, NUI Galway*

Corresponding Author Email: c.ludden2@nuigalway.ie

Keywords: environment, antimicrobial resistance, residential-care

Nursing homes represent potential reservoirs for antimicrobial resistant organisms (ARO). Shared space in such facilities creates conditions in which direct and indirect spread of microorganisms are facilitated. The aim of this study was to examine the time to environmental contamination with ARO in a new build nursing home.

A number of environmental sites in an occupied nursing home ($n=18$) and a newly built nursing home intended to replace the old nursing home ($n=21$) were selected for monitoring prior to and post habitation by residents over an 11 week period. Environmental screening was performed using Copan ESwab. Chromogenic agars were used for detection of extended spectrum β -lactamase (ESBL)-producing Enterobacteriaceae, meticillin-resistant *Staphylococcus aureus* (MRSA) and vancomycin-resistant Enterococci (VRE). Suspect isolates were confirmed using Pastorex™ STAPH-PLUS kit, antimicrobial susceptibility testing, PCR and sequencing.

Environmental contamination with MRSA was not detected on initial rounds of testing but was detected once staff of the existing NH had begun to work on commissioning. Subsequent to habitation, MRSA was detected from 42.8% (63/147) of swabs collected over an 11 week period and from all areas. MRSA was most commonly found on floors (11/14), bed frames (11/14), bed side lockers (10/14), arm chairs (6/14), toilet seats (7/21), tables (5/14) and door handles (13/56). CTX-M-15-producing *E. coli* was detected from a toilet seat in a SR on one occasion. VRE was not detected.

This study demonstrates that environmental contamination with MRSA can occur during commissioning and intense environmental contamination with MRSA occurs rapidly. Environmental contamination with VRE and ESBL is less common. Sampling times were not related to cleaning schedules therefore we have not determined if the high rate of isolation of MRSA is related primarily to more intense shedding or longer persistence in the environment.

An assessment of the development and spread of antibiotic resistance as a result of biocidal and antibiotic use in the natural environment

Aideen Dowling, Jean O'Dwyer and Catherine Adley

Centre for Environmental Research, Microbiology Laboratory, Department of Chemical and Environmental Science, University of Limerick

Corresponding author email: Aideen.Dowling@ul.ie

Keywords: Biocides, Antibiotics and Resistance

Antibiotic resistance has been recognised as a global health problem. The increase and spread of resistance to antibiotics linked to reports of co- and cross- resistance between antibiotics and biocides raised speculations on potential hazard of biocide use. Biocides are antimicrobial agents that have been in use for hundreds of years for disinfection, antiseptis and preservation. Despite this widespread use most fungal and bacterial species remain susceptible to biocides. However, over-reliance and inappropriate use of biocides has led to the emergence of biocide tolerant pathogens. Biocide tolerance has been reported in common foodborne and environmental pathogens, such as *E. coli* and *Salmonella* spp. This resistance could be linked to cross-resistance to antibiotics and a potential public health risk. Over recent years large amounts of biocides and antibiotics have been released into the environment. However little is known about the effects of these chemicals on bacteria found naturally in the environment. Furthermore, water sources, sewage and other wastes have been polluted with sub-lethal concentrations of biocides and antibiotics. This sub-lethal application could lead natural microbial populations developing a new resistance. To prevent biocide and antibiotic resistance it is important to incorporate best practice, this includes ensuring disinfection and environmental guidelines are in place. This project illustrates the substantial dissemination of biocides and antibiotics in the natural environment. Samples were taken from farms, clinical veterinary samples and potable water supplies, the isolates were examined for biocidal and antibiotics resistance and cross referenced with European Antimicrobial Resistance Surveillance Network data. This study will highlight the potential risk of using antimicrobial agents and should encourage all key stakeholders, including policy stakeholders and planners, the practitioners and prescribers, public and patients, veterinarians, farmers and the pharmaceutical industry to use antimicrobial agent responsibly, as this is the best way to combat biocide and antibiotic resistance.

Detection of Low Level Contamination of Water with Shiga-Toxigenic *E. coli*

Siobhán Kavanagh¹, Dearbhaile Morris^{1,2}, Martin Cormican^{1,2}

¹*School of Medicine, Clinical Sciences Institute, National University of Ireland, Galway*

²*Centre for Health from Environment, Ryan Institute, National University of Ireland, Galway*

Corresponding Author Email: siobhan.kavanagh@nuigalway.ie

Keywords: STEC, large water volumes, real-time PCR

Shiga-Toxigenic *E. coli* (STEC) incidence rates in Ireland have been rising steadily over the past number of years. Water is a key transmission route for STEC in Ireland. Bacteriological monitoring of drinking water relies largely on culture-based examination of small volumes of 100 ml to 1L; an approach likely to miss low level, intermittent contamination of potential public health significance. Examination of water for *Cryptosporidium* typically involves sampling of up to 1000 L by filtration with the IDEXX Filtra Max[®] system. The objective was to develop a protocol using the system with an additional bacterial filter for capture of STEC. STEC is detected from filter concentrate and overnight enrichments of filters, using real-time PCR assays targeting verocytotoxin (*vtx1* & *2*) and intimin (*eae*) genes. Concurrent culturing of enrichments on selective media allows for isolation of STEC. The system was evaluated with 10 L volumes of sterile water spiked with decreasing levels of STEC, with and without a microbial background. In spiked sterile water STEC was not captured to any significant degree by the IDEXX Filtra Max[®] but was captured by the bacterial filter. The limit of direct detection of STEC by real-time PCR was 10 colony-forming units (CFU)/L in a background of non-target cells, both from filter concentrate and from overnight enrichments of filters. Incubation of enrichments at 42 °C was found to decrease the microbial background and led to earlier STEC detection using real-time PCR and improved isolation on selective media. Pilot application of the method on 10L of untreated river water resulted in detection of verocytotoxin and intimin genes and isolation of a *vtx1/2* positive *E. coli* O26. To date results show that the system has potential for STEC detection from large volumes of water and further optimization of the method is in progress.

The effect of laboratory analysis on the design of a community digester

E. Allen^{1,2}, J. Browne¹, D. Wall¹ and J.D. Murphy^{1,2}

¹*Environmental Research Institute, University College Cork, Cork, Ireland.*

²*Department of Civil and Environmental Engineering, University College Cork, Cork, Ireland*

Key words: BMP, CSTR, Biogas, Anaerobic digestion.

This paper examines the design of an anaerobic digester in a rural town based on theoretical and experimental laboratory analysis. The population of the town is ca. 3,000 with a number of industries in close proximity. Substrates included for: waste from a cheese production facility; pig slurry; slaughter waste; sewage sludge; and food waste. In total 15 substrates were tested. From initial analysis some substrates were excluded from further trials as it would suggest that pig slurry and sewage sludge should not be included in the designed digester due to the low methane production, the increased size of vessel required due to the high levels of water in the substrate, and the poor energy balance.

Two mixes with different percentages of a number of substrates were proposed for further analyses. Theoretical biomethane potential (BMP) was assessed based on an ultimate analysis of all substrates. Laboratory BMP assays at a working volume of 0.4L were carried out on all individual substrates and on the two proposed mixes of substrates. Continuous digestion trials were undertaken in two 4L continuously stirred tank reactors (CSTRs) for a period of 24 weeks. From comparing the BMP tests to the CSTR trials on one of the mixes, an increase of 15% in Biomethane yields was recorded, from 440 L CH₄ / kg VS to 507 L CH₄ / kg VS. A preliminary design and costing was undertaken for the two proposed mixes. The design based on the more detailed laboratory analyses in the CSTRs was compared with the design based on preliminary laboratory analysis in the BMP assays. The paper seeks to establish the need for or otherwise long laboratory assessments to undertake a good engineering design of a biogas system.

Anaerobic digestion of restaurant food waste and an evaluation of hydrolysis of protein, carbohydrates, lipid and cellulose fractions

Corine Nzeteu¹, Denise Cysneiros^{1,2}, Katarzyna Bialek^{1,2} and Vincent O'Flaherty^{1,2}

¹*Microbial Ecology Laboratory, Microbiology, School of Natural Sciences and Ryan Institute for Environmental, Marine and Energy Research, National University of Ireland, Galway*

²*Technology Centre for Biorefining and Bioenergy, Ryan Institute, NUI Galway*

Corresponding Author Email: c.nzeteu2@nuigalway.ie

Keywords: Anaerobic digestion; Biomethane potential; Food waste; Hydrolysis; Volatile solids

Ireland produces over 100,000 tonnes of food waste annually, the majority of which is landfilled. This method of disposal has many drawbacks: i) poor recovery of resources; (ii) requirement for landfill space and iii) the possibility of ground water contamination. To remediate this situation and to comply with the EU Landfill Directive, alternative disposal methods need to be developed. Anaerobic digestion (AD) appears to be the most promising and viable alternative as not only it treats the waste but it also generates fertiliser and methane. Although AD of food waste has been widely applied, process failure or dysfunctions, usually related to the type of substrate or operational conditions of the reactors, remain the major drawback. In this study, AD of restaurant food waste (FW) was investigated in continuously stirred tank reactors. Substrate degradation, the hydrolysis patterns of individual fractions (protein, lipids, sugars and cellulose) and biomethane potential (BMP) were assessed. In addition, the first order hydrolysis constants of pure substrates, designed to target main stages of food waste digestion were calculated. The BMP of the food waste was 414 ml CH₄.g⁻¹ VS with 94% of volatile solid (VS) degradation achieved in 60 days. At least 90% methane production and 84% of VS removal was obtained by day 15, indicating that substrate was easily hydrolysed in the beginning of the test. Proteins were almost completely degraded (~99%) while cellulose was the most recalcitrant fraction of the FW (~73%). The hydrolysis rate constant of the FW, assuming first order kinetics, over the first 14 days was 0.14 d⁻¹. The first order hydrolysis constants for cellulose, protein, xylan and xylose were 0.121 day⁻¹, 0.178 day⁻¹, 0.118 day⁻¹ and 0.141 day⁻¹, respectively. The obtained data provide useful parameters for a continuous anaerobic digester operation on food waste.

An Investigation into the Degradation of Beachcast Seaweed

Brian Carpenter, Paul MacArtain, Caroline Gilleran and Siobhan Jordan.

Dundalk Institute of Technology, Dublin Road, Dundalk, Co. Louth.

Corresponding Author Email: brian.carpenter@dkit.ie

Keywords: Biodegradation, Macroalgae, *Laminaria*

Microbes are capable of degrading a variety of polysaccharides that are components of algal cell walls. The principal polysaccharides of the brown seaweeds are alginates, laminarins, cellulose, mannitol and fucoidans. In nature, marine microorganisms produce a multiplicity of specific enzymes to hydrolyse these polysaccharides into their constituent monomeric parts. There is little known about the enzymatic transformation and biodegradation of these polysaccharides in the marine environment. The overall objective of this research is to investigate macroalgae biodegradation in the marine environment in order to identify key microbial degraders to optimize this biodegradation process under controlled conditions.

A study was carried out on the degradation of beachcast seaweed, to investigate the breakdown of the complex carbohydrates found within macroalgae. Beachcast macroalgae, of the *Laminaria* variety, were collected at the surf line from Rush Head, north Co. Dublin. Two piles were created above the high water mark, to allow for exposure to the natural marine environment while four piles were created off site in a controlled environment. Each pile was observed over 28 days and each was tested regularly for total and volatile solids, NH₄ and CO₂ emissions, temperature, pH, conductivity, microbial analysis, C:N ratio, polyphenols, reducing sugars and total carbohydrates.

Overall the introduction of air through manual turning resulted in increased degradation of the piles in controlled environment. Each pile was observed to change over time with expected increases in microbial numbers related to changes in temperature profiles. NH₄ and CO₂ emissions increased during the initial stages of the trial while pH and conductivity increased and were observed to stabilize towards the end of the trial. Work is ongoing to isolate key carbohydrate degrading enzymes from these microbial strains identified, to further optimize the release of value added products from macroalgae.

Evaluation of building fabric retrofit options for achieving sustainable domestic building operation

Jamie Reynolds, Oliver Kinnane

Dept. of Civil, Structural & Environmental Engineering, Trinity College Dublin, Ireland.

Corresponding Author Email: reynolja@tcd.ie

Keywords: Building Energy, Retrofit, Sustainability, Climate Change, Building Fabric

Buildings account for an estimated 40% of the world's energy usage annually. Residential buildings are responsible for half of this total. Through the full lifecycle of a building, energy related to its operation outweighs energy related to the embodied energy of its construction. Therefore, energy related to domestic buildings in use can be considered to be a significant impactor on environmental sustainability.

Space heating accounts for up to half of residential buildings' energy usage, much of this is used compensating for heat loss due to inefficient building fabrics. This is an unsustainable situation. Current EU and national policies for reducing operational energy demands, and raising energy efficiency, are driving planning bodies and as a result home owners to improve their properties. In addition, due to the current economic climate, retrofitting has become a more popular choice for reducing energy costs over new construction.

This paper evaluates the different building fabric retrofit options, for application to common Irish residential constructions. Various methods for retrofitting homes to achieve passive house standards have been recommended by SEAI guidelines. These retrofit methods are each evaluated via Building Energy Simulation analysis software specific to the Irish climatic context. Space heating requirements for buildings of each fabric type are quantified. The embodied energy and sustainable nature of the envelope insulation materials are analysed. Energy simulations for a range of standard Irish domestic typologies are undertaken and the relative efficiency of each is quantified. The relative impact of solar gain and air tightness on the overall effectiveness of the fabric retrofit are also considered.

Recommendations for future optimum retrofitting methodologies for Irish domestic buildings are presented.

Comparison of the application of four standardised methodologies for the quantification of lifecycle greenhouse gas emission implications of building retrofits

Niall P. Dunphy

Cleaner Production Promotion Unit, Department of Civil and Environmental Engineering, University College Cork, Ireland

Corresponding Author Email: n.dunphy@ucc.ie

Keywords: lifecycle greenhouse gases; GHG quantification methodologies; standards

The need for consideration of lifecycle greenhouse gas implications of building energy retrofits is becoming more accepted and lifecycle GHG is increasingly being used as an evaluation metric for building energy retrofit projects, estimating the net climate impact of intervention options. However such studies are not without weaknesses, lack of standardisation means that they are rarely comparable. Additionally, they are often weakened by unclear assumptions; arbitrary boundary setting; variable data quality; indifference to temporal issues; and poor communication of results. This paper presents a comparative assessment on the use of four standards to evaluate the greenhouse gas implication of building energy retrofits, *viz.*

- ISO 14044:2006 Environmental management - Life cycle assessment - Requirements and guidelines;
- PAS 2050:2011 Specification for the assessment of the life cycle greenhouse gas emissions of goods and service;
- Greenhouse Gas Protocol Product Life Cycle Accounting and Reporting Standard;
- EN 15978:2011 Sustainability of construction works - Assessment of environmental performance of buildings - Calculation method.

The paper explores the commonalities and differences between the methodologies required by the standards, in such areas as: boundary setting; cut-off thresholds; allocation; date provenance and quality; capital goods; carbon storage; temporal issues; *etc.* The role of appropriate product category rules to provide for a common approach is examined and the meaning for lifecycle GHG determination for building retrofits is discussed.

Sustainable Retrofit Appraisal (SRA) of Energy Efficiency Options: A Project Approach for Low Carbon Buildings

John E. Morrissey, Niall P. Dunphy

Cleaner Production Promotion Unit, Department of Civil and Environmental Engineering, University College Cork

Corresponding Author Email: jemorrissey@ucc.ie

Keywords: decision-making; retrofit; strategic; appraisal; energy efficiency, lifecycle

Eight out of ten European buildings in use today will still be operational in 2030. Over the coming decades, these buildings will be subject to maintenance, upgrading, adaptation and rehabilitation activities. Not least because buildings offer greater potential for energy savings and greenhouse gas emissions reduction than any other single domain and at high benefit-cost ratios. On the supply side, retrofit is a significant and growing sector of the construction industry, and a major source of investment and added value. However, there are considerable challenges in defining success for retrofit projects. Methods to identify the most cost-effective retrofit measures remain a major technical challenge. For any given project, success may not be defined by a single criterion, but by the degree to which multiple criteria can be balanced, or competing criteria traded-off. For a particular project, optimal solutions need to accommodate building specific information, including: building envelope variations; construction; age; climatic locations; and associated lifecycle impacts. In this context, incorporating sustainability principles presents a complex task, particularly given the unique and multi-faceted nature of such projects. An appraisal of various project alternatives, taking account for stakeholder and expert input, building-specific characteristics, and criteria selection and weighting could effectively reduce project impacts and risks at low cost to project developers but provide significant benefit to wider communities, including communities of future stakeholders. This paper is the first exploratory step in developing a more systematic framework for evaluating alternatives for building retrofit projects, based on key sustainability principles. The forwarded Sustainable Retrofit Appraisal framework provides a means of appraising individual projects in terms of quantified ecological limits, taking account of multi-criteria performance across the entire lifecycle. Practically applied and timed appropriately, the framework can enable better decision-making and more efficient resource allocation for retrofit projects, which fully incorporate sustainability principles.

Artificial coastal defences: enhancing biodiversity using sensitive design

Louise B. Firth¹, Richard C. Thompson², Stephen J. Hawkins²

¹*Zoology, School of Natural Science; and Ryan Institute for Environmental, Marine and Energy Research, National University of Ireland, Galway*

²*School of Ocean and Earth Science, National Oceanography Centre Southampton, Waterfront Campus, University of Southampton, European Way, Southampton, Hampshire SO14 3ZH, United Kingdom*

Corresponding Author Email: louise.firth@nuigalway.ie

Global climate change is one of the greatest threats facing society, the predicted effects of which include rising global temperatures, rising sea levels and changes in weather patterns. The predicted effects of climate change will be increased flooding and erosion prompting the need for building and upgrading of coastal defences to protect property and infrastructures. These structures provide hard-substrate habitat in areas that typically comprise soft sediments, acting as stepping stones, facilitating the range extension of rocky shore species. Coastal defences can also alter local hydrodynamic processes which can in turn affect benthic infaunal communities.

Novel ecologically-informed engineering reduces loss of biodiversity on artificial shorelines. Increasing coastal urbanisation, population increase and the environmental impacts of global climate change are causing natural habitats to be replaced by artificial structures that support species-poor communities. Experiments in Wales manipulated the boulders of artificial coastal defence structures by adding multiple experimental habitats of varying dimensions. Here, we present the preliminary findings from these experiments. We also discuss how these engineering advances provide new insights into habitat-enhancement on artificial shorelines.

The Kerry Slug: How should we manage a protected species in commercial conifer plantations?

Inga Reich¹, Kim O'Meara¹, Eugene Cush¹, Fiachra Tierney¹, Mike Gormally^{1,2}

¹*Applied Ecology Unit, National University of Ireland, Galway*

²*Ryan Institute for Environmental, Marine and Energy Research, National University of Ireland, Galway*

Corresponding Author Email: ingaimperio@gmail.com

Keywords: Kerry Slug, protected species, conifer plantation, habitat requirements

The distribution of the Kerry Slug *Geomalacus maculosus*, a species protected under EU and Irish law, was believed to be limited to northern Iberia and to south-west Ireland, where it predominantly inhabits oak-dominated or mixed deciduous woodland and open moor or blanket bog. However, in July 2010, the slug was found for the first time outside its previously known range (i.e. Counties Kerry and Cork) in a Coillte plantation near Oughterard, Co Galway. This provided the incentive to undertake presence/absence surveys in 42 potentially suitable habitat sites south of Oughterard covering Counties Galway, Clare, Limerick and Kerry. However, the presence of *G. maculosus* could not be confirmed at any of the sites investigated. Given that the species was not found at the above sites, research focused on the recently discovered Kerry Slug population in the conifer plantation in Cloosh Forest, Co. Galway. The spatial distribution and habitat requirements of the Kerry Slug were investigated and positive correlations between the abundance of *G. maculosus* and bryophyte / lichen cover and tree circumference at breast height (CBH) were found. Subsequent feeding experiments carried out in the laboratory indicated that lichens are the favoured food source of *G. maculosus*, with certain species of lichen being preferred over others. Given the likely dependency of the Kerry Slug on lichens which are generally more prolific on mature conifer trees, the effects of clearfelling on the species are discussed in terms of food availability and habitat requirements. The results of this research will help to provide some of the necessary range, population and habitat data that are necessary to ensure the protection of this species in commercial conifer plantations

Integrating soil characteristics, land management and soil microbial communities

Andrea Richter^{1,2}, Evelyn Doyle¹, Nicolas Clipson¹, Rachel Creamer²,
Daire Ó hUallacháin²

¹University College Dublin

²Teagasc Environment Research Centre, Johnstown Castle, Wexford

Keywords: National Soil Survey, Soil Characteristics, Soil Microbiology, PLFA, DNA Fingerprinting, Ecosystem functioning

Soil ecosystems are highly complex and contain a great diversity and abundance of species. Microbial populations in the soil are of fundamental importance for ecosystem functioning, through determining nutrient cycling, organic matter decomposition and energy flow. Current challenges include how to maintain and increase soil fertility in a sustainable manner in order to feed an ever increasing world population and whilst protecting soil as a vital resource. This will require furthering our understanding of the relationship between soil physico-chemical and biological factors, and land use. Through a national survey of soil types, covering 300 sample locations and depth profiles in total, this soil microbial study is undertaking multivariate analysis of biotic and abiotic soil parameters to help shed light on these inter-relationships in Ireland. We will determine whether different soil types or soils from a range of land-uses display distinctive microbial fingerprints and how soil microbial community structures are influenced by physicochemical properties. Seventy A horizon (approx 0-25 cm) samples from sites with different land-uses were collected from locations throughout Ireland so far. These samples undergo physico-chemical analysis (amongst others C, N, pH) and biological assessments covering phenotypic, genotypic and functional analysis. In particular, total microbial biomass (fumigation extraction results) will be related to substrate induced respiration data (Microresp) as well as microbial community structures and abundances, made visible by PLFA and DNA fingerprinting through T-RFPL. Preliminary results have indicated that top-soil respiration data was related to soil types, physicochemical properties, microbial biomass and land-uses. It is anticipated that the knowledge gained from this study, in conjunction with other similar international studies, will give a better description of soil microflora in general. Furthermore it will potentially increase our understanding of how below-ground processes are influenced by microbial community structure.

The Potential of Microalgae as “Healthy” Foods

Freddy Guihéneuf and Dagmar B Stengel

Botany and Plant Science, School of Natural Sciences; and Ryan Institute for Environmental, Marine and Energy Research, National University of Ireland, Galway

Corresponding Author Email: freddy.guiheneuf@nuigalway.ie

Keywords: microalgae, bioactive compounds, health, optimised production.

Microalgae are an enormously diverse group of primary producers, abundant in all ecosystems on earth ranging from marine, freshwater and brackish water environments. It has been estimated that about 200,000-800,000 species exist of which about 35,000 species are described. Microalgae have numerous potential applications in different fields such as human and animal nutrition, pharmaceuticals, cosmetics, CO₂ sequestration and biofuel production. Particularly, there has been a growing interest in the development of functional foods from natural sources including algae because of their beneficial health effects. Over 15,000 natural marine products have now been screened for biological activity and 45 marine-derived natural products have been tested to be used as medical drugs in preclinical and clinical trials. Due to their extensive taxonomic and biochemical diversity, microalgae represent a valuable novel source of bioactive molecules. Long-chain polyunsaturated fatty acids (LC-PUFAs), carotenoids, phycobiliproteins, phenolic compounds, polysaccharides and vitamins are the major molecules of interest from microalgae, particularly due to their capabilities to enhance the nutritional and functional quality of foods. Nevertheless, only few microalgal species are successfully produced, commercialized and used in human diets today. The metabolic plasticity of microalgae allows them to adapt quickly to changing environmental factors such as light, temperature, salinity and nutrients, so that algal biomass production, induction and accumulation of bioactive high-value products can be optimised. In this project, as part of the NutraMara Marine Functional Food Initiative, microalgal culture techniques have been developed and optimised to obtain constant levels in molecules of interest and improve their nutritional value and high bioactive content.

Searching for Markers of Local Climate Adaptation in the Genome of *Bombus terrestris* Populations Originating from a Variety of Habitats

Moran S., Kakouli-Duarte T.

Molecular Ecology and Nematode Research Group, EnviroCORE, Institute of Technology Carlow, Kilkenny Road, Carlow

Corresponding Author Email: morans@itcarlow.ie

Keywords: Environmental adaptation, conservation genomics, molecular markers, AFLP, climate change

In any study of genetic-environment relationships, the separation of environmental from neutral effects (e.g. genetic drift) is essential (Kirk & Freeland, 2011; Cooke *et al.*, 2012). For example, candidate genes, believed to be influenced by climate, have been shown to exhibit consistent clines along environmental gradients. However, the variation in these genes may be due to both selective and neutral forces.

The fundamental aim of this research is to identify *loci* involved in local environmental adaptation among several European populations of the ecologically widespread bumblebee species, *Bombus terrestris*. An AFLP genome scan will be performed on populations of *B. terrestris* from habitats throughout Europe. Genomic regions exclusively affected by environmental selection will be identified using bioinformatics software designed for this purpose. This study will be based on the premise that these *loci*, will exhibit extreme levels of differentiation in comparison to those which are solely affected by neutral forces (Liukart *et al.*, 2003; Bonin *et al.*, 2006; Jump *et al.*, 2006; Stinchcombe & Hoekstra, 2006; Egan *et al.*, 2008; Holdegger *et al.*, 2008; Hoffman & Willi, 2008; Williams & Oleksiak, 2008; Nosil *et al.*, 2009; Chen & Yang, 2009; Coyer *et al.*, 2011; Kirk & Freeland, 2011). Environmental selection will be also confirmed by identification of such loci in comparisons of populations from habitats of diverse climates.

B. terrestris plays important roles as a pollinator both in nature and commercially. Its widespread occurrence throughout a range of diverse climates makes it an ideal model for a study of local environmental adaptation. This research may provide an overall picture of the *B. terrestris* genome in the context of gene-climate interactions and may yield markers which could prove fruitful in future conservation studies on bumblebee populations.

How Well Does the Irish Natura 2000 Network Encompass the Occurrences of Threatened and Protected Plant Species?

Aidan Walsh^{1,2}, John Finn¹, Matthew Jebb³, Steve Waldren², Caroline Sullivan¹

¹*Environment Research Centre, Teagasc, Johnstown Castle, Co. Wexford.*

²*Department of Botany, Trinity College Dublin, College Green, Dublin 2.*

³*National Botanic Gardens of Ireland, Glasnevin, Dublin 9.*

Corresponding author email: aidan.walsh@teagasc.ie

Keywords: Vascular plant diversity, Natura 2000, conservation in the wider countryside.

Records of vascular plants from the island of Ireland have been collated into a single plant distribution database. Rare and threatened plant species records were identified and subsequently mapped at the tetrad (2km by 2km) scale using a geographical information system. The plant species identified as rare and threatened are those named in the Irish Red Data Book (RDB), the Flora Protection Order, the Northern Ireland Wildlife Order and the Northern Ireland Priority Species list. We examined the overlap in spatial coverage between the Natura 2000 network of protected sites in Ireland and tetrads containing rare and threatened plant species. The effect of enlarging the protected sites on the coverage of the tetrads was also investigated.

The plant distribution database provided tetrad-level plant occurrence records for 30% of the island of Ireland and some counties were better represented than others. Rare and threatened species were well-represented in these records. There were a significant percentage of tetrads with rare and threatened vascular plant species that did not occur within the Natura 2000 network. For example, a third of tetrads containing RDB species are found outside of these protected areas. Large increases in the size of the Natura 2000 sites would be required to substantially reduce the number of these tetrads found outside of the network. These results indicate that protected areas alone cannot protect the Irish flora and that conservation in the wider countryside (outside of protected areas) should remain an important feature of conservation policy.

Trialling of a method for sustainability analysis in a local authority

Travis O'Doherty, Brian G. Fitzgerald, Prof. Richard Moles, Dr. Bernadette O'Regan

*Centre for Environmental Research, Department of Chemical and Environmental Sciences,
University of Limerick, Ireland*

Corresponding Author Email: travis.odoherty@ul.ie

Keywords: urban sustainability, *ex-ante* policy modelling, evidence based policy, integrated planning.

Given the slow movement towards a more sustainable system, more radical and systematic policies are needed. While technological development is crucial, significant gains may be made through the wider adoption of existing proven technologies through improved planning and behaviour change, on the basis that if such technologies be used to their full effect there would be a large reduction in human impact on the environment and dependency on fossil fuels. It is however unclear to policy makers which technologies should be prioritised and there is need for quantitative evidence to guide policy prioritisation and implementation.

A quantified modelling framework package, Quantitative Evaluation of Settlement Sustainability Policy (QESSP) which combines a policy testing metric with a policy feasibility testing method has been developed. QESSP measures settlement sustainability and evaluates likely outcomes of policy implementation. Policies have been identified which are most appropriate in settlements of differing size. It is a unique package developed to fill a significant knowledge gap, which assists planners and policymakers in more transparent, evidence based decision making.

The methods are currently being trialled in a local authority which will enable the development of a transparent indicator based package for assessing plans and programmes and a public interface for evidence based planning. This will enable examination of the application of QESSP to the wider issue of standardisation of evidence based policy making tools, and identification of a common set of indicators for use within regional planning guidelines, county development plans, local area plans and town plans. In addition the method may identify policies needed to meet national obligations under the EU Effort Sharing Decision, Water Framework Directive, Habitats Directive and Strategic Environmental Assessment. The method has been developed for Irish urban areas but may have relevance for policy prioritisation in other comparable states.

Incorporating coastal risk within coastal planning, a practical decision making approach

J Massey, A DiLucia, K Lynch

RPS Group Galway

Corresponding Author Email: james.massey@rpsgroup.com

Atlantic Europe is made up of 33 regions along a coastline of 1,550 miles, home to around 70 million inhabitants. These regions are characterized by a strong identity, linked to their proximity to the ocean and displaying great natural and cultural diversity. They are also very vulnerable due to the pressure of human and natural origin that they are subjected to: for example, urbanisation or coastal erosion.

In this context, the ANCORIM project intended to strengthen the operational capacities of coastal decision-makers and managers in the Atlantic regions, with the aim of informing and supporting the consideration of coastal risks. To do this, it created a network of the scientific and technical resources existing in the European Atlantic area, as well as to provide tools to aid decision-making.

The handbook (Lynch, De Lucia, & Massey, 2011) outlines the key coastal risks identified in the western coastal regions of Europe. It outlines the existing governance at international and national level and identifies regional models and best practice within and adjacent to the ANCORIM project partners. The handbook identifies methodologies within the existing legislative and planning frameworks to integrate coastal risk consideration. within existing planning, project and activity considerations in the coastal zone. The proposed methodology uses the EU legislation, environmental assessment requirements and existing planning systems to ensure coastal risks are adequately considered.

Using this starting point and reviewing European legislation a method for the assessment of coastal risks within the existing legislative infrastructure was developed. Using Strategic Environmental Assessment as a tool the interdependencies of the EU legislation considered within local and national development plans could be utilised to provide a cross referenced framework where key coastal risks were properly assessed within existing planning processes and without the need for further specialist review and input.

Following the lead from other EU countries, the consideration of marine planning under the Marine Strategy Directive will focus on Sustainability Appraisals. This assessment goes beyond traditional SEA approach to include environmental, health, socio-economic and sustainability impact assessments for the propose plans.

Visioning for more Sustainable Food Consumption in Ireland: Challenges and Opportunities

Jessica Pape

Trinity College Dublin, Ireland

Corresponding Author Email: papej@tcd.ie

Keywords: Sustainable food consumption; social practice theory; environmental policies; visioning and backcasting methodology

Household decision-making is an important factor shaping the demand and supply for greener products and services. Aspects of localization are increasingly shaping this debate, especially with regard to more sustainable food consumption and production in Ireland and abroad.

The aim of this paper is to present participatory visioning and backcasting methodologies as an approach for innovative solutions to tackle the challenge of more sustainable food consumption. First, drawing from social practice theory, the interplay of individual behaviour (motives and barriers) and contextual factors is explored. The often observed 'value-action-gap' between people's values and their observed behaviour makes it necessary to explore the external factors that matter for individual behaviour in more detail. Second, a multifaceted methodological approach including creative visioning, scenario development and the sustainability assessment of these scenarios will be discussed. A visioning workshop has been conducted with various stakeholders in the area of food consumption and production, at which more than 100 ideas were generated about how to make food consumption more sustainable in the future. Based on these ideas, three scenarios were developed based on varying degrees of technological, organisational and social change. The feedback to these scenarios by participants of three focus groups informed the creation of three 'promising practices', which were the starting point for the final backcasting workshop, where action plans to implement the 'promising practices' were discussed. The results are integrated in a 'transition framework', which will inform environmental policy-making in Ireland. Third, the challenges and opportunities of the visioning methodology are debated.

It is argued here that participatory visioning methodologies provide a good starting point to conceptualize the impact of social practices on food consumption behaviour, as it involves a multi-stakeholder approach at each step of the research process, thereby incorporating the experiences of a range of people about their social practices.

Patterns and drivers of seafood mislabelling in European markets

Amanda L. Bréchon¹, Anna R. Davies², Stefano Mariani³

¹*School of Biology and Environmental Science, University College Dublin, Belfield, Dublin 4, Ireland*

²*School of Natural Sciences, Department of Geography, Trinity College Dublin, Dublin 2, Ireland*

³*School of Environment & Life Sciences, Room 316, Peel Building, University of Salford, Salford M5 4WT, UK*

Corresponding Author Email: amanda.brechon@ucdconnect.ie

Keywords: Europe, cod, seafood mislabelling, governance, DNA barcoding

In recent years, seafood mislabelling has been recognised internationally as a widespread phenomenon with evidence from many studies. There is concern that species are being mislabelled as a result of a shortage of the desired species, therefore, seafood mislabelling is not only an indication of fraud but is, importantly, an indication that global fisheries are deteriorating. Resource scarcity, the potential for economic profits, and poor policy implementation are the main drivers of mislabelling, the results of which hold implications for the sustainable management and conservation of overexploited marine resources, food safety and even consumer health. In the EU, seafood mislabelling is prevalent despite a strong and detailed set of laws on both labelling and traceability of fishery products. The aim of my research is to assess the prevalence of Atlantic cod (*Gadus morhua*) mislabelling across EU and non-EU member states and to determine at what level within the production chain this problem is taking place as well as its influential factors. Cod products were collected from supermarkets in both cod-producing and cod-importing countries bordering the North Atlantic Ocean and genetically identified by mtDNA COI barcoding. The proportion of mislabelled samples as well as patterns of mislabelling by particular retailers was examined. Subsequently, differences in aspects of governance between countries, such as policy implementation and enforcement, will be analysed and their effect on national levels of mislabelling evaluated. The results of this research can contribute to determining shortcomings in particular aspects of the seafood industry legislation and, in turn, achieving sustainable fisheries.

Using discrete choice methods to calculate generic values for water

Geraldine Murphy¹, Stephen Hynes¹, Edel Doherty¹ Cathal Buckley²

¹ *Socio-Economic Marine Research Unit (SEMRU), National University of Ireland, Galway*

² *Rural Economy & Development Programme (REDP), Teagasc, Athenry, Co. Galway*

Corresponding Author Email: g.murphy11@nuigalway.ie

Keywords: Choice experiments, water valuation, public's revealed preferences

Current legislation emphasises the importance of recognising the multi-attribute nature of water when considering best management practices for improving its ecological quality and eco-system functions. Thus, when estimating the non-market value of water to society, it is beneficial to use a method that is capable of capturing the multi-dimensional features that are encapsulated within complex environmental goods such as water. In this regard, the choice experiment (CE) (the most commonly applied discrete choice method) methodology has particular advantages over other types of non-market valuation techniques. In a CE framework, choices are broken down into component attributes/features, which are presented to respondents normally as a choice set composed of a combination of the attributes/features. Respondents are then presented with a sequence of these choice sets, each containing alternative descriptions of a water/river alternative, differentiated by attributes and levels. Respondents are then asked to state their preferred alternative within the choice set. By observing and modelling how respondents change their preferred alternative in response to the changes in the levels of the attributes/features, it is possible to determine how respondents' trade-off between the different generic features of water and to estimate the marginal value of these attributes. The CE model developed in this study provide a rich array of information that should enable those responsible for setting policy in the area to prioritise funding for features that are most highly valued among the general population of Ireland. In particular, the study estimates the values associated with access to alternative water body types for recreation, the value of alternative levels of erosion and flood prevention, the value of water quality and the value of healthy water body ecosystems to the Irish public.

Uphill Struggle or Plain Sailing? Connecting Transport Policy and Human Health

Catherine Swift¹ and Dr. Henrike Rau^{1,2}

¹*School of Political Science and Sociology, National University of Ireland, Galway*

²*Ryan Institute for Environmental, Marine and Energy Research,
National University of Ireland, Galway*

Keywords: transport, active commuting, human health, cycling policy, sustainability

Recent calls for a radical shift in transport policy and land use planning both in Ireland and elsewhere in Europe reflect a growing awareness that fossil-fuelled transport and related infrastructure represent major sources of greenhouse gases, thereby threatening the integrity and health of the global ecosystem. There is also mounting evidence that active commuting on foot or by bike could make a significant contribution to addressing pressing health problems in developed countries today, most notably obesity caused by sedentary lifestyles. Policy efforts to reverse car dependency and encourage active commuting are thus more than just ‘transport solutions’; they also touch on important social, economic and health issues. This paper argues that cycling policy that combines the twin goals of environmental sustainability and human well-being can produce more integrated outcomes. Overemphasising the health and environmental benefits of cycling, on the other hand, can in some cases limit the extent to which cycling is seen as a viable alternative to the car.

This paper combines a critical assessment of Ireland’s weak performance in the area of sustainable transport with empirical data on transport policy, in particular in relation to cycling. Focusing on Ireland’s National Cycling Policy Framework (2009), this paper argues that Ireland is unlikely to reach the national cycling target of 10% by 2020 without radically reforming how cycling policy is made and implemented. It presents empirical evidence which captures the diversity of implementation efforts at local level. Importantly, the paper reveals how an implementation programme largely decoupled from established policy and devoid of concern for prevailing transport culture rather than an implementation deficit *per se* can produce unsustainable outcomes that negatively impact on the health of the physical environment and those who inhabit it.

Landscape complexity and sediment flux: is landscape organisation preventing excessive sediment losses from agricultural land?

S. Sherriff^{1,2}, Rowan, J.S.², Melland, A.R.³, Jordan, P.⁴ and Ó hUallacháin, D.¹

¹*Teagasc, Johnstown Castle Research Centre, Wexford, Ireland*

²*School of the Environment, University of Dundee, Dundee, DD1 4HN, Scotland, UK*

³*Agricultural Catchment Programme, Teagasc, Johnstown Castle, Wexford, Ireland*

⁴*School of Environmental Sciences, University of Ulster, Coleraine, Northern Ireland*

Corresponding Author Email: sophie.sherriff@teagasc.ie

Keywords: Sediment, Water Framework Directive, Intensification, Soil Erosion, Landscape Complexity

Sediment, in excess, can be a significant pollutant in watercourses. Accelerated delivery of sediments and sediment associated pollutants (e.g. phosphorus) can negatively impact water quality, through degradation of in-stream habitats, reduction in light penetration and physically damage biota. The Water Framework Directive stipulates that “good” chemical and ecological status needs to be achieved by 2015, therefore river catchments with intense land-uses may pose a significant management challenge to meet these aims. Agricultural catchments are often associated with particulate pollutants, where unprotected soils, e.g. bare arable soils or trampled grazing areas near streams; may be readily available for transport into watercourses. Intensification of farming may encourage landscape modifications such as expansion of unsealed roads to improve access, and removal of hedgerows and marginal land to increase productive area, in turn reducing the complexity of an area. The Food Harvest 2020 strategy targets a 33% increase in primary productivity, which could result in such landscape modification. Reduction of landscape complexity may consequently act to enhance sediment fluxes in-stream.

Complexity features such as land-use type, hedgerow density, field size, road density and stream metrics were quantified for three intensive agricultural catchments in Ireland (grassland, arable and mixed land-use). Sediment flux was passively measured using multiple in-stream sediment samplers, at a number of points in each catchment. Samplers were collected every three months and their mass, representing a proportion of each channel cross-section, was converted using discharge data to provide a sediment flux estimate.

Data show that complexity metrics, e.g. field size and road densities; vary greatly with predominant land-uses both between and within catchments. Comparison of these data with sediment fluxes are being carried out to analyse trends and identify key features preventing or accelerating sediment losses. Protection of complexity may therefore provide a management tool to protect soil resources and water quality.

The Fate of Pathogens And Nutrients in On-Site Wastewater Effluent Disposal Systems

Kilroy, K.¹, Barrett, M.¹ Gill, L.W.², O'Flaherty, V.¹

¹ *Microbial Ecology Laboratory, Microbiology, School of Natural Sciences; and Ryan Institute for Environmental, Marine and Energy Research, National University of Ireland, Galway*

² *Civil Structural & Environmental Engineering, Trinity College, Dublin, Ireland.*

Corresponding Author Email: k.kilroy1@nuigalway.ie

Keywords: Microbial Source Tracking, N-cycle functional genes, qPCR.

In Ireland, 25% of all domestic water supplies are provided by groundwater. The domestic wastewater of over 1/3 of the population in Ireland is treated by on-site treatment and disposal systems. Inefficient treatment is often associated with these systems and can cause pollution of local aquifers and waterways. The effluent nutrient load can contribute to eutrophication, depletion of dissolved oxygen and excessive algae growth in surface water bodies, while human enteric pathogens associated with faecal contamination of water sources may promote the outbreak of disease through contamination of drinking water supplies.

This project aims to confirm by microbial source tracking (MST), the source of faecal microorganisms detected in groundwater, surface water and effluent samples, and to monitor the transport of pathogens specific to on-site wastewater outflows. In combination with MST, the evaluation of nitrate removal and the overall potential for nitrification and denitrification in surrounding soil and effluent samples is being assessed at specific intervals; pre-remediation and post-remediation. Sampling is carried out at experimental sites of low permeability subsoil using suction lysimeters located at various depths (1.8m; 1.45m; 1.2m) and a range of physical and chemical parameters are routinely measured. A robust and reproducible DNA extraction method was developed, applicable to both sites. MST markers based on host-specific *Bacteroidales* bacteria for universal, human and cow-derived faecal matter are being employed to determine quantitative target occurrence using real-time Polymerase Chain Reaction (qPCR) assays (Kildare *et al.*, 2007). The abundance of both archaeal and bacterial 16SrRNA and of several functional nitrification and denitrification genes (i.e., *amoA*, *narG*, *nirS*, *nirK*, and *nosZ*) is being determined and compared in all sites. The diversity of bacterial 16SrRNA genes is also being determined using Denaturing Gradient Gel Electrophoresis (DGGE), to uncover changes in the microbial community as a result of effluent disposal on low permeability subsoil.

Next generation autonomous chemical sensors for environmental monitoring

Deirdre Cogan, John Cleary, Thomas Phelan, Dermot Diamond

CLARITY Centre for Sensor Web Technologies, Dublin City University, Dublin 9, Ireland

Corresponding Author Email: deirdre.cogan2@mail.dcu.ie

Keywords: Microfluidics, water quality, environmental monitoring, nutrients, chemical analysers.

Microfluidic technology has great potential as a solution to the increasing demand for environmental monitoring, by producing autonomous chemical sensing platforms at a price level that creates a significant impact on the existing market. The development of sensing platforms for ammonium, nitrate and nitrite in water and wastewater are being investigated. Our approach is to combine microfluidics with colorimetric chemical assays; low cost LED/photodiode-based optical detection systems; and wireless communications, developing low cost systems.

The colorimetric study of nitrite was performed using the Griess test, and an autonomous nitrite analyser has also been developed forming the basis of a sensitive, low cost, simple colorimetric technique that can be integrated into a field deployable platform.

A simplified colorimetric technique for nitrate has also been established and optimised using chromotropic acid. The method shows great relevance as a linear range was achieved from 0-80mg/L NO_3^- . A blind test using real samples was performed, showing excellent agreement to ion chromatography demonstrating a direct, simple technique. A colorimetric method for the determination of ammonium was also investigated. The reagent cocktail includes a variation on the Berthelot method reagent.

Results for the direct determination of nitrite, nitrate and ammonia achieved suggest that these may be suitable for integration into a similar field deployable platform to that of a phosphate monitoring platform which was previously developed¹.

References:

Cleary, John and Slater, Conor and Diamond, Dermot (2009) Analysis of phosphate in wastewater using an autonomous microfluidics-based analyser. In: ICEST 2009 - International Conference on Environmental Science and Technology, 28-30 April 2009, Rome, Italy.

An Assessment of the Spatial and Seasonal Distribution of Microbiological Contamination in Groundwater Derived Potable Water Supplies

Jean O'Dwyer, Aideen Dowling and Catherine Adley

Centre for Environmental Research, Microbiology Laboratory, Department of Chemical and Environmental Science, University of Limerick

Corresponding Author Email: Jean.ODwyer@ul.ie

Key words: Microbiological, GIS, Groundwater, Aquifer.

The microbiological quality of drinking water is a concern to consumers, water suppliers, regulators and public health authorities alike. The potential of drinking water to transport microbial pathogens to a great number of people is well documented in Countries at all levels of economic development. The municipal treatment of drinking water provides a barrier to the transmission of bacterial pathogens; however, in relation to private water supplies in Ireland, this treatment is often absent and instead relies on the natural hydrogeological properties of the area for decontamination. Approximately 200,000 households within the Republic of Ireland depend on their own private water supply, usually from groundwater by means of a borehole and well. The drilling of boreholes is undertaken without any technical specification or standard, is completely unregulated by the state and largely unsupervised by a professional engineer or hydrogeologist. As a result of this poor management; many private wells in Ireland are at risk of pollution, at least intermittently, and bode serious implications for human health. This study sets out to investigate the relationship between the geophysical properties of productive aquifers and the overall microbiological status of groundwater. Using a combination of information gathered from Geological Survey Ireland and test results from field studies, a Geographic Information System is being created to visually display the data for groundwater quality in areas of different geophysical features. The aim is to derive a risk assessment based on aquifer vulnerability potential which can then be used as a driver for policy and infrastructural planning.

Anaerobic digestion of perennial rye grass

Aoife Vaughan, Denise Cysneiros, Vincent O'Flaherty

¹*Microbial Ecology Laboratory, Microbiology, School of Natural Sciences; and Ryan Institute for Environmental, Marine and Energy Research, National University of Ireland, Galway*

Corresponding Author Email Address: a.vaughan1@nuigalway.ie

Keywords: Anaerobic digestion, biorefinery, hydrolysis, Leach Bed Reactors and perennial rye grass.

Many studies have shown that it is possible to use grass as a biomass source for anaerobic digestion resulting in the production of methane. However, cellulosic biomass sources, such as grass, consist of a heterogeneous complex of carbohydrate polymers along with lignin (mainly cellulose and hemicellulose) which are both potential sources of fermentable sugars that can be more profitable than methane in the market. This work employed three Leach Bed Reactors to digest ensiled perennial rye grass and pressed cake for the production of soluble high added value products in a biorefinery concept. The reactors were operated at 37°C over the course of 161 days (23 x 7-day batches). Reactor pH was not controlled during the study and therefore it was maintained naturally within the range of 4.4-4.7. This inhibited methane production which reached a maximum yield of 1.236 ml CH₄ g⁻¹VS_{added}. The leach bed reactor configuration allowed soluble compounds to accumulate, with yields of 0.15 g COD g⁻¹VS_{added}, which is desired in a biorefinery context. Volatile Solid (VS) destruction was surprisingly lower when ensiled pressed cake was used than when the ensiled grass was used as substrate, being on average 29% (±4.8) and 71% (±4.5), respectively.

Vegetative composition of aquatic buffer zones in Irish plantation forests

Cormac McConigley¹, Heather Lally¹, Declan Little², Philip O'Dea³, Mary Kelly-Quinn¹

¹*UCD School of Biology and Environmental Science, University College Dublin, Belfield, Dublin 4, Ireland.*

²*Declan Little, Woodlands of Ireland, Seismograph House, Rathfarnham Castle, Dublin 14, Ireland.*

³*Coillte, Church Road, Newtownmountkennedy, Co Wicklow, Ireland.*

Corresponding Author Email: cormacmconigley@gmail.com

Keywords: riparian zone, aquatic buffer zone, conifer afforestation, native woodlands, soil types.

The Forest Service, Department of Agriculture, Food and the Marine introduced guidelines in 1991, subsequently revised in 2000 which stipulated the establishment of aquatic buffer zones (ABZs)(10 – 25 m) at afforestation along all rivers, streams or lakes that are shown on Ordnance Survey 6" maps. To assess the vegetation species composition of ABZs, sites were chosen across three forest type (afforested, reforested, and non-forested controls) on six soil types (peat, peaty podzols, peaty gley, well-drained mineral, mineral gley and mineral alluvium) yielding a total of 18 treatments. At each site six stations (10m x 10m quadrats) were sampled 100m apart upstream on both banks. Three relèves (2m x 2m), 2m apart, were carried out along a line transect through the centre of each station. All vegetation within the relève was recorded and percentage cover estimated. Multivariant analysis of the species composition showed a significant difference between reforested and afforested treatments on peat, peaty gley and mineral gley. Reforested and control treatments differed significantly on mineral gley and mineral alluvium. There was no significant difference between afforested and control treatments on any of the soil types investigated. These results indicate that the species composition of the riparian zone can be preserved on a site that has buffer zones implemented at afforestation. The presence of conifers within the buffer zone in the past for approximately one rotation, i.e. ca 40 years, may explain the difference in species composition found on reforested sites.

Utilising a biomonitor, *Deroceras reticulatum* (Mollusca, Gastropoda), to investigate metal contamination on wetlands infilled with Construction and Demolition (C&D) waste

Staunton, J.^{1,4}, McDonnell R.², Henry T.^{3,4}, Gormally, M.^{1,4}, Morrison, L.^{3,4}

¹ Applied Ecology Unit, School of Natural Sciences, NUI Galway

² Dept. of Entomology, University of California, Riverside, CA 92521, USA.

³ Earth and Ocean Science, NUI Galway

⁴ Ryan Institute for Environmental, Marine and Energy Research, NUI Galway

Keywords: wetland, construction & demolition waste, infill, metal, biomonitor

Wetlands are important components of water systems, providing a list of valuable ecosystem services, including water cleansing, storage and habitat provision. The recent construction sector boom increased the volume of C&D waste being produced in Ireland from 1.3 (1995) to 14.9 (2005) million tonnes, and wetlands were unfortunately often used as disposal sites for this. The composition of C&D waste varies, but generally includes mixed aggregate, concrete, wood, gypsum, metals and glass. Controlled laboratory experiments have shown that C&D waste can leach metals, but no field studies investigating the ecological impacts of infilling wetlands with this waste have been carried out. The main aim of this study was to investigate the use of *Deroceras reticulatum* as a biomonitor of metals on C&D waste sites. Samples were collected using refuge traps on C&D waste infill sites, pristine wetlands (control) and former mining locations (known 'contaminated' comparison). After 48hrs dehydrating, they were sacrificed by freezing, freeze dried (preserving integrity) and digested using a microwave digester. Inductively Coupled Plasma Mass Spectrometry (ICP-MS) was used for metal determination. Initial results suggest that some elements (As, Cd, Co, Mo, Pb, Sb, Se) have elevated concentrations in molluscs collected on C&D waste.

Microbial structure and function during anaerobic digestion of food waste

Paul McAteer, Florence Abram, Vincent O'Flaherty

Department of Microbiology, School of Natural Sciences; and Ryan Institute for Environmental, Marine and Energy Research, National University of Ireland, Galway

Corresponding Author Email: p.mcateer1@nuigalway.ie

Keywords: Anaerobic digestion, food waste, metaproteomics

Recent environmental legislation coupled with the constant drive for alternative energy sources has led to increased interest in anaerobic digestion as a means of waste disposal and a source of renewable energy. However, despite recent progress the anaerobic digestion of complex substrates such as food waste can still prove challenging. Problems include long-term stability of the process within the reactor; and slow progression during the rate-limiting hydrolysis step. Understanding the microbial community structure and their functionality during under these conditions is crucial as we attempt to solve these problems and improve the overall process.

This study aims to apply a metaproteomic approach to microbial analysis during the anaerobic digestion of food waste. A method of simultaneous extraction of bacterial DNA, RNA and proteins has been developed which allows the integration of genomic and proteomic information to give a more complete picture of this complex system. SDS-PAGE has been used for analysis of proteins and to target bands for protein identification with LC MS/MS.

An interdisciplinary approach to engagement with, and conservation of, campus trees

Richard Manton^{1,2}, Paul O'Donnell³, Ruairi Duggan⁴, Noelle Dunne⁴,
Caitríona Carlin^{2,5}, Michael Gormally^{2,5}

¹*Department of Civil Engineering, College of Engineering and Informatics, NUI Galway.*

²*Ryan Institute for Environmental, Marine and Energy Research, NUI Galway.*

³*College of Arts, Social Sciences and Celtic Studies, NUI Galway.*

⁴*School of Science, Galway-Mayo Institute of Technology*

⁵*Applied Ecology Unit, Centre for Environmental Science, NUI Galway.*

Corresponding Author Email: r.manton1@nuigalway.ie

Keywords: trees, public engagement, conservation, university campus

Irish trees have been shown to bring a wide range of benefits, including 6 million tonnes of carbon sequestration per year. In particular, urban trees yield major economic benefits, through air pollutant deposition (CO, O₃, PM₁₀, NO₂, SO₂), stormwater runoff reduction and increased real estate value, and in addition to which they improve the aesthetics of open space and increase physical activity. Monetising these benefits shows: for every €1 invested in tree management, residents receive €5.80 in indirect economic benefits. Views of trees have even been shown to restore students' attention.

The main NUI Galway campus is home to over 40,000 trees on 102 ha on the banks of the River Corrib (a Special Area of Conservation). Significant construction, although necessary to meet the needs of a rapidly growing student population, means that, now more than ever, valuable trees need to be identified and retained. Not only are these trees important for students, staff and the public (through benefits described above), they provide shelter and food for on-campus wildlife.

A project team comprising staff and students from Environmental Science, Civil Engineering and the College of Arts, Social Sciences and Celtic Studies (NUI Galway) and the School of Science (GMIT) was assembled to produce on-campus tree walks at NUI Galway. The aim of these walks is to encourage engagement by the campus population with on-campus flora and fauna. An inventory of campus trees and previous campus tours were reviewed and a south campus 'Walking with Trees' tour was compiled. This tour provided information on each tree, including whether the tree is native, typical heights, folklore associated with the tree etc*. Work is underway on a riverside tour which will follow a new greenway running through the campus. Finally, these tours will be compiled as an interactive, online map and mobile app. It is envisaged that greater engagement by the campus population with the campus environment, particularly trees, will lead to better understanding of the value of campus trees for all university students and staff, thereby promoting conservation.

Acknowledgement: Funding for this project was provided through the Explore innovation initiative, supported by NUI Galway Bright Ideas and NUI Galway Student Union.

**The Walking with Trees brochure is available at Environ 2013 or online at: tinyurl.com/bozsgsw*

Identification of grassland management and land-use change using high resolution spatial databases

Jesko Zimmerman¹, Phillip O'Brien², Stuart Green³, Ainhua Gonzales Del Campo⁴, Michael B. Jones¹, Jane Stout¹

¹Department of Botany, TCD

²Climate Change Unit, EPA, Richview, Dublin

³Spatial Analysis Unit, Teagasc, Astown

⁴Centre for the Environment, TCD

Corresponding Author Email: zimmerjr@tcd.ie

Carbon dynamics linked to land-use and land-use change (LULUC) have been recognised as a major factor in the global green-house gas (GHG) budget. The major sources of carbon to the atmosphere are the loss of above and below ground biomass as well as the loss of soil organic carbon. Estimates have shown that in the decade between 1990 and 2000 emissions related to LULUC and forestry have been between 0.5 and 2.7 Gt C yr⁻¹. The major sources are conversion from forestry to agriculture and from grasslands to cropland; on the other hand land-use change from cropland to grassland can facilitate soil carbon sequestration. While the effects of different types of land-use change on the GHG budget have been well studied, recent research shows that different management practices can have a significant impact on soil organic carbon stocks. In Ireland grassland, as the dominant land-use type, deserves particular attention. While grassland is generally considered a carbon sink, management practices can have a significant impact on carbon dynamics. Major practices influencing the GHG balance are: (1) grazing management, (2) sowing of improved species, especially nitrogen fixing plants, (3) increasing organic input, and (4) restoring degraded grasslands. Owing to a lack of available data only two types of grassland are currently used in the national greenhouse gas budget, improved and unimproved grasslands with no further breakdown of type and management. The trajectory of land-use change from, to, and within grassland is calculated from annual data on the total amount of grassland, received from the Central Statistics Office. The aim of this project is to use a high resolution spatial database (LPIS) to refine the grassland classification in Ireland taking management practises into account as well as developing tools to more accurately detect changes among as well as within land-use types.

The Biology and Behaviour of *Tetanocera elata* (Diptera: Sciomyzidae), Potential Biological Control Agent of Pestiferous Slugs

T. Hynes^{1,3}, R. Mc Donnell² & M. Gormally^{1,3}

¹ Applied Ecology Unit, Centre for Environmental Science, National University of
Ireland, Galway

² Department of Entomology, University of California-Riverside, Riverside, CA 92521 USA.

³ Ryan Institute for Environmental, Marine and Energy Research, National University of
Ireland, Galway

Corresponding Author Email: t.hynes1@nuigalway.ie

Keywords: Biological control; pestiferous slugs; marsh flies; *Tetanocera elata*; Diptera; Sciomyzidae

Approximately 15% of global food production (worth US\$75 billion) is lost annually to pests of which slugs are one of the most important. The annual output value of the Irish horticulture sector is €291m and sustainable alternatives to chemical slug control which affect non-target organisms are currently being sought. Since climate change in Ireland is predicted to exacerbate crop damage by slugs, the need for a control option that is environmentally benign, cost effective and successful is urgently required.

Preliminary research has shown that the larval stages of *Tetanocera elata* (Diptera: Sciomyzidae) prey on slugs. However, little is known about the species regarding its efficacy as a biocontrol agent of slugs or its optimal laboratory rearing conditions. The objectives of this research are to: (1) identify optimum laboratory growth conditions to facilitate mass culture production; (2) determine the prey preference/prey location behaviour of *T. elata* and quantify its efficacy as a biocontrol agent using controlled laboratory experiments; (3) record its habitat preferences / phenology to determine appropriate field conditions for biocontrol release programmes; and (4) design controlled field experiments by releasing *T. elata* in field crops with high slug densities. Given that *T. elata* is present in Ireland, biocontrol of slugs by augmentation (releasing laboratory bred *T. elata* to increase numbers in the field) and / or conservation biocontrol (manipulating non-crop vegetation around the crop to enhance *T. elata* populations) are real possibilities. To date, this project has seen the successful capture and laboratory breeding of *T. elata* from egg to adult at various temperatures. Initial results show the ability of an individual larva to kill a maximum number of 16 slugs before reaching its puparium stage.

The Relationship Between Species Interactions and Multifunctionality in Grasslands

Laura Kirwan¹ and John A. Finn²

¹*Waterford Institute of Technology, Cork Road, Waterford.*

²*Teagasc Environment Research Centre, Johnstown Castle, Wexford.*

Keywords: Biodiversity, ecosystem services, multifunctionality, species interactions, grasslands

Modern grassland management seeks to provide many ecosystem services and the use of multispecies mixtures has been proposed as a strategy to improve agricultural sustainability. Recent studies suggest that biodiversity enhances the ability of an ecosystem to simultaneously maintain multiple functions (multifunctionality). Increasing the number of species in a grassland mixture increases the potential for species to interact, and interactions such as complementarity and facilitation have been proposed as mechanisms in diversity-function relationships. However, species interactions can be negative as well as positive, and a pair of species that interact positively for one ecosystem function may interact negatively for another. In this study we explore the impact of species interaction on multifunctionality in a grassland ecosystem. We build on diversity-interaction modelling, a statistical approach that assesses the impact of species identity and interaction effects on ecosystem function. By developing a multivariate extension of this, we apply the models to experimental data on multiple grassland functions, including above ground biomass, forage quality measurements and soil measurements. We report that differing species interaction relationships are associated with the multiple grassland functions. This approach can facilitate the selection of a community composition that optimises species interactions for multiple functions.

Multifunctionality and the Grassland Biodiversity-Ecosystem Functioning Relationship

Áine Dooley¹, Forest Isbell², Laura Kirwan³, John Connolly⁴, John A. Finn⁵, Caroline Brophy¹

¹*Department of Mathematics and Statistics, National University of Ireland Maynooth, Maynooth, Co. Kildare, Ireland*

²*Department of Ecology, Evolution, and Behavior, University of Minnesota, St Paul, Minnesota 55108, USA*

³*Department of Chemical and Life Science, Waterford Institute of Technology, Cork Road, Waterford, Ireland*

⁴*School of Mathematical Sciences, Ecological and Environmental Modelling Group, University College Dublin, Dublin 4, Ireland*

⁵*Teagasc Environment Research Centre, Johnstown Castle, Co. Wexford, Ireland*

Corresponding Author Email: ainedooley@gmail.com

Keywords: multifunctionality, ecosystem functioning, biodiversity, evenness, diversity effect.

A greater understanding of the biodiversity ecosystem-functioning (BEF) relationship has been an area of interest for ecologists for many years and some recent work has focused on how biodiversity can affect multiple ecosystem functions simultaneously (multifunctionality). Multifunctionality is a vital progression for the understanding of the BEF relationship as analysing ecosystem functions separately may provide an incomplete picture of the effects of biodiversity.

We developed the Diversity-Interaction multivariate model to analyse the BEF relationship. This modelling method allowed us to explore how biodiversity affected several ecosystem functions simultaneously whilst also providing information about how the ecosystem functions related to one another. We used this technique to address a number of questions namely

How does biodiversity affect multiple ecosystem functions?

How do multiple ecosystem functions relate to one another?

Do biodiversity effects change for different ecosystem functions and, if so, how does this affect our understanding of the BEF relationship?

We used this method to analyse data from a four species grassland experiment and found that there was a positive effect of increasing biodiversity on multiple ecosystem functions. The methodology developed and the results found can lead to enhanced understanding of how to maintain multiple ecosystem functions simultaneously.

Public Perceptions of the Irish Marine Environment

Stephen Hynes, Danny Norton, Rebecca Corless

SEMRU (Socio-Economic Marine Research Unit), J.E. Cairnes School of Business and Economics, National University of Ireland, Galway

This paper presents the results of a nationwide survey in Ireland that explored the values, concerns and preferences of individuals regarding the Irish marine environment. The results of the Irish survey are also compared to the results from similar surveys carried out in other maritime countries in the EU. Given the increased impetus on marine spatial planning for commercial and environmental sustainability regulation in areas such as fisheries, marine energy, and aquaculture, national governments and marine policy makers are in need of a range of social and economic indicators for the sector including information on the opinions and preferences of the persons and communities using Ireland's coastal and marine resources. The views of the Irish public towards the seas and oceans around the Irish coast are relatively unknown. This is despite the fact that Ireland has sovereign rights over 900,000km² of seabed (which is an area 10 times the size of the land area of Ireland). While the positions of organised stakeholder groups are often captured through responses to policy consultations such as those provided for the recently launched Integrated Marine Plan for Ireland, the opinion of the 'ordinary person in the street' is difficult to include in the decision making process. However, it is the collective choices made by communities through the marine and coastal resources they use, the coastal areas they visit or reside in that drive many pressures on the marine environment. The viewpoint of the Irish public on the seas and oceans around Ireland will also play an important role in supporting policies such as the Marine Strategy Framework Directive, the deployment of marine renewable, large scale aquaculture projects, and marine protected areas that have considerable social and economic consequences.

The Validity of Integrating UK Hydrological Catchments into Irish Pooling Groups

David Forde

Cork Institute of Technology

Corresponding Author Email: davidforde89@gmail.com

This project examines the validity of integrating UK catchments into Irish pooling groups to supplement existing hydrometric data. Pooling groups are collections of hydrologically similar catchments (gauging stations) that can be analyzed as a 'group' to derive flood frequency growth curves. They are used when flood records at the study site are too short (or non-existent) to allow reliable estimation of long return-period events.

This project involves comparing potential, cross-jurisdictional pooling groups with those consisting solely of Irish catchments using statistical analysis. This would establish whether or not there is a correlation between them. The pooling group analysis has been conducted using the Flood Estimation Handbook and forthcoming Flood Studies Update methods, as well as formulating a tailor-made methodology that is capable of catering for both sets of data.

At present, there is a deficiency in Irish gauging data as many of the stations that are in place on indigenous rivers have only been commissioned in the past 20 years. This presents significant difficulties in the accurate prediction of flood magnitudes and their respective return periods. However, the majority of UK gauging stations have been installed and have been operating since the early 1950s. It would be extremely beneficial if this vast bank of data could be integrated into current Irish flood estimation practices.

The primary outcome of this research has been the preliminary confirmation of the use of UK hydrometric data for inclusion in Irish catchment analysis. The application of these outcomes could be wide-ranging with regards to Irish flood risk assessment. It would present engineers with an additional tool with which flood frequencies could be predicted and substantially increase the levels of information at their disposal.

Understanding the dynamics of maërl debris beach systems

Zoe Elliott^{1,3}, Kevin Lynch^{1,3}, Marie Mahon^{1,3}, Charles Lemckert²

¹ School of Geography and Archeology, National University of Ireland, Galway

² Griffith School of Engineering, Griffith University, Australia

³ Ryan Institute for Environmental, Marine and Energy Research, National University of Ireland, Galway

Corresponding Author Email: z.elliott1@nuigalway.ie

Maërl debris beach systems present a significant knowledge gap in our understanding of coastal environments. Maërl is a collective name for unattached, living, red coralline algae. When the red algae dies, its hard calcareous structure persists in relatively unchanged physical form and contributes to the sediment stores in the vicinity and in some unique cases, it accumulates to form beaches. Maërl debris beaches are not as commonly occurring as other beach sediment types such as sand or gravel, and for this reason have a high conservation value. The maërl debris beach systems in County Galway this research will investigate are Mannin Bay and Carraroe.

In Ireland, research has been undertaken into various aspects of maërl beds including spatial distribution and the related fauna and flora (De Grave et al., 2000). However, the sediment transport dynamics of maërl debris in terms of the nearshore zone and also the beach growth rates of the backshore zone have not been widely explored. This research investigates the characteristics of maërl debris beach systems and how they behave under variations in forcing factors, such as fluctuations in wind and wave action. These beach systems are being analysed over time through the utilisation of high precision repetitive topographic surveys, coupled with fine resolution meteorological and marine data. Analysis of beach profile data provides a good indication of changes in sediment transport patterns allowing comparisons with current theories on coastal processes including berm and swash bar development.

Transformative Marine Stakeholders: Moving from a Marine, Fisheries and Coastal Management Centric View to a Societal Marine Ecosystem Perspective

Michelle Devaney¹, Dr. Christine Domegan¹, Dr Michael Hogan², Patricia McHugh¹

¹*J.E. Cairnes School of Business and Economics, National University of Ireland, Galway*

²*School of Psychology, National University of Ireland, Galway.*

Corresponding Author E-Mail Address: michelle.devaney@nuigalway.ie

Keywords: marine stakeholders, societal stakeholders, systems thinking, collective intelligence

Marine ecosystems are crucial to the sustainability of societies and global health. However, consultations with marine stakeholders tend to take a marine, fisheries and coastal management centric view. It is micro in perspective, displaying mechanistic linear structures of power, command and control where expert actors perceive they know best. This view neglects the complexity underlying marine ecosystems. A normative ethical, macro/holistic and network-focused orientation to stakeholder engagement is emerging. It details how holistic ecosystems thinking can overcome the myopic view of mechanistic market structures, by focusing on the intricate interplays between stakeholders to manage complex societal issues. This societal stakeholder strategy aims to make collaborative improvements in the long term, where the integration of multiple levels in a system are non-linear and interactive, requiring intensive communication, co-ordination and collaboration between stakeholders. The ecosystems view of marine stakeholders focuses on knowledge, networks, relationships and governance. Knowledge measures transfer, exchange and generation. Networks consist of involvement, connections and positions. Relationships measure shared values, trust, commitment, learning, reciprocity and sociality; and governance measures openness and co-ordination, highlighting the importance of feedback loops and reciprocal value co-created exchanges. This macro management perspective underlines Sea for Society (SFS), a multidisciplinary EU study focused on influencing human behaviour and the choices we make concerning the ocean. With its problematic stance requiring societal systems thinking, SFS will mobilise stakeholders through the use of Warfield's collective intelligence (CI). CI involves participants collaborating to resolve complex issues and to engender change. SFS recognises a wide array of marine stakeholders who will inevitably have very different, conflicting perspectives. CI recognizes these conflicting perspectives, arriving at collective solutions to tackle the challenges. SFS seeks to develop deep understandings of stakeholder priorities and concerns, taking into account co-authored recommendations for change.

Molecular Microbial Ecology of Ammonia Oxidation in Coastal Bay Sediments

Duff, A.^{1,3}, O'Flaherty, V^{2,3}, Smith, C.J.^{1,3}

¹Marine Microbial Ecology Laboratory, Microbiology, School of Natural Sciences, NUI Galway, Galway, Ireland

²Microbial Ecology Laboratory, Microbiology, School of Natural Sciences, NUI Galway, Galway, Ireland

³Ryan Institute for Environmental, Marine and Energy Research, NUI Galway

Keywords: nitrogen cycle, ammonia oxidising bacteria and archaea, *amoA* gene, primers, nitrification rate assay

The nitrogen cycle plays an important role in the marine environment as nitrogen is often the limiting factor of primary productivity. The nitrogen cycle is so important to understand as it requires a fine balance between nitrogen loss or conservation, this can be misbalanced due to human impact (e.g. nitrates entering the water from fertilisers etc.). Furthermore N₂O, a greenhouse gas can be produced via microbial transformations of the nitrogen cycle. Microorganisms within marine sediments play an important role in the global nitrogen cycle mediating the fate of nitrogen entering coastal waters. For example, microorganisms such as ammonia oxidising bacteria (AOB) and more recently ammonia oxidising archaea (AOA) have been found to drive ammonia oxidation, the first step of nitrification (oxidation of ammonia to nitrate). The overall aim of this research is to understand AOA and AOB dynamics in marine sediments and evaluate their contribution to global nitrogen and carbon cycles by linking community structure and activity with ecosystem function. The *amoA* gene encodes the oxidation of ammonia to nitrate; it is found in both AOA and AOB and can be exploited as a genetic marker for potential activity. Thus far DNA and RNA have been successfully extracted from coastal sediments in Silverstrand and Rusheen Bay, Galway. Bacteria and Archaea were detected in all sediment sampling using 16S rRNA primers. Subsequently, the ammonia oxidising bacteria and archaea were detected using a suite of primers that target the functional gene *amoA*. Moreover, potential nitrification rate assays were carried out to indicate if nitrification was occurring in the sediments.

Nepheloid layers along the North-East Atlantic continental margin Case study: The Whittard Canyon System

Annette Wilson^{1,2}, Louise Allcock², Robin Raine^{1,2} and Martin White^{1,2}

¹Earth and Ocean Sciences, School of Natural Sciences, NUI Galway, Ireland

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

Corresponding Author Email: wilson.m.annette@gmail.com

Key words: nepheloid layer; continental margin; deep-sea canyons; suspended particulate material; sediment transport fluxes; biogeochemical cycles; organic carbon; biodiversity

Extensive, persistent and transient benthic (BNLs) and intermediate nepheloid layers (INLs) were detected in two branches of the Whittard Canyon by means of hydrographic survey, as part of an Irish bio-discovery programme along the North-East Atlantic continental margin. Vertical profiles of beam attenuation (m^{-1}), used as a proxy for suspended particulate material, revealed strong BNLs extending from the upper canyon near the shelf edge to depths of >2000 m. BNLs were particularly strong between 750-1200 m, extending >100 m off the seabed and were possibly associated with the Mediterranean Outflow Water (MOW) core found at this depth. Numerous INLs were present at depths of 750 m and 1500 m, with an appreciable signal extending a horizontal distance of about 20 km.

Severe storm activity disrupted the weak spring surface stratification and caused vertical mixing down to 200 m. INLs detected after the storm may have been a result of this activity reaching the depths of the canyon walls. A six hour repeat cross canyon channel CTD survey during the storm suggested significant baroclinic activity (internal waves) in the depth range 500-800 m.

Remotely Operated Vehicle (ROV) deployments in the eastern arm of the canyon revealed the presence of large limid bivalves, *Acesta excavata*, and deep-sea oysters, *Neopycnodonte zibrowii*. These suspension feeders were found in high density between 640-740 m, within the range of the permanent thermocline (600-1000 m) and where intense BNLs and INLs were detected. Our findings suggest a relationship between the areas of nepheloid layer activity, where enhanced tidal and residual currents exist, and the presence of these suspension feeders.

Vegetation monitoring of farmland in west Mayo: Potential use for identification of extent and quality of High Nature Value farmland in North-West Ireland

Pamela Boyle¹, Margaret Hayes², James Moran¹, Mike Gormally^{2,3}

¹*Department of Environmental Science, School of Science, Institute of Technology, Sligo, Ash Lane, Sligo, Ireland*

²*Applied Ecology Unit, Centre for Environmental Science, National University of Ireland, Galway, Galway, Ireland*

³*Ryan Institute for Environmental, Marine and Energy Research, National University of Ireland, Galway*

Corresponding Author Email: Pamela.Boyle@mail.itsligo.ie

Keywords: High Nature Value (HNV) farmland, vegetation, cluster analysis, semi-improved grassland

EU member states are required under the current Common Agricultural Policy (2007-2013) to demonstrate that measures are in place to maintain HNV farmland. However, very little information is available regarding the extent or quality of HNV farmland at national level. This provided the incentive for this study in the Clew Bay region of Co. Mayo. Thirty farms were surveyed by walking a 'W' pattern across each field and recording all plant species encountered. Each field was classified according to 'A Guide to Habitats in Ireland' (Fossitt, 2000) with an additional grassland category, semi-improved grassland included. Cluster analysis of field data using PC-ORD software indicated distinct groupings of vegetation types which mirror the modified habitat classification method. This system has potential for incorporation into a farm scale decision support tool for HNV identification and management. The proposed vegetation groupings identified within this study could play a significant part in the identification and monitoring of HNV farmland. Ireland has potentially large amounts of HNV farmland (20-30% of utilisable agricultural area), which is a significant contributor to multiple ecosystem services (production, regulatory, support, aesthetic and cultural) with associated positive impacts on human health and well-being.

National Study on Environmental Waste Enforcement: Issues, Best Practices and Technologies

Aidan McDermott, Dr Alvaro Palomo, Dr John Dooley, Dr Ronan Farrell

Environmental Enforcement Research, Callan Institute, Dept. Of Electronic Engineering, NUI Maynooth, Maynooth, Co. Kildare, Ireland.

Corresponding Author Email: aidan.mcdermott@nuim.ie

Keywords: Environmental Management, Waste Enforcement, Local Authorities.

Local Authorities in Ireland are challenged each and every day with illegal environmental practices across their jurisdiction. Issues experienced depend on the geographical characteristics of the Local Authority. Historical enforcement practices (technological and behavioural) have demonstrated various levels of effectiveness. However, enforcement of environmental regulations has become increasingly difficult in the current economic climate where both Local Authorities and households are constrained by tighter budgets. Consequently, environmental enforcement technologies and practices need to adapt to meet the demands faced today.

In order to identify new technological and procedural approaches for environmental waste enforcement, a good understanding of current issues and effectiveness of historical practices must be gained. To that end, this research conducted a national survey gathering data across all Local Authorities in Ireland. Each Local Authority was requested to share information regarding their environmental enforcement issues, best practices and technological solutions.

A total of 17 Local Authorities (50%) participated in the survey providing information for their jurisdiction. The main environmental enforcement issues experienced by each Local Authority were tabulated and subsequently developed into a pareto of issues at a national level where differences were observed between rural and urban areas. In addition, a set of best practices were identified which could be replicated nationwide. Finally, an analysis of effective technologies highlighted a set of core solutions that are widely used, but also others which could be more widely deployed. In summary, these results could influence more effective technology investments and practices locally and nationally in the future.

Assessment of Zinc and Cadmium Distribution in Plant Tissues Using a Complementary Micro-PIXE, EXAFS and Laser-Ablation-ICP-MS approach.

Lutts S¹., Vogel-Mikuš K²., Han R¹., Pelicon P.³, I. Arčon^{3,4}, van Elteren J.T.⁵, Lefèvre I¹.

¹*Université catholique de Louvain, Earth and Life Institute – Agronomy (ELI-A), Groupe de Recherche en Physiologie Végétale (GRPV), Croix du Sud 4-5, bte L7.07.13, 1348 Louvain-la-Neuve, Belgium*

²*University of Ljubljana, Biotechnical Faculty, Department of Biology, Večna pot 111, 1000 Ljubljana, Slovenia*

³*Jožef Stefan Institute, Jamova 39, 1000 Ljubljana, Slovenia*

⁴*University of Nova Gorica, Vipavska 13, 5000 Nova Gorica, Slovenia*

⁵*National Institute of Chemistry, Analytical Chemistry Laboratory, Hajdrihova 19, 1000 Ljubljana, Slovenia*

Zinc and cadmium are two largely widespread pollutants of major environmental concern. Heavy metal effects on plant tissues directly depend on their localization and their coordination with ligands. These information are crucial for the interpretation of plant metabolic responses to heavy metals but also for assessing the risk of food chain contamination by agricultural plants and identification of heavy metal resistant plant species which could be used for phytoremediation purposes. Micro-PIXE and LA-ICP-MS are efficient tools to reveal distribution and quantification of specific elements at the tissue level although their application in plant sample remains poorly documented. Those experimental strategies were applied on two plant species, the xerophyte *Zygophyllum fabago* and the halophytic hydrophyte *Kosteletzkia virginica* exposed to 50 μM ZnSO_4 or to 10 μM CdCl_2 . Data demonstrated that Zn accumulates mainly in mesophyll cells while Cd accumulated mainly near vascular bundles. Both heavy metals induced a modification in the distribution of major elements such as Mg, Ca and Fe. Stress-induced modification in Ca and Mn concentration in palisade mesophyll cells may explain the recorded decrease in photosynthetic activity. Proteomic approach confirmed that photosynthetic apparatus is a major target of heavy metal-induced disorders. EXAFS analysis (beam line 29 ESRF facilities) revealed that Cd was mainly coordinated to S-containing ligands while accumulated Zn was mainly bound with O. At the seed level of *K. virginica*, Zn was mainly recorded in the testa, endosperm, and to a lower extent in embryo. It is demonstrated that salinity may induce a chalazal retention of Zn during seed maturation and reduced final Zn content. It is concluded that complementary strategies for elemental mapping in plant tissues may help to unravel the underlying mechanisms involved in plant response to heavy metal stress and constitute powerful and promising tools for a more accurate interpretation of physiological data.

The Identification of High Nature Value (HNV) farmland in the north- west of Ireland: How Important are Terrestrial Invertebrates?

Margaret Hayes^{1,3}, Pamela Boyle², Mike Gormally^{1,3}, James Moran²

¹*Applied Ecology Unit, Centre for Environmental Science, National University of Ireland, Galway*

²*Department of Environmental Science, School of Science, Institute of Technology, Sligo, Ash Lane, Sligo, Ireland*

³*Ryan Institute for Environmental, Marine and Energy Research, National University of Ireland, Galway*

Corresponding Author Email: m.hayesneefitzpatrick1@nuigalway.ie

Keywords: High Nature Value farming, bioindicators, invertebrates, biodiversity

High Nature Value (HNV) farming is low intensity farming associated with a high diversity of semi-natural habitats and species. Despite the fact that most biodiversity throughout the EU is formed and managed by agricultural practices, there have been few targeted actions taken to protect this important resource. Action is urgently required given the two major threats to HNV farming i.e. increased intensification of agricultural practices and land abandonment. At national level little effort, to date, has been directed towards identification of the extent or quality of HNV. This project aims to remedy this by compiling baseline data which can be used in the north-west of Ireland, with the potential for applying similar methodologies throughout the Republic of Ireland. Of particular interest is the potential use of terrestrial invertebrates as bioindicators of HNV farmland, given that this group, apart from some charismatic species, is sometimes overlooked in determining the biodiversity value of farmed landscapes. With this in mind, Carabidae and Diptera were sampled on wet grassland habitats across three ecological character areas in the north-west of Ireland. Preliminary analyses reveal that the distribution and abundances of different invertebrate families are affected in different ways by plant species richness, % cover of dead vegetation / bryophytes and plant structure. The implications of this for HNV farmland identification and its optimal management for both biodiversity and agricultural sustainability, is currently being investigated in the light of farming practices at the sampling sites.

Remote sensing of slurry spread on grasslands with exposed soil

Ross Donnelly-Swift, Nicholas Holden

UCD School of Biosystems Engineering, University College Dublin, Belfield, Dublin 4, Ireland

Corresponding Author Email Address: swiftross@hotmail.com

Keywords: slurry, spectral signature, grasslands

The spreading of slurry is subject to regulatory control. Remote sensing offers a means of monitoring compliance with legislation. This experiment was set up to help understand the difference in spectral response of spread slurry depending on the surface medium it is spread on. Slurry is often spread on fields that have a high proportion of exposed soil such as after the cutting of grass for silage production or periods of slow grass growth. For this reason it is important to ascertain how exposed soil will interfere with the spectral signature of slurry that has been spread on a grass field. Five plots each measuring a metre square was marked out in a pasture field and cut to a uniform height. Each of the plots received a different treatment, 500ml of slurry, 250ml of slurry mixed with 250ml of water, 500ml of water, 500 ml of farm yard run-off and the last plot acted as the control with nothing added. This was replicated around the field using a random block design. A multi-spectral radiometer was used to record the spectral signature of each plot. Eight wavelengths were examined ranging over the visible and near infrared spectrum. Data were collected over a number of weeks and the experiment was repeated several times during the slurry spreading season with different levels of soil exposure. From analysing the results it is clear that there is a significant difference between the 500 ml of slurry and the other plots for all eight spectral bands. The 500 ml mix of slurry and water was significantly different at the start of recording but after the first few days this became less apparent. The results of this experiment show that slurry can be identified when spread on grassland with exposed soil. This will help with accurate identification of slurry when using remote sensing.

Seabird Interactions with a Novel Tidal Energy Conversion Device, the Scotrenewables SR250

Jean Hamilton, Tom Kelly

School of Biological, Earth and Environmental Sciences, University College, Cork, Distillery Fields, North Mall, Cork, Ireland.

Keywords: Tidal turbine, seabird populations, behaviour, collision detection, displacement effects.

The production of clean renewable energy is of vital importance in order to curb the effects of anthropogenically-influenced climate change. However, the potential ecological impacts of renewable energy devices on their surrounding environment must be assessed prior to the installation of large-scale renewable energy developments. The conversion of kinetic energy from tidal stream currents using tidal turbines is a relatively new technology, and at present very little is known regarding the ecological effects of the operation of these devices. The purpose of this study was to develop a monitoring strategy to examine and quantify the effects of the operation of a prototype tidal turbine, the Scotrenewables SR250, on seabird populations. The SR250 underwent a testing procedure at the European Marine Energy Centre (EMEC) tidal test site in the Falls of Warness, Eday, Orkney during the spring and summer of 2012. A combined approach of visual observations and analysis of underwater acoustic and camera recordings was used in order to 1) examine the behavioural responses of sea birds in the vicinity of the turbine 2) examine the rate of collisions with the turbine, 3), examine 'near misses' of diving birds with the turbine and 4) to determine whether displacement of seabirds is taking place. The main behavioural response noted in the study was the tendency of seabirds, mainly black guillemot (*Cepphus grylle*) to use the hull of the turbine for perching. Though no conclusive statements can be made regarding collision rates or displacement effects, the monitoring strategy developed during this study is considered to be very useful to the renewables sector, and may be used to inform future environmental impact assessments of renewable energy developments.

Analysing the Carbon Impact Factors of OSB from Irish Forests

Desmond Dolan^{1,2}, Dr. Annette Harte^{1,2}

¹ Civil Engineering, College of Engineering and Informatics, NUI Galway

²Ryan Institute for Environmental, Marine and Energy Research, NUI Galway

Corresponding Author Email: desmond.dolan@nuigalway.ie

Keywords: OSB, Life Cycle Assessment, Embodied Energy, Embodied Carbon

Climate change is widely accepted as the greatest environmental challenge facing the world today, predominantly due to the increase of greenhouse gas emissions, especially CO₂. As buildings account for 36% of EU CO₂ emissions, the environmental impacts associated with building materials are becoming increasingly important. The use of sustainable construction materials, such as Oriented Strand Board (OSB), has a major role to play in the reducing CO₂ emissions.

The aim of this project is to quantify the carbon impacts associated with the OSB produced in Ireland using Life Cycle Assessment (LCA). LCA is an internationally accepted method that of analysing and quantifying the total environmental impacts generated by a product at each stage of its life cycle from raw material extraction through to disposal or recycling. This involves quantifying the inputs and outputs, such as the energy and material usage, generated at each stage and assessing the total environmental impact associated with each.

Similar studies have calculated the carbon released and energy used with the production of OSB to be approximately 0.45 CO₂e/kg and 14.95 MJ/kg, respectively*. These figures do not include the beneficial aspect of carbon sequestration which takes into account CO₂ absorbed by the trees while growing which is then stored in the wood product for the duration of its life. This demonstrates the potential to produce carbon negative construction products and ultimately carbon negative buildings.

The values for these environmental impacts for OSB can vary significantly from country to country due to differences in local climate and in forestry, product manufacture, and construction practices. For example, the manufacturing of OSB in both Canada and Scandinavia is approximately one third less energy intensive than OSB produced in USA*. * As no data is currently available for OSB produced in Ireland, it is the aim of this project to fill this knowledge using actual production data.

*Hammond G.P. and Jones C. I. (2011). Inventory of carbon and energy (ICE) Version 2.0. Retrieved on 20th of August 2012, from http://www.bath.ac.uk/mech-eng/sert/embodied_

**Meil J., Bushi L., Garrahan, P., et al. (2009). "Status of Energy Use in the Canadian Wood Products Sector."

Transboundary Air Pollution Measurements in Ireland from 2005 to 2010

Michael Geever¹, David Dodd², Margaret Ryan³, Stefan Leinert²

¹Centre for Climate and Air Pollution Studies (C-CAPS), Ryan Institute, NUI Galway

²EPA, Clonskeagh, Dublin 14

³Met Éireann, Glasnevin, Dublin 9

Corresponding author email: michael.geever@nuigalway.ie

Keywords: Transboundary air pollution, air quality monitoring

As part of the Transboundary Air Pollution theme under the EPA Climate Change Programme (CCRP), measurements of a number of atmospheric parameters known to be connected with air pollution have been conducted at a number of strategically located stations around Ireland since about 2005/2006. The three main stations are located at Carnsore Point, Co. Wexford, Malin Head, Co. Donegal, and Mace Head, Co. Galway, with smaller instrument packages deployed at Oak Park, Co. Carlow, Johnstown Castle, Co. Wexford, Glenveagh National Park, Co. Donegal and Valentia Meteorological Observatory, Caherciveen, Co. Kerry. Although measurements of all parameters did not begin simultaneously, most measurements were fully operational by 2005. The aerosol measurements included atmospheric aerosol total number concentration (cm^{-3}), black carbon mass loading (ng m^{-3}), total particulate mass (PM_{10}), aerosol light scattering coefficient and daily high-volume bulk filter samples for PM_{10} chemical analysis. Precipitation samples were collected at three of the inland stations, Oak Park, Johnstown Castle and Glenveagh National Park, and some gas phase measurements were conducted for a time at Carnsore Point and Malin Head. Statistical analyses of five years of data provide a good estimate of variability and background values of black carbon and aerosol total number concentration. Similar analyses of the PM_{10} aerosol chemical composition data obtained from the bulk filter samples yield values for some of the key aerosol constituent species. Partition of the data based on wind sector provides information both on pollution sources and on typical characteristic background levels at these locations.

Estimation of Deforestation in Ireland 2000 – 2012; a Comparison of Assessment Methods

John Devaney¹, John O'Halloran^{1,2}, John Redmond³

¹*School of Biological, Earth and Environmental Sciences, University College Cork, Enterprise Centre, Distillery Fields, North Mall, Cork, Ireland*

²*Environmental Research Institute, University College Cork, Lee Road, Cork, Ireland*

³*Forest Service, Department of Agriculture, Food and the Marine, Johnstown Castle Estate, Wexford, Ireland*

Corresponding Author Email: j.devaney@ucc.ie

Keywords: deforestation, land-use change, National Forest Inventory

Since its establishment in 1994, the United Nations Framework Convention on Climate Change has required Annex 1 Parties to provide an annual inventory of GHG emissions and removals. As forests act as an important and manageable carbon sink, a common challenge is to quantify spatial and temporal patterns of forest carbon. Over the last half of the 20th century, forest cover in Ireland increased from less than 1% to 11% and it is a government aim to increase forest cover to 17% by 2030. Results from Ireland's first National Forest Inventory (NFI) in 2006 indicate that 6,000 (\pm 3,000) ha of forest land was deforested during 2000 - 2006. Such deforestation may have a significant impact on GHG emissions, as well as negatively affecting biodiversity and ecosystem services provided by forest habitats. However, a recent review identified weaknesses in the current system used to track forest related land-use change. The objective of this project is to report on the accuracy and validity of current methods used to estimate deforestation in Ireland. A combination of high resolution aerial photography, satellite imagery and ancillary datasets are being used to provide a spatially explicit map of deforestation in Ireland (2000 – 2012) in two study regions. This base map will be compared with estimations of deforestation provided by other land-use change assessments (NFI, CORINE, and other spatial datasets held by the Forest Service), and used to determine an optimal methodology for reporting forest related land-use change. Preliminary results indicate a high proportion of land-use transitions from forest to grassland, although trends vary between study regions. In surveyed counties, average size of each deforestation event was <2 ha, highlighting the need for high resolution estimation procedures. The findings of this research can be used to inform future policies aimed at decreasing deforestation in Ireland.

The Interaction of a Large Scale Sea-Water Pumped Hydro Energy Storage Plant, Proposed Electrical Interconnectors and Large Scale Wind Farms with the Irish Energy System

McCarthy F., Harrington J., O' Driscoll, L.

Cork Institute of Technology

Corresponding Author Email: fionanmccarthy@gmail.com

Keywords: Hydro Energy Storage, Electrical Interconnectors, Wind Energy, Irish Energy System.

Over the past decade where Ireland sources its energy has begun to change. Historically oil, natural gas and peat have formed the basis of our energy requirements. Sources such as natural gas and renewable energy are now becoming an increasingly important energy source for Ireland. These changes in energy source have been driven by economic, social, legal, domestic and international commitments which has the potential to ensure Ireland becomes energy independent. This paper assesses the impact that a large scale seawater PHES plant and proposed wind farms and interconnectors may have on the Irish energy system. Ireland's abundance of renewable sources presents many opportunities for Ireland to become, not just energy independent, but also an energy exporter. It has been estimated that Ireland can produce three times more energy from renewable sources than it would use and up to 2.5% of total projected European electricity demand by 2050. This excess energy can either be stored (e.g. pumped storage) or exported for use (electrical interconnectors).

A software package has been developed to assess the technical, power, environmental and economic elements of a project or site. The ability of the pumped storage plant and interconnectors to allow wind energy onto the system is presented. The research has shown that the optimum configuration is a combination of multiple medium sized interconnectors, circa 500Mw alternating current interconnectors, connected to different grid systems, in conjunction with one large scale pumped-storage plant. By 2020 it is estimated that Ireland could produce 4694Mw of wind representing 11970 GWh in a scenario where additional interconnectors are not constructed to export energy, with additional interconnectors this rises to 7145Mw wind representing 19,832GWh, resulting in a surplus for the cooperation mechanism of 6.6%. Without pumped storage the scenario of exporting power, with no demand, could arise at high wind penetration levels. This shows that the construction of interconnectors to alternative markets such as France and Britain markets will offer some security towards price and supply, but it also shows that it could have the potential to limit the growth of Ireland's renewable energy industry due to the availability of cheaper electricity from France and the UK in the short term.

The developed model has been tested against existing operational sites where Pumped Hydro Energy Plants have been installed. The effect of the proposed construction of circa 3000Mw of wind energy and associated interconnectors to export wind energy to the UK is also being analysed. The positive effect of a large scale PHES plant on these projects by allowing balancing and phase control at "source" is shown. The analysis shows that interconnectors provide more stability and security of supply during periods of excess power production but the opposite can result in periods of high demand with restricted or expensive supply options. Storage provides security of supply and grid stabilisation. Analysis of the research shows that the construction and development of electrical interconnectors in conjunction with large scale storage plans and wind farms provides a comprehensive solution to Ireland's future energy requirements.

Metaproteomics: Grass Anaerobic Digestion

Aoife Joyce^{1,2}, Aoife Vaughan^{1,2}, Vincent O'Flaherty^{1,2} & Florence Abram^{1,2}

¹*Microbiology, School of Natural Sciences, NUI Galway, Galway, Ireland*

²*Ryan Institute for Environmental, Marine and Energy Research, NUI Galway*

Keywords: Anaerobic Digestion, Grass, Renewable Energy

Renewable energy is becoming a more attractive alternative to fossil fuels as an energy source due to the increasing concern for the welfare of our environment. Anaerobic digestion is a well established technology for the treatment of liquid wastes and can also generate a renewable energy in the process. Recent studies have been carried out with the view to use grass and solid waste as feedstock for AD-mediated biofuel (methane) production. AD consists of a chain of biological reactions, namely hydrolysis, acidogenesis, acetogenesis and methanogenesis, which are carried out by the sequential and cooperative action of various microbial trophic groups in the absence of oxygen to produce methane. There is relatively little known about the functional activities of the microbial consortia involved in AD, with no information available on the AD of grass. Advancement of the process relies on a greater knowledge and understanding of the behaviour of these microbial populations. Metaproteomics investigates all proteins expressed within an ecosystem at a particular point in time and should allow for exposing new functional genes and metabolic pathways and establishing the link between identity and functionality (protein assignment). The extraction of proteins from anaerobic mixed communities is proving to be especially complex. Metaproteomics is demonstrated as a powerful tool with the ability to uncover key biochemical metabolic pathways occurring in specific bioreactor processes. In this work we demonstrate the feasibility of metaproteomics applied to an anaerobic digester containing perennial rye grass. Proteins were successfully extracted from biofilms attached to the grass, and initial experiments have proven successful for protein identification. Such an approach allows us to inform on the structure-function relationships occurring in the complex microbial communities from the perennial rye grass bioreactors, allowing for the optimisation of the process while providing a renewable energy source.

**You are Where and When You Eat:
Seasonal and Spatial Variability in Edible Seaweed Bioactives**

M. Schmid, F. Guihéneuf and D. Stengel

Botany and Plant Science, School of Natural Sciences; and Ryan Institute for Environmental, Marine and Energy Research, National University of Ireland, Galway

Corresponding Author Email: m.schmid2@nuigalway.ie

Keywords: macroalgae, functional food, health, bioactives, environmental factors

To cope with the extreme conditions of their environment, seaweeds produce a variety of chemical compounds like phycobilliproteins, carotenoids and polyunsaturated fatty acids. Many of them have bioactive properties, including antioxidant and anticancer activities, with multiple applications in the human food and health market. Particularly the steadily growing functional food sector has an increasing demand for naturally-derived bioactive compounds such as omega-3 fatty acids; besides microalgae, seaweeds represent an important source to meet these requirements. However the composition and quantity of functional compounds in seaweeds can be highly variable and is dependent on abiotic (environmental) conditions, including temperature, light and nutrient availability, and single and synergistic effects of these on the chemical composition of macroalgae are not fully understood. In order to achieve optimised levels and preferable compositions of bioactives, an improved knowledge of the effects of extrinsic factors that control their production is necessary.

To address this scientific gap, a range of Irish macroalgae, including species of red (Rhodophyta), brown (Phaeophyceae) and green (Chlorophyta) seaweeds, were collected at different seasons and bioactive profiles compared. For a detailed investigation of spatial effects, key species were identified and sampled at sites characterised by different environmental regimes, including sites on the Irish north, south, east and west coast. At the relevant collection sites, abiotic factors were monitored to establish the potential source of variability in chemical composition of seaweeds. The screening of bioactives in samples collected from the wild is complemented by laboratory cultures of macroalgae that aim to achieve high levels of bioactives in target species under specific culture conditions.

As part of the NutraMara Marine Functional Foods Initiative, this study provides a first comprehensive overview of the bioactive profiles of key seaweed species and a detailed inventory of polyunsaturated fatty acids in common Irish seaweeds. The results can be used in the future by industry to select specific harvesting sites and seasons, and will provide a baseline for future optimised production of species of commercial interest in culture.

Child Car Seats: a habitat for dust mites and reservoir for harmful allergens?

David Clarke^{1,2}, Dr. Mike Gormally¹, Dr. Miriam Byrne²

¹*Applied Ecology Unit, School of Natural Sciences; and Ryan Institute, National University of Ireland Galway*

²*School of Physics; and Ryan Institute, National University of Ireland Galway*

Corresponding Author Email: davejclarke@gmail.com

Keywords: dust mites, allergens, child car seats

Dust mites which produce allergens derived mainly from mite fragments and faecal pellets, accumulate readily in soft furnishings and carpets in the home. Mechanical disturbances such as vacuuming and bed-making cause these allergens to become airborne and when inhaled, can cause reactions such as asthma, rhinitis, dermatitis and eczema in sensitized people (approximately 1-2% of the global population). While these conditions are aggravated by people's increased tendency to remain indoors, little quantitative research has been conducted on the role played by cars in facilitating dust mite populations. Although children in western Europe spend increasing amounts of time in cars (approximately 225 hours per person per year, as estimated by the National Travel Survey, Department for Transport, UK, 2009), no studies have yet been undertaken to quantify dust mite populations in child car seats or to determine whether levels of dust mite populations, in conjunction with time spent in cars by children, is sufficient to elicit an allergic response. This provided the incentive for this project, whereby current mite-promoting conditions in cars with particular reference to child car seats as a habitat for dust mites were determined by developing a quantitative mite sampling strategy in conjunction with recording environmental variables and analysing questionnaires. Results show that over 13% of the child car seats analysed exceeded the threshold for sensitisation for genetically predisposed individuals of 100 mites/gram of dust, highlighting a cause for concern from an epidemiological point of view. The results of this study will be used to develop cost effective mite mitigation strategies based on environmental conditions which indicate optimum growth conditions for dust mite populations in cars.

**REVITALIZING EUROPEAN ENVIRONMENTAL HEALTH LAW AND POLICY:
CAN ADAPTIVE REGULATION HELP?**

William Onzivu

Bradford University Law School, Bradford, UK

Corresponding Author Email: w.onzivu@Bradford.ac.uk

This paper discusses some key issues and challenges facing contemporary European environmental health law and policy. It identifies relevant legal and policy regimes as well as drivers for the promotion of the health objective in Europe. It examines the strengths and limits of evolving European legal and policy responses to the protection of environmental health in a comparative globalized perspective. It explores prospects for optimizing health protection in Europe. It attempts to achieve this by proposing an adaptive regulatory framework to re-invigorate the current legal and policy regime governing European environmental health law. The paper concludes by discussing the implications for domestic environmental health law and policy with a focus on the legal regime for protecting environmental health in the United Kingdom.

***Salmonella enterica* can readily form a biofilm in the environment and is highly resistant to eradication with chemical disinfectants**

M. Corcoran^{1,4}, D. Morris^{1,4}, N. De Lappe², J. O'Connor², P. Lalor³, P. Dockery^{3,4}, M. Cormican.^{1,2,4}

¹*Antimicrobial Resistance and Microbial Ecology (ARME) group, School of Medicine, National University of Ireland Galway*

²*National Salmonella Shigella and Listeria Reference Laboratory, Galway*

³*Discipline of Anatomy, School of Medicine, National University of Ireland, Galway*

⁴*Centre for Health from Environment, Ryan Institute, National University of Ireland, Galway*

Keywords: *Salmonella enterica*, biofilm formation, disinfectants, food contact surfaces

Microbial biofilm formation can pose a serious threat to public health. *Salmonella* can survive in the environment for up to ten years and can become established in the environment of food production premises. Eradication of an established biofilm with cleaning and chemical biocides is difficult. The objectives of this work were to examine the density of biofilm growth on a variety of surfaces likely to be present in the indoor and outdoor environment and to assess impact of disinfectants.

The CDC biofilm reactor (CBR) was used establish *Salmonella enterica* biofilm on glass, steel, polycarbonate, tile and concrete. The CBR was operated under batch-phase for 24 -hours followed by continuous-flow for 24-hours (standard-biofilm) or 144-hours (mature-biofilm). To assess cell reduction concrete coupons were treated with sodium hypochlorite, sodium hydroxide and benzalkonium chloride.

All strains studied were able to form a biofilm on all surfaces. In most incidences, biofilm cell density increased with age, from 48 to 168-hours. For the 48 hour biofilm the *S. Agona* and *S. Typhimurium* strains formed a more dense biofilm than *S. Enteritidis* ($P<0.05$). The *S. Agona* and *S. Enteritidis* strains formed a more dense biofilm at 168-hours compared with 48 hours. Biofilm was significantly more dense on tile than any other surface ($P<0.05$). Biofilm was significantly more dense on concrete than glass, steel and polycarbonate ($P<0.05$). Only sodium hydroxide resulted in eradication of *Salmonella* from the 48-hour biofilm and it was not possible to kill the 168-hour biofilm with any of the agents studied.

Salmonella can readily form a biofilm on all materials studied and once firmly established (168-hours) none of the chemical agents studied achieved eradication. This serves to emphasize the importance of bio-security in farms and food processing environments as prevention of the introduction of contamination appears to be the most practical approach.

Decadal trends of atmospheric pollution at Mace Head, Ireland and over Europe

D. Ceburnis, S. Gerard Jennings and Colin D. O'Dowd

School of Physics; and Centre for Climate and Air Pollution Studies (C-CAPS), Ryan Institute, National University of Ireland, Galway

Keywords: pollution, aerosol, sulphate, trend, Mace Head

A number of air pollutants including particulate matter (PM) contribute to regional acidification, eutrophication, and air pollution across Europe and here in Ireland. Under the UN-ECE Convention on Long Range Transboundary Air Pollution [CLRTAP], member countries have an obligation of addressing scientific issues such as the effect of hemispheric transport of air pollutants on air pollution concentration in the Northern Hemisphere for a range of air pollution parameters. This necessitates the development and sustained support of an integrated system of observational data sources and of predictive models in order to address these important issues and related scientific questions such as apportionment of sources to receptor regions. During the last decade a robust network of observations has been created in Ireland and significant trends have recently emerged manifesting the value of continued long-term measurements. The Mace Head Atmospheric Research Station has got one of the longest uninterrupted and scientifically validated observational data records in Ireland and Europe.

Nss sulphate, nitrate and ammonium concentrations have been decreasing in Ireland and over Europe over the last decade at similar pace and along the steadily declining emissions. More significant trend emerged after 2005 and concentrations may reach Northern Hemisphere background in 2015-2030. Chemical species concentrations are markedly different in westerly and easterly air masses pointing at import-export pollution budget in Ireland and Europe.

Atmospheric particulates have significant climatic implications through direct (scattering of incoming solar radiation) and indirect (cloud droplet formation and cloud lifetime) effects. As concentrations of atmospheric pollutants have been decreasing, the amount of total radiation reaching the ground has been increasing over the last decade. Clearly, the atmosphere has been brightening over Mace Head as the atmosphere became cleaner, but it remains to be seen if the pattern is consistent over the larger European region.

Eco-Driving Policy & Technology: Benefits, Limitations & Future Research

Md. Saniul Alam and Aonghus McNabola

Dept of Civil, Structural & Environmental Engineering, Trinity College Dublin, Ireland

Corresponding Author Email: alamms@tcd.ie

Keywords: Eco-driving, CO₂, emission, modelling, traffic, climate

Eco-Driving has received significant attention in literature and among policy makers for its claimed benefits in reducing CO₂ emissions and fuel consumption. Many investigations of Eco-Driving policy have reported potential reductions in fuel consumption and CO₂ emissions ranging from 5% to 40% across various jurisdictions and initiatives. Eco-Driving can be achieved through several methods, such as the addition of advanced vehicle technology (e.g. controlling acceleration/speed), and/or the energy-efficient choice of route (Eco-routing) to reduce idling, and time in traffic congestion, etc. Many investigations claim that these methods cause lower emissions from a single vehicle trip. However, a rigorous review of Eco-Driving policy and its claimed benefits highlighted negative impacts of Eco-Driving which were often neglected in previous research. These include increases in accident risk, and CO₂ emissions at traffic network level. Although the emission reduction benefits can be achieved in certain circumstances such as in arterials routes or bus-only lanes etc., uncertainties exists for complex traffic situations like city centres, and thus provides grounds for further research. In addition, conflicting views exists in the literature for common network level impacts. Technological aids for Eco-driving only on the Eco-routes in general may be advantageous. However, the existing devices providing such technological aids also have limitations. None of them offers combined information to the travellers, e.g. pre-trip, during trip and post trip information. In addition, aiding devices do not often work in real-time and thus, their information is often ineffective. Furthermore, the methodology behind many Eco-Driving devices for emission estimation has also scope for improvement. This study concludes that Eco-Driving is often promoted worldwide without any rigorous level of assessment on its possible impact at network level and its suitability in differing contexts. Thus, the study discusses contexts for Eco-Driving promotion, and improvements for trip-by-trip emission modelling for Eco-Driving purpose.

The Effect of Irrigation with Wastewaters on the Abundance of Earthworms, Springtails and Mites in Established Short Rotation Coppice (SRC) Willow

Mr. J. Feighan

IT Sligo

Corresponding Author Email: s00021638@mail.it.sligo.ie

Keywords: Biodiversity, Waste-water Irrigation, Short Rotation Coppice (SRC), Soil ecology

This study investigates the effect of irrigation with wastewaters on the abundance of earthworms, springtails and mites in established Short Rotation Coppice (SRC) willow. Willow crop has generated substantial interest in the past few years through its use as an alternative carbon neutral fuel in wood chip heating systems. Another potential use of SRC willow is to bio-remediate wastewaters although it is imperative in this regard that soil quality does not suffer. The protection of soil is addressed in the EAP EU soil thematic strategy.

Two different sites were used to investigate the effects of irrigation on the abundance of earthworms, springtails and mites. Site one was treated at a constant rate with primary effluent from a local wastewater treatment plant. Site two was treated with agricultural effluent applied at three different irrigation rates. An in-situ chemical extraction method was used to determine the abundance of earthworms while a heat extraction method was used to determine the abundance of springtails and mites. Limited physical and chemical analysis was also undertaken.

The fieldwork for the project is underway but initial findings indicate irrigation with wastewaters results in a reduction in the abundance of earthworms, springtails and mites. The reduction is most marked at the higher application rates of agricultural wastewaters.

Climate and Species Identities Affect the Composition of Four-Species Grassland Mixtures Over Three Years and Across 23 Sites

Caroline Brophy¹, John Finn², Áslaug Helgadóttir³, Laura Kirwan⁴, Andreas Lüscher⁵, Maria-Teresa Sebastià^{6,7}, Matthias Suter⁵, John Connolly⁸

¹*Department of Mathematics and Statistics, National University of Ireland Maynooth, Maynooth, Co Kildare, Ireland*

²*Teagasc, Environment Research Centre, Johnstown Castle, Co. Wexford, Ireland*

³*Agricultural University of Iceland, Keldnaholti, 112 Reykjavík, Iceland*

⁴*Waterford Institute of Technology, Cork Road, Waterford, Ireland*

⁵*Agroscope Reckenholz-Tänikon Research Station ART, Reckenholzstrasse 191, 8046 Zurich, Switzerland*

⁶*Dept HBJ, ETSEA, Universitat de Lleida, Av. Rovira Roure 191, 25198 Lleida, Spain*

⁷*Centre Tecnològic Forestal de Catalunya, Ctra Sant Llorenç km 2, 25280 Solsona, Spain*

⁸*School of Mathematical Sciences, University College Dublin, Dublin 4, Ireland*

Corresponding Author Email: caroline.brophy@nuim.ie

Keywords: grass, legume, climate change, relative abundances.

Changes in the relative abundances of species in grassland mixtures over time may be driven by the identities of species in the system, species initial abundances and climatic factors. We tested the effects of these drivers in an agrodiversity study conducted at 22 sites across Europe and one site in Canada. At each site, four-species mixtures were established at a range of differing initial relative abundances and two seed densities giving 22 plots at each site and a total of 506 plots. The four grassland species were classified as a fast-establishing grass, a temporally persistent grass, a fast-establishing legume and a temporally persistent legume. The annual biomass yield of each species for each plot was recorded for three years, and the relative changes in biomasses between year 1 and year 3 were modeled as linear functions of the identities of the species, the initial species' biomasses in year 1 and climatic variables to predict changes in relative abundances over time. We found that species identity was the strongest determinant of changes in relative abundances, favouring the growth of the temporally persistent grass species. There were effects of species initial biomasses which altered the impact of some of the species identities but did not dampen the strong identity effect of the temporally persistent grass species. Increased site daily maximum temperature had a beneficial effect on the relative abundances of the two grass species compared to the two legume species. Over the three year period, the temporally persistent grass species became, on average, the most dominant species in these grassland systems. Understanding the drivers of grassland dynamics in agronomic systems can aid the development of well-balanced mixtures, thereby promoting sustainable management practices.

The Relationship Between Stormwater Pollution and Rocky Shore Assemblages

Chloe Kinsella and Tasman Crowe

*UCD School of Biology and Environmental Science, University College Dublin, Belfield,
Dublin 4, Ireland*

Corresponding Author Email: Chloe.Kinsella@ucdconnect.ie

Keywords: stormwater, marine biodiversity, intertidal assemblage, climate change

Increased levels of anthropogenic stressors in the marine environment are leading to complex changes in its diversity and functioning. Stormwater has been identified as an anthropogenic stressor which negatively impacts water quality, but its ecological effects remain unclear. This study aimed to identify the relationship between stormwater pollution and rocky shore assemblages. In April 2012, intertidal assemblages were sampled on rocky shores at a range of distances (0m, 10m, 20m, 60m, and 100m) from three stormwater outfalls north of Dublin. Preliminary results show that, in general, biodiversity increased with increasing distance from the stormwater outfall. For most variables, the relationship was non-linear in all three locations, with a step up in diversity between 20m and 60m. Multivariate analysis identified significant differences in assemblage structure between 0m and 100m, and 10m and 100m, at all three locations. Pollutants such as metals and polycyclic hydrocarbons may be the cause of reduced diversity in assemblages closer to the stormwater outfall. With the likelihood of increased rainfall in future years due to a changing climate, stormwater output is predicted to increase. The findings of this survey, along with planned experimental stormwater simulations in the field, may be used to improve the effectiveness of stormwater management and remediation approaches to benefit ecosystem functioning and provision of ecosystem services.

Modelling Pollen Dispersal and Reproductive Success of Invasive *Spartina Anglica* (Common Cordgrass) in Mud Flat Environment

James T. Murphy, Mark Johnson

Ryan Institute for Environmental, Marine and Energy Research, National University of Ireland, Galway

Corresponding Author Email: james.murphy@nuigalway.ie

Keywords: *Spartina anglica*, biological invasion, pollen dispersal, spatial modelling

Spartina anglica is a rhizomatous perennial salt marsh grass that forms extensive meadows via clonal growth in inter-tidal coastal zones. *S. anglica* appeared in Britain in the late 19th century as the result of a hybridization (F2 generation) between *S. maritima* and introduced *S. alterniflora*. Since then, the spread of *S. anglica* has drawn much concern due to its ability to invade coastal habitats and convert them into cordgrass monocultures thus altering native and commercial food webs and threatening natural biodiversity. The patterns of invasion of *Spartina* species are amenable to spatially-explicit modelling strategies that take into account both temporal and spatio-temporal processes. In this study, an agent-based model of *Spartina* growth on a simulated mud flat environment was developed in order to study the effects of spatial pattern and seedling distribution on the invasion dynamics of the population.

It has been demonstrated that pollen limitation plays an important role in limiting reproductive potential in *Spartina* populations during the initial phases of invasion and can contribute to a pronounced allee effect (i.e. depressed rate of seed production when individual density is low). We have incorporated a modified version of Sutton's Equation for dispersion and deposition of particulate matter into our spatial model in order to represent the pollen dispersal patterns of *Spartina*, taking into account the physical characteristics of the pollen grains as well as local environmental conditions such as wind speed, turbulence and atmospheric stability. By incorporating this into our existing spatially-explicit model of *Spartina* growth we can study the effects of spatial pattern and population density on reproductive potential from a theoretical perspective and analyse their impacts on invasion success. This can give important insights into the population dynamics of invasive *S. anglica* populations in order to better inform efforts to control or eradicate infestations.

An integrated approach to conserving specific Annex I habitats in the Burren, Co. Clare

O'Loughlin Irwin, S.A.¹, Sheehy Skeffington, M.¹, Parr, S.², Dunford, B.², Williams, B.²

¹ Botany and Plant Science, School of Natural Sciences, NUI Galway.

² Burren Farming for Conservation Programme (BFCP), Old Schoolhouse, Carron, Co. Clare.

Corresponding Author Email: sarahann.o@gmail.com

Keywords: Alpine heath, plant communities, habitat management, *Molinia caerulea*, *Arctostaphylos uva-ursi*, farming.

The Burren is internationally renowned for its biodiversity and supports many habitats of European importance (Annex I-listed under the EU Habitats Directive) that depend on farming, in particular low-input grazing systems. The Burren Farming for Conservation Programme (BFCP) is a locally-targeted, research-based, programme which relies on a partnership between the farming community, agricultural advisors and ecological scientists to develop best practice guidelines for farmers to sustainably manage habitats of conservation importance. Given the complexity of Burren habitats and their management requirements, further targeted research is required to underpin policy and guidelines for farming practice. Annex I habitats in the Burren, such as Alpine Heath, are under threat from changes in land-use and their conservation status is considered poor. In certain areas, vigorous species such as *Calluna vulgaris* and *Molinia caerulea* are increasing at the expense of less frequent species. It is essential to devise management prescriptions in order to best conserve these habitats. This project will focus on vegetation dominated by *Arctostaphylos uva-ursi* and/or *Empetrum nigrum*. The vegetation will be mapped and classified in relation to soils and microhabitat characteristics and areas noted where *Calluna* or *Molinia* are encroaching. Farmer questionnaires will document past and recent land-use of target sites and, through experiments, the effects of a range of cutting regimes on the Alpine heath plant communities will be analysed. The further development of methodologies for the management of such habitats in the Burren will inform future measures under the BFCP and can be modified and applied to other low-intensity farming regions of high nature value.

Species and population diversity of Maerl-forming corallines (Corallinales: Rhodophyta)

Jazmin J. Hernandez-Kantun

Irish Seaweed Research Group, Ryan Institute, National University of Ireland, Galway

Corresponding Author Email: j.hernandez2@nuigalway.ie

Keywords: Maerl, *Phymatolithon calcareum*, *Phymatolithon purpureum*, Phylogeography

Maerl beds are important habitats due to the high diversity of organisms (flora and fauna) associated and with a monetary value due to their commercialization. This habitat is formed by branched calcareous red algae in the order Corallinales (Rhodophyta) and they have been considered for protection by the Habitats Directive Natura 2000 network and the OSPAR network of MPAs for the NE Atlantic. In general, coralline algae have been difficult and sometimes impossible to identify using morphological information due to their phenotypic plasticity and no information on their molecular diversity is available. Molecular diversity among and within species is waiting to be described and possibly used for conservation strategies. In this study, I present new data on the molecular diversity of maerl-forming species from Europe (Mediterranean and Western Europe) at species and population level. Information obtained from *psbA* gene and SSU for species level diversity showed that molecular diversity of maerl-forming corallines is higher than previously believed for the genera *Lithophyllum* from where several cryptic species were found for some morphospecies (e.g. *Lithophyllum dentatum*, *L. incrustans* and *L. margaritae*). Population level diversity was obtained using three markers, *psbA*, *cox2-3* and ITS, for *Phymatolithon calcareum*, *P. purpureum* and *Lithothamnion corallioides*. The three species presented a differential phylogeographic (population) pattern, where *Phymatolithon calcareum* presented two main groups (Mediterranean and Western Europe) supported by the three markers and *Phymatolithon purpureum* has an important presence in Irish maerl beds and its presence was detected in the Mediterranean. This information can be used to understand connectivity between the Mediterranean and Western Europe maerl beds and to identify hot spots of diversity; both approaches are important for monitoring and conservation strategies at local and international level.

Development of a Computational Model to Evaluate Personal Exposure to Particulate Matter in Indoor Microenvironments

James McGrath¹, Miriam Byrne¹, Mike Ashmore², Andrew Terry² and Sani Dimitroulopoulou³

¹Centre for Climate and Air pollution Studies (C-CAPS), Ryan Institute, National University of Ireland, Galway

²Environment Department, University of York, York

³National Centre for the Environment and Sustainable Development, Kifissia, Greece

Corresponding Author Email: jamesmcgrath1986@gmail.com

Keywords: modelling, ventilation, PM, Residential Emissions.

This abstract outlines the development of a computational model to determine the levels of air pollution in indoor microenvironments, and hence, the exposure of individuals. The European Commission, along with the Clean Air for Europe Programme (CAFE), have highlighted particulate matter (PM₁₀ and PM_{2.5}) as the pollutants of most concern. The importance of indoor and outdoor air pollution as contributors to exposure has been previously highlighted. However indoor exposures need to be further separated into the contributions of indoor sources and the penetration of outdoor pollution, for the proper management of air quality to be fully evaluated. Modelling approaches are essential if this is to be effectively achieved.

A microenvironmental approach is described, whereby the levels of particulate matter are determined based on the location and the activities taken place in each individual zone. Infiltrated external air pollution and indoor sources are considered, as well as indoor transport processes such as aerosol deposition. In the current project, an existing air pollution model is further enhanced, to include improved time resolution, additional rooms to more accurately represent the residential environment, inclusion of additional sources in the model e.g. (variation in cooking style, candles, incense and solid fuel fires), variation in internal and external opening and closing of doors.

It is envisaged that the model will ultimately be able to simulate exposure to PM₁, PM_{2.5} and PM₁₀, and will allow the demonstration of the effect on exposure of seasonality variation and the effects peak traffic flows have on indoor exposure. The model has the potential to aid in regards to new planning regulations and creation of new legislation, especially when assessing the impact of adjusting a building's heat retention, on indoor air quality.

Promoting Active Travel in Cities: The Role of Permeability

Richard Manton^{1,2}, Rosie Webb³, Eoghan Clifford^{1,2}

¹*Civil Engineering, College of Engineering and Informatics, NUI Galway*

²*Ryan Institute for Environmental, Marine and Energy Research, NUI Galway*

³*Department of Housing, Galway City Council*

Corresponding Author Email: r.manton1@nuigalway.ie

Keywords: permeability, active travel, cities, carbon emissions, built environment

Cycling in Irish cities is on the rise; in the last five years, modal share of cycling has increased by 34% in Dublin, 33% in Cork and 5% in Galway although cycling modal shares in these cities are still relatively low: 7.6%, 2.9% and 5% respectively. Cities are far outstripping rural towns, in terms of modal share of cycling, and are expected to exceed the national cycling modal share target of 10% by 2020. Meanwhile, in every city except Dublin, walking has fallen nationally from 11.7% to 10.4% in the last five years and driving a car to work has increased significantly, and is responsible for the release of approximately 6 million tonnes of CO₂e per year.

One major impediment to active travel in cities is the existence of impermeable suburbs and city centres. Permeability is the ease, directness and ambience of movement through the built environment. Filtered permeability is the concept that active transportation modes should be separated from other modes and given an advantage in ease, directness (time or space) and/or ambience. Impediments to permeability can include: cul-de-sacs, walls between housing estates, hedges, closed alleys, lack of direct paths and roundabouts. A lack of permeability is a major issue in Ireland: most residential development has been built in the past 20 years and has taken the form of curvi-linear cul-de-sacs. These are not conducive to bicycle or pedestrian access and can lead to increased car-dependence.

Improvements to permeability have been linked to increases in active travel rates and can yield improved public health, reduced carbon emissions and large (positive) benefit-cost ratios. This research examines a case study of residential districts in Galway City, conducted in collaboration with Galway City Council. A permeability audit of the study area was carried out, highlighting all impediments along with informal walking and cycling routes. This information was added to the formal roads and paths to form a network in ArcGIS. Running network analysis and using indicators of permeability, it was possible to assess and demonstrate the permeability of each area. Recommendations are presented for the improvement of permeability along with methods of engaging communities to allow for a bottom-up design approach. Such a methodology can be used by researchers and planners in other cities to aid in urban planning and to promote more active and environmentally friendly cities.

Acknowledgement

This research was conducted in collaboration with Galway City Council and is funded by the National Sustainable Transport Office at the Department of Transport, Tourism and Sport and by the College of Engineering and Informatics at the National University of Ireland, Galway.

A New Geochemical Atlas of European Agricultural Soils

Patrick O'Connor and the GEMAS Project Team

EuroGeoSurveys Geochemistry Expert Group

Corresponding Author Email: pjoconnor30@gmail.com

Keywords: agricultural soil quality, geochemical mapping, REACH Directive

The implementation of the EU REACH Directive (EC 2006) and the pending Soil Protection Directive require reliable and harmonised information on soil quality at the European scale. To achieve this aim, the GEMAS Project was conceived by EuroGeoSurveys (the association of Geological Surveys of Europe) and was supported financially by Eurometaux. GEMAS stands for GEochemical Mapping of Agricultural Soils in Europe. The project has delivered comparable exposure data for metals in agricultural (arable) and grazing land soils across Europe for the first time as well as data on soil properties known to influence the bioavailability and toxicity of metals in soils.

Some 2211 samples of agricultural soil (0 – 20 cm depth range) and 2118 samples of grazing land soil (0 – 10 cm depth range) were collected during 2008 across 33 European countries at an average sample density of 1 site/2500 km.sq. Samples were analysed by ICP-MS for 53 elements following an aqua regia extraction and by XRF for >40 elements; additionally CEC, TOC, total C, total S, pH, grain size, Kd values for selected metals, MIR, Pb isotopes and Sr isotopes were determined. All determinands were measured at one laboratory only. The outcome is the creation of one of the highest quality, harmonised, datasets on soil quality available in Europe today.

The element abundance data determined for European soils range over 4 to 5 orders of magnitude for many elements. The spatial distribution patterns seen in the geochemical maps are robust and are primarily due to geogenic causes. The effects of anthropogenic soil pollution due to agricultural practices, mining activity, industrial activity and urbanisation are seen only at a local scale. Some climatic effects are also evident. GEMAS shows clearly that the methodology used for continental-scale mapping of the geochemical environment is scientifically sound and transferable.

Dose and Personal Exposure to Air Pollution in Office Workers in Dublin, Ireland: Measurements, Analysis & Policy Implications

A. McCreddin, B.M. Broderick, L.W Gill, & A. McNabola

Department of Civil, Structural & Environmental Engineering, Trinity College Dublin, Ireland.

Corresponding Author Email: amcnabol@tcd.ie

Keywords: Air Pollution, PM₁₀, Personal Exposure, Activity Patterns, Dose

An experimental assessment of personal exposure to PM₁₀ in 59 office workers was carried out in Dublin, Ireland. 256 samples of 24 hour personal exposure were collected in real time over a 28 month period. The investigation included an assessment of the uptake of pollutants in the lungs of subjects during various daily activities using a Human Respiratory Tract (HRT) Model. Personal PM₁₀ exposure data for each subject was collected using a real-time nephelometer device, which recorded concentrations at two minute intervals. Sampling subjects were also required to complete activity diaries and carry a GPS device with them at all times during sampling in order to record their movements.

The study population was found to spend over 90% of their time indoors. The mean 24 hour PM₁₀ personal exposure for the study population was found to be below the EPA daily limit value. However, a number of indoor microenvironments were highlighted in which high concentrations could be encountered, and these included cafés, public houses, and recreation facilities such as gyms. Exposure to ETS was also found to be a large factor in raising personal exposure concentrations among subjects. The lowest personal concentrations were consistently found when the subjects were sleeping.

Analysis of the uptake of PM₁₀ in the respiratory system for each subject was largest when individuals were in their workplaces. While large uptake of particulates was also found for other activities and locations, such as during recreation/sport and in the home. The uptake for male subjects was found to be higher than female subjects owing to their greater lung capacity. The results of this investigation highlight the importance of indoor air quality on human health particularly in the workplace and home, whereas air quality in other microenvironments, such as commuting, had a minor influence on overall exposure and dose.

Designing Building Facades to Reduce Environmental Noise

Dr O. Kinnane

Trinity College Dublin, Dublin, Ireland

Corresponding Author Email: oliver.kinnane@tcd.ie

Environmental noise is strongly correlated with high blood pressure and heightened stress levels. A quiet environment is increasingly seen by residents, planners and developers as crucial for promoting sustainable urban living. Growing public concern has given rise to new and pending noise-related legislation across Europe and in Ireland. To date building acoustic performance has focused on insulating the building interior from external noise, however, proposed legislation will force developers and planners to consider specifying products that reduce levels of reflected street noise.

This paper focuses on the development of novel products for cladding systems for new and for retro-fit building façades with the dual objectives to abate the propagation of traffic noise in urban environments and to enable energy savings in buildings through thermal insulation. The unique feature will be the use of Noise Abatement Panels (**NAPS**) to enhance the façade's ability to absorb noise hence, reducing reflected noise back into the local environment, while still preventing sound transmission inwards. The innovation will involve the development of products for cladding systems with enhanced acoustic absorption developed from sustainable materials.

The materials proposed as most appropriate, and currently undergoing investigation, are a mixture of hemp and binder. With proper control of the mixture constituents and fabrication process, the sound absorption properties can be significantly enhanced. Hemp-lime/concrete has an inherent porous macro and micro-structure. Control of the porosity, binder quantity and compaction of the hemp shiv allows manipulation of the acoustic characteristics of the mixture enabling abatement of the range of urban noise frequencies.

Exciting opportunities exist to develop external wall cladding products that can significantly reduce the level of environmental noise and hence enable healthy and desirable living environments.

A GIS model for personal exposure to PM₁₀ for Dublin commuters

Dr. Francesco Pilla, Prof. Brian Broderick, Dr. Oliver Kinnane

Trinity College Dublin, Dublin, Ireland

One of the topics in which the European Commission has shown a greater concern is the necessity of developing actions that allow increasing the knowledge on transport dynamics and related atmospheric pollution to assure the accomplishment of legislation. At the same time, the mother directive 1996/62/EC and daughter directives establish the possibility of using modelling techniques to assess air quality.

The aim of the research presented in this paper is based on the necessity to understand the dynamics of air pollution with the aim of obtaining a precise estimation of the air quality through high-resolution modelling and use it as a tool for managing transport and mobility and improve the infrastructure towards a reduction of the cities' inhabitants exposure to air pollutants. Artificial neural networks and air quality models are used to have an insight into the complex non-linear relations between traffic, weather, city geometry and concentration of air pollutants at street level.

Once the different air pollutants concentration levels are calculated, they are imported in ArcGIS and dedicated layers are created along with thematic dynamic layers for traffic (and time to drive a segment of road) and population density. The three layers are combined and an estimate of the population exposure varying with time and location is calculated. As such the model is able to predict the exposure to particulate matter and NO_x of Dublin inhabitants and also of commuters on their way in/out of the city according to traffic and weather forecasts. The model calculations are repeated every time any weather forecast and traffic conditions updates are available, to improve the accuracy of the prediction. Alternative scenarios are also calculated to pre-empt the outcomes from the proposed traffic and mobility management actions before they are given the green light.

An Examination of the Potential Vectors and Pathways of Spread for *Corbicula Fluminea* in Ireland

Rory Sheehan¹, Dr. Frances Lucy¹, Dr. Joe Caffrey²

¹*Institute of Technology Sligo*

²*Inland Fisheries Ireland*

Corresponding Author Email: rory.sheehan@mail.itsligo.ie

Keywords: *Corbicula fluminea*, vectors, pathways, invasive species

The highly invasive Asian clam, *Corbicula fluminea* was first reported from the island of Ireland in 2010 in the River Barrow. *Corbicula fluminea* has subsequently spread to the Rivers Nore and Shannon. Within the Shannon River, *C. fluminea* is now present throughout much of its length, with two established populations separated by a distance of c. 100km.

A study was devised to identify the principal vectors of spread for *C. fluminea* in the northern section of the Shannon river basin. The vectors most likely to spread *C. fluminea* within the study area are unintentional movement by anglers, recreational boaters and waterfowl.

A hub of lakes radiating out from the Shannon River, at the town of Carrick-on-Shannon, was chosen for the study. This sampling area was selected for a number of reasons. These included the proximity of an established *C. fluminea* population in the main river corridor, the number of lakes in the area that are subject to angling pressure and the fact that this area represents an active navigable waterway and habitat for migratory waterfowl. The survey was designed to examine various vectors and pathways of spread. Sampling sites were selected on the basis of angling activity, boater movement, and a navigable connection to the Shannon River. Control sites were selected on the basis of remoteness and lack of boating or angling activity. The popularity of the Carrick-on-Shannon lake hub with tourist anglers renders the area particularly susceptible to the introduction of non-native aquatic species, including *Corbicula*.

This paper will present results from the survey work carried out between June 2012 and March 2013 along with the planned future works under the scope of the project. An overview of the current state of the *C. fluminea* invasion on the island of Ireland will also be presented.

Chemical Amendment of Pig Slurry Prevents P loss in Runoff – but Don't Forget to Examine Gaseous Emissions!

Cornelius J. O' Flynn¹, Owen Fenton², Gary J. Lanigan², Shane M. Troy³, Cathal Somers², Mark G. Healy¹

¹*Civil Engineering, National University of Ireland, Galway, Co. Galway, Ireland.*

²Teagasc, Environmental Research Centre, Johnstown Castle, Co Wexford, Ireland

³Scottish Rural College, Roslin Institute Building, Edinburgh, UK.

Corresponding Author Email: c.oflynn5@nuigalway.ie

Keywords: pig slurry, greenhouse gases, methane

The effectiveness of chemical amendment of pig slurry to ameliorate phosphorus (P) losses in runoff is well studied, but research mainly has concentrated only on the runoff pathway and has avoided investigating leaching or gaseous emissions. The present study avoids such simplifications and assesses amendments of pig slurry in a more holistic way using the following treatments (in addition to soil and slurry controls) and rates: (1) commercial grade liquid alum (8% Al₂O₃) (applied at a rate of 0.88:1 [Al: total phosphorus (TP)]); (2) commercial-grade liquid ferric chloride (38% FeCl₃) applied at a rate of 0.89:1 [Fe:TP]; and (3) commercial-grade liquid poly-aluminium chloride (PAC) (10% Al₂O₃) applied at a rate of 0.72:1 [Al:TP]). Columns filled with sieved soil (<2 mm) were incubated for 8 mo at 10°C and 75% relative humidity, and were leached with 160 ml distilled water wk⁻¹. Nitrous oxide (N₂O), carbon dioxide (CO₂) and methane (CH₄) were analysed for 28 d after slurry application. Soil ammonium was also tested at 0, 7 and 28 d following slurry application. Water extractable and plant available P were both reduced ($p < 0.05$) in the upper 50 -mm-depth of soil compared to the slurry only treatment. Generally, there was no significant ($p > 0.05$) difference in emissions between slurry and amended slurry treatments. However, N₂O emissions were higher with FeCl₃-amended slurry, but that this may have been due to a reduction in ammonia volatilisation. This was supported by higher observed soil ammonium levels. The addition of FeCl₃ provided a CH₄ sink, possibly due to CH₄ oxidation. Results showed that it is prudent for any investigation of chemical amendment of slurry to adopt a holistic approach. Recommendations for the utilization of a certain amendment which do not consider such an approach should be treated with suspicion.

A growing problem - invasive species distribution modelling of *Rhododendron ponticum* and the implications for conservation

Paul A. Egan, David Bourke & Jane C. Stout

*Department of Botany, School of Natural Sciences, Trinity College Dublin, Dublin 2, Ireland
Trinity Centre for Biodiversity Research, Trinity College Dublin, Dublin 2, Ireland*

The invasive alien *Rhododendron ponticum* is a widely naturalised and problematic weed throughout Ireland, Britain and areas of NW continental Europe. Using invasive species distribution modelling (iSDM) at a fine (2 km) spatial resolution, we examined the bioclimatic and landscape factors which govern the distributional pattern of *R. ponticum* across the Atlantic biogeographical region compared to its native range in Iberia and the Black Sea region. Good model performance allowed successful prediction of known areas of intense invasion. For the island of Ireland, the model suggested that invasion has not yet reached equilibrium, and there is still potential for range expansion. Model predictions of habitat suitability can help indicate the challenges for local eradication of *R. ponticum* and therefore help prioritize conservation efforts. In addition, identification of 'candidate' sites of high suitability where the species has not yet invaded can allow targeted preventative measures to be employed to avoid establishment. Paradoxically, iSDMs generated from the invasive range also provides much needed assessment of the species' severely restricted native range, where *R. ponticum* is presently classified as endangered.

Attitudes to Recycling in Limerick, Ireland- Knowledge Action Gap

Susan Byrne, Bernadette O'Regan

*Centre for Environmental Research, Department of Chemical and Environmental Science,
University of Limerick, Limerick, Ireland*

Corresponding Author Email: susan.byrne@ul.ie

Keywords: recycling, waste collection services

Recycling across Ireland has increased incrementally since the introduction and implementation of the Landfill Directive 1999/31/EC, July 2001; the WEEE directive 2002/96/EC, August 2005 and the Waste Framework Directive 2008/98/EC December 2008. As a result of the implementation of the aforementioned directives the volume of waste sent to landfill has fallen, household composting increased and recovery of municipal waste recyclables continues to improve. The improvements witnessed, are in part achieved as a result of the introduction of the 2-bin and 3-bin collection service. The improvement of facilities at recycling centres and bring banks has also been instrumental in the gains achieved in recycling rates.

NIMBYism however, remains a constant impediment to procuring suitable sites for the recycling receptacles. It is not unusual for people to seek convenience whilst not wanting the associated problems on their doorstep. NIMBYism is something that most individuals are guilty of and it is considered to be quite normal.

The structural difficulties associated with recycling rates are the first that need to be confronted. By altering the landscape, behaviours can be changed and improved. In the instance of bring banks and the social problems that are associated with them such as fly-tipping, changing the visual aspect of the receptacles and their positioning may improve recycling rates and reduce the number of instances of fly-tipping and littering.

This paper presents the results of 509 questionnaires distributed to nine primary schools actively participating in the Green School Programme. The questionnaires were analysed in an attempt to get an understanding of the motivations and the deterrents surrounding household recycling of waste. From the analysis recommendations are made to reduce the social problems associated with bring banks and to increase the percentage of householders availing of waste collection services.

Assessment of Alternative Effluent Disposal Options for Single Houses in Low Permeability Subsoil Settings Based on Economical and Environmental Sustainability

Donata Dubber¹, Laurence Gill¹ and David Smyth²

¹ *Department of Environmental Engineering, Trinity College Dublin, Ireland*

² *National Centre for Geocomputation, National University of Ireland, Maynooth, Ireland*

Keywords: on-site wastewater treatment, septic tank, subsoil permeability, decision support, effluent disposal

Typical on-site wastewater treatment systems for single houses in rural areas with no main drainage consist of septic tanks followed by a percolation area (soil attenuation system). If the subsoil permeability is not sufficient to take the effluent load, surface ponding may occur with associated health risks and a risk of runoff of pollutants to surface water. Hence, a lower limit on subsoil permeability was defined as T-value > 90 below which, at typical on-site wastewater hydraulic loads, percolation into the ground will not be fast enough and therefore discharge to ground is not permitted. It is estimated that such low permeability subsoils cover about 25% of the country and according to the current legislation further house development in such areas would probably be very limited. Furthermore, existing houses built in such areas may represent both a risk to human health and the environment causing eutrophication and pollution of nearby surface waters.

The project therefore investigates alternative wastewater treatment and disposal options for these areas and has developed a GIS decision support toolset for Local Authority planners and managers to evaluate alternative strategies on the basis of both cost-benefit and environmental impact/sustainability principles. Considered alternative on-site disposal systems are for instance pressurised distribution (i.e. low pressure pipe or drip distribution), evapotranspiration systems as well as cess-pools with regular tankering and disposal at a central wastewater treatment plant. Furthermore, the toolset will assess the possibility to connect houses to the nearest existing sewer network or the feasibility of clustering together several houses that could be served by a decentralized treatment plant with a consented discharge to a water course.

A suitable management of septic tanks will protect ground- and surface water from faecal pollution and eutrophication, promoting a well functioning ecosystem. Consequentially, it will protect water resources and improve human health.

Materials Efficiency in Building Construction; Systematic Appraisal of Business Ecosystems for Construction Projects

Rosemarie MacSweeney, Niall P. Dunphy

Cleaner Production Promotion Unit, Department of Civil and Environmental Engineering, University College Cork

Corresponding Author Email: rmacsweeney@ucc.ie

Keywords: C&D waste; lifecycle; systematic appraisal; business ecosystem

Construction and demolition (C&D) waste is a significant waste in Ireland. Common approaches to divert this waste from the waste stream include: improved construction site management; on-site segregation; recovery and recycling. More recently, attempts have also been made to eliminate waste in the design process. Furthermore, it is increasingly common in construction projects to hear of 'materials management' approaches in place of 'waste management'. These efforts to minimise waste and treat waste as a resource are welcome, but unless such efforts are carried out on a whole life basis, they may just result in waste being transferred from one lifecycle stage to another. This paper considers C&D waste optimisation from a lifecycle perspective by expanding on existing research and using a hybrid of corporate methodologies specifically adapted here for the construction industry, to identify and prevent waste generation across the business ecosystems that contribute to the design, construction, operation and end-of-life of a building. The paper explores the adaption of methodologies such as value chain analysis, business ecosystems, and total quality management for whole life waste optimisation in construction projects. The various actors and stakeholders that form these business ecosystems are mapped and their roles and interactions throughout the major stages of a building's life from inception to demolition are characterised. This paper posits that significant waste minimisation can be achieved through an integrated material management process considering all actors involved in the delivery of construction projects, which can be facilitated through a systematic appraisal of the business ecosystems involved.

Pathogen Detection and Quantification in Drinking Water

Abberton, C.^{1,3}, Boxall, J.B.², Smith, C.J.^{1,3}

¹Marine Microbial Ecology Laboratory, Microbiology, School of Natural Sciences, NUI, Galway, Galway, Ireland

²Department of Civil and Structural Engineering, Sir Frederick Mappin Building, Mappin Street, Sheffield, S1 3JD

³Ryan Institute for Environmental, Marine and Energy Research, NUI Galway

Safe, hygienic drinking water is the foundation of society. Substandard water quality can have considerable effects on human health. Chlorine is the most universally used disinfectant in water industries. The loss of disinfectant proficiency can signify a considerable contamination issue in drinking water. The intention of this research is to detect and quantify the occurrence and activity of viable *Escherichia coli* (*E. coli*) in drinking water after a contamination event. To this end, 12 *E. coli* primer sets from the literature were extensively tested and evaluated for specificity by Quantitative Polymerase Chain Reaction (Q-PCR) against a panel of 34 closely related *E. coli*, *Shigella* and *Enterobacter* strains and variety of non-related bacteria e.g. *Serratia*, *Citrobacter*, *Klebsellia*. As a result of specificity tests, four (RT)-Q-PCR primer and probe sets targeting *tuf*, *uidA*, *rodA* (specific for *E. coli* but also amplifying *Shigella*) and 16S rRNA genes (100% specific for *E. coli* when annealing temperature is 72 °C) were selected. Subsequently, time-point experiments (15 time-points between 0 and 100 hours) were conducted to investigate the relationship between detection of DNA, RNA, mRNA and cellular viability. An environmental *E. coli* isolate (chosen to best represent a drinking water contamination event), was killed using 20 mgL⁻¹ chlorine. Cell death was confirmed by non-recovery of cells in liquid culture, standard plate counts and microscopy using LIVE/DEAD BacLight bacterial viability kit. Subsequently DNA, RNA, mRNA was extracted from the chlorine-killed cells at each time-point. Results from the first trial indicate the persistence of both DNA and mRNA transcripts from all gene targets up to 100 hours after cell death. Further trials are currently underway with additional strains.

The results of this research will aid in providing improved methods to detect viable pathogens in drinking water that can be directly applied to improve water quality for human health.

Alternative Infiltration Systems for Disposal of Domestic Wastewater in Low Permeability Subsoils

Mary Keegan, Dr. Laurence Gill, Dr. Donata Dubber

Department of Civil, Structural & Environmental Engineering, Trinity College Dublin, Dublin 2, Ireland

Corresponding Author Email: keeganm2@tcd.ie

Keywords: Septic Tanks, Subsoil, Low pressure pipe systems, drip distribution

Today approximately 500,000 Irish households depend on onsite wastewater treatment systems for their effluent disposal. One of the most critical aspects of these systems is the permeability of the receiving subsoil into which they discharge and its ability to cope with the hydraulic loads produced. In Ireland, many counties consist of areas of low permeability subsoils which are not suitable to accept the typical on-site wastewater effluent loadings.

As part of this project two low permeability sites in Ireland have been upgraded from traditional septic tank soakaway systems to two alternative pressurised infiltration systems. At each site, 50% of the effluent is distributed via a Low Pressure Pipe System (LPPS), the other 50% via a Drip Distribution System (DDS). Both are shallow, pressure-dosed distribution systems consisting of a network of small diameter pipe work. One of the key aims of the project is to determine if these systems improve the ability of the receiving subsoil to handle the hydraulic load in low permeability areas. This is being investigated using soil moisture probes and tensiometers to determine the saturation of the subsoil at a range of depths below the new systems. Rainfall and other meteorological data are also being collected to determine how adequately these systems function across the year in the Irish climate. This research reveals the temporal patterns of varying subsoil moisture under such on-site loading.

Results from the monitoring of these systems will help to establish the design limits for both the LPPS and DDS in Irish subsoils, with the aim of providing alternative systems for householders in low permeability areas.

Assessment of the Impact of Traditional Septic Tank Soakaway Systems on Water Quality in Ireland

Mary Keegan, Dr. Laurence Gill, Dr. Donata Dubber

*Department of Civil, Structural & Environmental Engineering, Trinity College Dublin,
Dublin 2, Ireland*

Corresponding Author Email: keeganm2@tcd.ie

Keywords: Septic Tanks, Subsoil, Water Quality, Soakaway

In Ireland, it is often assumed that septic tanks discharging to soakaways are a significant source of pollution and yet very few studies have set out to quantify the effect of the estimated 450,000 septic tanks (CSO, 2011) located throughout the country. Through this study the performance of six traditional septic tank soakaways are being monitored across a range of subsoils: two in high, two in moderate and two in low permeability subsoils. The aim of the project is to determine the chemical and microbiological pollutant attenuation in the subsoil of these existing septic tank soakaways with respect to groundwater and surface water pollution.

Over the past year two low permeability sites have been monitored with the effluent passing through the subsoil being sampled regularly at a range of depths for various chemical and microbiological determinants. Through the installation of upstream and downstream boreholes groundwater quality has also been assessed. In addition, rainfall data and other meteorological parameters have been recorded to determine the effect of recharge at different times of the year on the effluent concentrations with depth.

The monitoring results to date have indicated that in low permeability subsoils effluent is dispersed by means of distinct lateral pathways to surface water channels or higher permeability lenses of subsoil. As such, the findings point to the lateral movement of effluent rather than the more desired vertical percolation and treatment of effluent through the subsoil. However, the results of groundwater analysis at both sites indicate that although the effluent is not evenly distributed, there is little presence of groundwater contamination downstream of these soakaway systems. Through the findings of this research, in combination with the ongoing monitoring of further soakaway systems, it is hoped to quantify the impact of these legacy systems on water quality and their potential risk to human health.

Developing an Advanced Marine Cyber-Infrastructure to Support Technology Development and Marine Environmental Monitoring Through SmartBay - Ireland's National Test Facility for Marine Technology

Paul Gaughan, Regina MacNulty, Eric Cullen, John Breslin, Niamh Cullen

SmartBay Ireland Ltd. Parkmore West, Galway, Ireland

Corresponding Author Email: paul.gaughan@smartbay.ie

SmartBay - Irelands national test facility for Marine Technology is facilitating the development of innovative approaches to sensing, communication and data management/visualisation technologies through sensor deployments in a real world marine environment. SmartBay comprises a suite of commercially available technology platforms including a network of buoys, sensor hardware and communication systems against which new technologies can be validated. This paper elaborates on how the functionality requirements of the SmartBay Data Platform were defined and details how sensor data acquisition, sensor middleware and data visualisation tools can be integrated to develop an innovative, robust, flexible, foundational cyber-infrastructure which can quickly adapt to support new projects, sensors, input data streams, and users, providing numerous benefits to a diverse research community. The paper focuses on how this cyber-infrastructure underpins the marine sensing platforms through a detailed case study which illustrates how the environmental data streams are collected, analysed and presented to a diverse group of stakeholders. In this paper the classic cloud computer model of Infrastructure as a service (IaaS), Platform as a service (PaaS) and Software as a service (SaaS) have been developed to incorporate both the SmartBay physical and cyber-infrastructure.

Novel Sorbents for Temperature Swing Adsorption of Carbon Dioxide

David Madden, Teresa Curtin

*Materials and Surface Science Institute, Department of Chemical & Environmental Sciences
SFI-SRC in Solar Energy Materials, University of Limerick, Ireland*

Corresponding Author Email: David.Madden@ul.ie

Keywords: Carbon dioxide adsorption; Porous adsorbents; Hybrid materials.

With the advent of climate change, CO₂ emissions from manmade sources have come under scrutiny as a driver of manmade climate change. Current CO₂ capture technologies tend to be limited by cost, effectiveness, amine emissions and corrosion problems. In the conventional technology, amines in aqueous solution are used for CO₂ adsorption from the gas into the liquid and subsequent desorption to produce an almost pure CO₂ stream.

Conventional CO₂ capture technologies from large emission points such as power plants involve amines such as monoethanolamine (MEA) in aqueous solution. High energy requirement in this process can reduce power plants efficiency by up to 40%. The aim of this project is to develop an alternative to using amines in aqueous solution by attaching various amines onto the surface of porous solids. Porous solids such as mesoporous silicates and various zeolites have been modified with aminopropyltriethoxysilane (APTES), polyethyleneimine (PEI) and tetraethylenepentamine (TEPA). The adsorption capacities of the resulting solids were tested in a purpose built rig with an online mass spectrometer. Factors that were shown to be important for maximum CO₂ adsorption capacity included the synthesis method of the sorbent, the surface characteristics of the solid, the amine modification method and amine type.

An important issue with regard to the potential use of these solids for large scale processes is the energy requirement for CO₂ removal, selectivity of adsorption and stability over extended use. The stability of the solids was tested by subjecting the solid to repeated adsorption desorption cycles. The stability of the solids depended on the amine used.

Review of a five year study on pharmaceuticals in the Irish aquatic environment

Brian Quinn^{1,2}, Wiebke Schmidt¹, David Sheehan³, Gillian McEneff⁴, Leon Barron⁵, Brian Kelleher⁶ and Brett Paull⁷

¹*Irish Centre for Environmental Toxicology, Galway-Mayo Institute of technology, Galway, Ireland*

²*Ryan Institute, National University of Ireland, Galway, Ireland*

³*Proteomic Research Laboratory, Dept of Biochemistry, Univeristy College Cork, Cork, Ireland*

⁴*Irish Separation Science Cluster, National Centre for Sensor Research, Dublin City University, Ireland*

⁵*Analytical & Environmental Sciences Division, Kings College London, London, UK*

⁶*School of Chemical Sciences, Dublin City University, Dublin 9, Ireland*

⁷*Australian Centre for Research on Separation Science, University of Tasmania, Australia*

Corresponding Author Email: brian.quinn@gmit.ie

Keywords: Pharmaceuticals; Mussels; Chemical analysis; Sub-lethal

The presence of pharmaceutical compounds in the aquatic environment is a research area of growing concern, particularly with the current review of annex X of the WFD and the identification of new potential priority substances including 17 β -estradiol (E2), 17 α -ethinylestradiol (EE2) and diclofenac. In 2008 the Environmental Protection Agency funded a five year study into the assessment and potential human impact of exposure to novel environmental contaminants (pharmaceuticals) on marine and freshwater bivalves. This multidisciplinary project was divided into the two distinct but inter-related area involving (a) chemical analysis of various pharmaceutical compounds in municipal effluents and receiving environments and their ability to bioconcentrate / bioaccumulate; (b) biological analysis of the potential effects (both acute and sub-lethal) of these novel pollutants on animals exposed in the aquatic environment and development of new endpoints to measure these effects. The five pharmaceuticals investigated (diclofenac, mefanamic acid, gemfibrozil, trimethoprim and carbamazepine) were all detected in high ng/L low μ g/L range in both municipal effluents and the marine receiving environment. Both *Mytilus spp* and *D. polymorpha* showed expression of biomarkers of stress (glutathione transferase) and damage (lipid peroxidation, DNA damage) at environmentally relevant concentrations (1 μ g/L) of gemfibrozil & diclofenac. Proteomic analysis revealed a significant impact on proteins involved in energy metabolism, oxidative stress response, protein folding and immune responses. An oxidative stress effect was also confirmed by the biomarker response. Steroid levels were measurable in mussels using human immunoassay technology and were significantly effected following exposed to EE2. Human diagnostic techniques showed a significant impact on liver and kidney function from *Mytilus* and fish exposed to diclofenac. From this work it is apparent that pharmaceuticals are entering the Irish aquatic environment from municipal effluent and have the potential to negatively impact on aquatic species.

Life Cycle Energy and Environmental Balance of Micro-Hydro Turbines in the Water Industry: An Ireland-Wales Context

J. Gallagher, D. Styles, I.M. Harris, A.P. Williams

School of Environment, Natural Resources & Geography, Bangor University, Wales, LL57 2DG

Corresponding Author Email: j.gallagher@bangor.ac.uk

Keywords: Energy Recovery; Micro-hydro Turbines; Water Industry; Life Cycle Assessment.

The water industry consumes between 2-3% of global energy resources in water treatment, supply and disposal processes. This demand is set to further increase due to a growing global population. However, the Hydro-BPT project has identified the potential for energy recovery arising from excess pressure (as flow or head) in the water industry in Ireland and Wales. Approximately 200 sites have been identified as potential locations to install micro-hydro turbines in the water supply network and wastewater treatment facilities in the region. Using a rigorous life cycle assessment approach, the project has found that this recovered energy has potential financial and environmental benefits as it can be fed back into the electricity grid, displacing greenhouse gas emissions associated with electricity generation and off-setting the water sector's own emissions. Significant challenges include taking into account temporal variability in pressure and flow characteristics, site-specific efficiencies for different turbine types, and the different renewable energy incentives between the two countries. Therefore, the calculation of net life cycle financial and CO₂ savings depends on (i) accurate identification of energy recovery opportunities (potential sites) across the sector, (ii) matching appropriate, economically viable turbine types to each potential site, and (iii) quantification of applicable financial incentives for micro-hydro, such as feed-in-tariffs, in both Ireland and Wales.

What Role did Fire Play in the Irish Uplands, from the Early Holocene to the Present Day, and How Should Fire be Best Managed in the Future?

Hawthorne Donna¹, Mitchell Fraser Dr¹, Turner N Jonathan Dr², Goodhue Robbie Dr³

¹*Botany Department, School of Natural Sciences, Trinity College Dublin, College Green, Dublin 2*

²*School of Geography, Planning and Environment Policy, Newman Building, University College Dublin, Belfield, Dublin 4*

³*Geochemistry Laboratory, Department of Geology, Trinity College Dublin, Dublin 2*

Corresponding Author Email: hawthord@tcd.ie

Keywords: fire, charcoal, Irish uplands, management

Significant changes in global and regional climate as well as changes in vegetation, land use, agriculture and policy, have promoted an increase in fires in the Irish landscape, especially in upland areas. Past climatic oscillations have been studied at 10 sites throughout Ireland in an attempt to understand the current climatic changes which may mirror future patterns in climate. This coupled with the palaeo-reconstructed landscape character and fire regime at each of these upland sites, will seek to develop a model of risk assessment and management for future fire in the Irish landscape. The data span from the early Holocene to the present day, drawing on charcoal and pollen data, radiocarbon dating, and mineral and chemical data from lacustrine sediments, as well as the historical record from a number of sites in Killarney National Park. This work presents the first chronological comparison of regional fire activity across various locations throughout Ireland, and provides a base line level of data which can be drawn on in future scenarios when fire frequency is expected to increase. This work is in its second year of a four year PhD programme and preliminary results will be presented.

Considerations for Nitrate Source Determination in Environmental Forensics Studies

Cecilia Fenech¹, Luc Rock², Kieran Nolan³, Anne Morrissey⁴

¹*School of Biotechnology, Dublin City University, Dublin 9, Ireland.*

²*School of Planning, Architecture and Civil Engineering, Queen's University Belfast, N. Ireland.*

³*School of Chemical Sciences, Dublin City University, Dublin 9, Ireland.*

⁴*Oscail, Dublin City University, Dublin 9, Ireland.*

Corresponding Author Email: cecilia.fenech@dcu.ie

Keywords: nitrate, source determination, chemical markers, decision tool, IDEF0

Interest in environmental forensics applications for nitrate source determination has been increasing in the past years. This is especially in view of legislative obligations related to the Water Framework and Environmental Liability directives and due to health and environmental considerations. To date, various approaches have been suggested for differentiating various point and diffuse sources of nitrate contamination. These include the use of nitrate stable isotopes, microbiological analyses, genetic markers and chemical markers.

The use of chemical markers, for the characterisation of sewage and manure inputs through the detection of human and veterinary pharmaceuticals is a recent development (Fenech et al., 2012). The use of chromatographic (LC-MS/MS) techniques is the most widely adopted approach for this purpose. However, it is a costly and time intensive technique. The use of high-throughput screening methods for pharmaceutical detection has been investigated. In particular, the use of immunoassays resulted in limits of detection that are relevant to low-level contamination of surface waters.

A limitation of most research to date is that it has largely focussed on the identification of a universal solution on the basis of one analytical approach. However, evidence is pointing towards the need for a toolbox approach where suitability for use is scenario dependent. The considerations for selecting the most suitable approach include such factors as the approach's technical capabilities, site characteristics, budget and time constraints and sample requirements. Therefore, a decision support tool was developed using IDEF0 modelling incorporating the various considerations, and validated through interviews with key stakeholders.

The various considerations related to the potential approaches one may adopt for achieving nitrate source determination will be presented, with a focus on the developed decision support tool for use in such environmental forensics studies.

Fenech, C., Rock, L., Nolan, K., Tobin, J., Morrissey, A. (2012) *Water Res.* **46**(7), 2023-2041.

The Visual Evaluation of Soil Structure Under Arable and Pasture Management

Mohammad Sadegh Askari¹, Junfang Cui^{1,2}, and Nicholas M. Holden¹

¹ UCD School of Biosystems Engineering, University College Dublin, Dublin 4, Ireland

² Institute of Mountain Hazards and Environment, CAS, Chengdu, Sichuang, China

Corresponding Author Email: mohammad.askari@ucdconnect.ie

Keywords: visual evaluation of soil structural quality, soil quality, management practices.

Soil performs a crucial role in the sustainability of land use and the environment. Conventional methods for assessing soil quality require considerable time and specific knowledge. On the other hand visual methods based on field assessment can provide reliable and quick tools for evaluating soil quality. In this study the application of visual evaluation of soil structural quality (VSS) under different arable and pasture management systems was investigated in order to assess the validity of VSS for differentiating the effects of soil management practices on soil structural quality. The objectives were to relate type and intensity of management to VSS score and to relate the VSS scores to established indicators of soil quality. The study was conducted on 40 sites in 13 counties in Ireland. Twenty sites were selected on arable distributed evenly between conventional and minimum tillage with crop rotation or continuous crop system, and 20 sites were distributed under low, medium and high intensity pasture management. At each site VSS was implemented and some soil properties which are related to soil structural quality were measured. Visual soil quality score (Sq) varied by conventional management system, and it was statistically different to that for the minimum tillage system. Measured soil parameters confirmed a negative effect of conventional tillage on soil quality and supported the VSS results. Under pasture management the visual assessment method detected the impact of intensity on soil quality as significant differences were found, and revealed the detrimental effects of high intensity management. The VSS method was capable of differentiating the effects of management practices on soil structural quality and can use as a fast and simple method for assessing soil quality on arable and pasture farms in Ireland.

Zebra Mussel Control Using Zequanox[®] in an Irish Waterway

Sara Meehan¹, Bridget Gruber², Dr. Frances Lucy³

¹ Innovation Centre, Institute of Technology, Ash Lane, Co Sligo; sara.meehan@mail.itsligo.ie

² 2121 Second Street, Suite B-107, Davis, CA 95618; bgruber@marronebio.com

³ Dept. of Environmental Science, Institute of Technology, Ash Lane, Co. Sligo;
lucy.frances@itsligo.ie

Due to the invasion of zebra mussels in European and North American waters there is currently a need for an environmentally friendly mussel control method to replace chlorine and other control products currently utilised. Marrone Bio Innovations (MBI), an American company that develops natural pesticides, is commercialising a natural product, Zequanox[®], comprised of *Pseudomonas fluorescens* CL 145A, which effectively controls zebra and quagga mussels.

Since invasion in the 1990s, Ireland's waterways, including navigation canals require a management method to deal with the zebra mussel infestation, as they attach to the canal walls as well as boats. The Grand Canal at Tullamore harbour has a zebra mussel infestation with no control measures in place.

The objectives of this study were to: demonstrate an effective method of zebra mussel control in inland waterways using Zequanox[®]; trial a method which could be used by Waterways Ireland (government body that manages canals) for zebra mussel fouled jetties, pontoons, navigational structures; reduce the spread between waterways; and evaluate water quality to demonstrate "no negative impact" and to monitor product dispersion.

A curtain made of scaffband was placed into the canal sealing off an 8 x 0.5m section on either side of the canal wall. This section was treated with Zequanox[®] at a concentration of 150mg/l for an 8 hour treatment period. During this time water turbidity was monitored as a means of controlling the product concentration. After the 8 hour treatment the curtain was kept in place for a total of 24 hours, to allow for natural degradation of the product where after the curtain was removed and the product naturally dispersed. Water quality was monitored before during and after treatment of this area as well as the selected control area. Natural zebra mussel settlement on the canal wall as well as adult mussels seeded into the treatment and control area were monitored for mortality after treatment.

The results of this study will be presented and compared with other similar studies carried out in North America using Zequanox[®]. These results provide important insights into zebra mussel control methods and potential future use of Zequanox[®] to control zebra mussel populations whilst conserving and maintaining the ecology of Ireland's waterways.

Estimating the Value of Achieving Good Environmental Status in Irish Marine Waters

Daniel Norton, Dr. Stephen Hynes

*Socio-Economic Marine Research Unit (SEMURU), College of Business, Public Policy and Law,
NUI Galway, Galway, Ireland*

Corresponding Author Email: d.norton1@nuigalway.ie

Keywords: Marine Strategy Framework Directive, MFSD, Choice Experiment, Non-use value

The Marine Strategy Framework Directive (MSFD) aims to have all EU marine and coastal waters achieve good environmental status (GES) by 2020. Within the MSFD GES is measured using 11 different indicators which were set out in the EU Commission Decision (2010/477/EU). Along with achieving GES, Member States, including Ireland, will have to undertake economic analysis on the costs and benefits of their programme of measures. Many of the benefits produced by the MSFD are not valued by the market place and other valuation methodologies must be employed to estimate their value. A large component of this non-market value is the non use value. Non use values include values such as existence value, bequest value and altruistic value. In order to estimate the non-use value of achieving GES in Irish marine waters, a stated preference valuation methodology known as a choice experiment was undertaken with 800 members of the Irish public in tandem to other questions related to the MSFD. The 11 indicators used to determine GES were used as a basis for generating attributes and levels. In the choice experiment the respondent is asked to trade off different levels of attributes. The choice experiment also included a monetary amount as an attribute. This allows for implicit prices for changes to the marine environment as envisaged by the MSFD to be estimated and respondents' willingness to pay for various scenarios can also be measured.

Social, economic and environmental sustainability in important fisheries areas in Northern Ireland: An industry perspective

Lynn Gilmore

Seafish Industry Authority

Corresponding Author Email: l_gilmore@seafish.co.uk

Keywords: Strangford Lough, Irish Sea, SAC, MCZ, MPAs, fishing, pot fishing, environmental designation

The Northern Irish seafood industry, through the Seafish Northern Ireland Advisory Committee, is collaborating on a range of projects. The aim is to assist in securing a sustainable and profitable future for the fishing industry in highly protected zones and areas where designation is likely around the coast of Northern Ireland. This presentation will give details of current projects with special mention of fishing in the Strangford Lough SAC and in proposed Marine Conservation Zones in the Irish Sea. Industry led initiatives on brown crab management, the use of technology in fisheries protection and voluntary initiatives will also be presented.

Applying multi-disciplinary walkability criteria to area selection for the Cleaner, Greener, Leaner (CGL) study

Lorraine Fitzsimons D'Arcy¹, Kevin Leyden², Catherine Woods¹

¹*School of Health and Human Performance, Dublin City University, Ireland*

²*Whitaker Institute for Innovation and Social Change; and Centre for Health from Environment, National University of Ireland, Galway, Ireland*

Corresponding Author Email: lfitzsimonsdcu@gmail.com

Keywords: walkability, geographic information systems, deprivation, site selection

The Cleaner, Greener, Leaner study investigates the relationship between neighbourhood walking, human health and transport carbon emissions. Neighbourhood features that contribute to walkability (pedestrian friendliness) are diverse and depend on the physical and social attributes of an area. The purpose of this study was to identify examples of high or low walkable areas for further examination as part of the CGL study. International walkability research favours macro-scale objective geographic information systems (GIS) information when identifying study areas. However, limitations with available GIS information and unrepresentative neighbourhood boundaries on GIS datasets meant additional methods for site selection had to be established. A multi-disciplinary focus group study, made up of planners, designers, engineers, public representatives and public health professionals (N=5 focus groups, 26 participants) was used to generate walkability criteria with macro (city level), meso (neighbourhood level) and micro (street level) considerations. They also gave a list of potential study sites. Of the original 171 valid area selections, 20 areas grouped under four categories: high walkable deprived, high walkable not deprived, low walkable deprived or low walkable not deprived were included in the final CGL study. These were selected based on the developed criteria, the examples given and checked with GIS, audit and ground truthing to determine their validity. Only 2 sites selected by focus group participants as high walkable met the inclusion criteria for a deprived neighbourhood. This could potentially reflect a bias within participants or how social characteristics influence the perceptual walkability of an area. An investigation of the role of high and low walkable environments on resident's behaviours and health can be used to inform future planning, transport, public health and neighbourhood design policies.

The development of Key Performance Indicators for the Effectiveness of Strategic Environmental Assessment in Ireland

Nicola Dwyer^{1,2}, Tadhg O'Mahony¹, Bernadette O'Regan², Richard Moles²,

¹*EPA Office of Environmental Assessment, Environmental Protection Agency Regional Inspectorate, Inniscarra, Co. Cork.*

²*Centre for Environmental Research (CER), University of Limerick, Limerick.*

Corresponding Author Email: n.dwyer@epa.ie

Keywords: Strategic Environmental Assessment, performance indicators, effectiveness

A framework of Key Performance Indicators (KPIs), for use by Statutory and Local Authorities, for evaluating the influence of Strategic Environmental Assessment (SEA) on development Plans and Programmes, and on environmental protection in Ireland will be developed. A literature review will identify criteria and indicators currently used, or recommended for, the evaluation of SEA effectiveness, along with effectiveness/performance criteria used by relevant organisations at the Irish, EU and international level. Minimum criteria for effectiveness will be established and KPIs will be developed for a) the quality of SEA reports; b) the effectiveness of SEA implementation, i.e. how well the recommendations of SEA are being integrated into Plans/Programmes; and c) the effectiveness of SEA for environmental protection i.e. the extent to which these Plans/Programmes, which have been refined through the SEA process, are contributing to environmental protection. Consultation with practitioners will inform the development of the KPIs. Case studies will be selected at the regional, county and local planning scale, and used to test the three sets of KPIs. The KPIs will be tested on development Plans which are in the process of undergoing SEA, and on adopted Plans. Refinement of the KPIs will be carried out where necessary. Guidance notes on the use of the KPIs will be produced, and the potential for applying the finalised KPIs in other countries will be investigated, through collaboration with other international environmental agencies such as the Scottish Environmental Protection Agency.

Zero-Discharge Willow Wetlands for On-Site Domestic Wastewater Treatment in Ireland

Fergus Mc Auliffe, Pádraig Whelan, Peter Jones

School of Biological, Earth and Environmental Sciences, University College Cork

Corresponding author email: fergus.mcauliffe@umail.ucc.ie

Keywords: on-site domestic wastewater treatment, *Salix viminalis*, evapotranspiration, zero-discharge

Across Ireland there are over 400,000 on-site domestic wastewater treatment systems. Many of these systems use soil infiltration as a crucial step in the treatment of the wastewater. However, there are areas of Ireland where the subsoil conditions are not suitable for wastewater infiltration. This can be due to inadequate subsoil permeability, shallow subsoil depth or high water tables. Under the Water Services (Amendment) Act 2012, inspection of on-site domestic wastewater treatment systems will commence in 2013. A solution is needed for on-site domestic wastewater treatment in areas where soil infiltration is not possible. During recent years, zero-discharge willow wetland systems have been used in Denmark to treat on-site wastewater, without the infiltration of effluent in to the subsoil. All septic tank effluent entering the wetland is lost from the system through evapotranspiration, resulting in a zero-discharge. The use of these systems in Ireland is to date very limited. The aim of this research is to fine-tune the Danish system for use in an Irish setting. Differences in annual temperature range and precipitation levels exist between both countries. Assessment of the system under Irish climatic and soil type conditions must take place to allow for their correct design and dimensioning. The effects of a range of soil clay proportions (5-30%) and plant regeneration following coppicing on wastewater use by *Salix viminalis* was investigated using a mesocosm study. Preliminary results show that primary wastewater use during the growing season by non-coppiced trees was approximately 15% higher than coppiced trees. Soil clay proportion of 30% reduced wastewater evapotranspiration by approximately 10% and plant growth by approximately 30% in comparison to lower levels of soil clay content. The results of this research can be used in the development of guidelines for the design, installation and operation of these systems in an Irish setting.

Potable Water Distribution Network Model for Quality and Operations Management

Anne-Marie Brady¹, Paul Vesey¹, Josephine Treacy²,

¹ *School of the Built Environment, Limerick Institute of Technology, Moylish Park, Limerick*

² *School of Science, Engineering and I.T., Science Department, Limerick Institute of Technology, Moylish Park, Limerick*

Corresponding Author Email: annemarie.brady@lit.ie

Creating a computerised water distribution network model requires a considerable amount of geographical information. Preliminary work suggests that the principle data needed to generate such a model can be obtained from existing Geographical Information Systems (GIS) within Irish Local Authorities. The remaining data required must be sourced from various other locations. This segregation and absence of data results in effective analysis of any distribution network becoming arduous and cumbersome.

This project eliminates superfluous IT infrastructure by funnelling all necessary data into a single database. Information gaps were narrowed by formulating figures based on existing quantified data. A prototype model was subsequently produced using standard software for the purpose of verifying technology selection and to ensure that the data mining activities have been sufficient to develop a larger generic model with the required functionality.

Further development of a generic methodology for the creation of a GIS based water distribution network model will provide a platform from which any municipality can evolve within their Water Services. By integrating such a model, acknowledged problematic areas such as leakage and network condition monitoring can be addressed, thus aiding in maintaining a high standard of water quality for healthy consumption in Ireland.

Optimisation of a novel Horizontal Flow Biofilm Reactor (HFBR) for the removal of nuisance gases

C. Kennelly^{1,3}, S. Gerrity^{2,3}, G. Collins^{2,3}, E. Clifford^{1,3}

¹*Civil Engineering, National University of Ireland, Galway*

²*Department of Microbiology, National University of Ireland, Galway*

³*Ryan Institute for Environmental, Marine and Energy Research, NUI Galway*

Corresponding Author Email: c.kennelly1@nuigalway.ie

As the legislation governing greenhouse gas and odour emissions from waste and wastewater treatment facilities grows ever more stringent, novel, robust solutions offering simple, sustainable, energy efficient remediation are timely. In this study, a horizontal flow biofilm reactor (HFBR) was investigated for its efficacy treating nuisance gases associated with emissions from waste and wastewater treatment facilities, namely methane (CH₄), ammonia (NH₃) and hydrogen sulphide (H₂S). Previous studies ^{[1], [2]} revealed the potential of the HFBR for nuisance gas removal. The purpose of these trials was to further optimise the technology as an alternative to increasingly defunct traditional methods.

The performance of the HFBR was investigated in three parallel experiments. Nine pilot scale HFBR units were used, three to investigate CH₄ removal, three for H₂S removal and three for NH₃ removal. The CH₄ trials were carried out over 3 experimental phases (Phases 1, 2 and 3), in a temperature controlled (10°C) purpose built laboratory. These trials investigated the potential for chemical enhancement of the liquid phase, to increase mass transfer of CH₄ into the liquid phase. Enhancement of the liquid phase during Phases 2 and 3 of the experiment, resulted in an average performance improvement of 63% (over the Phase 1 performance) recorded during Phase 2. This average improvement increased to 140% (over the Phase 1 performance) during Phase 3. Trials investigating H₂S removal were carried out over 5 experimental phases (Phase 1 - Phase 5) of incrementing H₂S loading rates. During each phase, 100% removal was achieved and excellent odour removal was observed. Trials investigating NH₃ removal were carried out over 2 experimental phases (Phase 1 and Phase 2). During both phases, 100% removal was immediately achieved and high levels of nitrification were recorded, demonstrating the excellent potential of the units to biologically eliminate ammonia gas and nitrify ammonium-nitrogen in the liquid phase.

These results show the HFBR to be an excellent alternative to traditional greenhouse gas and odour removal technologies. The technology is simple and can be easily retrofitted to existing facilities for use in treating an array of different gases. The simplicity and flexibility of the design lends itself to exceptional energy efficiency (running costs are negligible), excellent performance even at low temperatures. The application of this technology to waste facilities has to potential reduce both carbon footprint and odour making their presence more acceptable to both the public and to legislators.

Clifford, E., Kennelly, C., Walsh, R., Gerrity, S., O. Reilly, E., Collins, G. (2012). Optimisation of a horizontal flow biofilm reactor for the removal of methane at low temperatures. Journal of the Air and Waste Management Association. UAWM-2011-0177.R1

Kennelly, C., Clifford, E., Gerrity, S., Walsh, R., Rodgers, M., Collins, G. (2012). A Horizontal Flow Biofilm Reactor (HFBR) Technology for the Removal of Methane and Hydrogen Sulphide at Low Temperatures. Water Science and Technology. WST-EM12399

Microarrays for monitoring a toxic bloom of *Alexandrium minutum* in the North Channel of Cork Harbour

Gary R McCoy¹, Sara McNamee², Katrina Campbell², Christopher T Elliott², Gerard TA Fleming¹, and Robin Raine¹

¹Ryan Institute for Environmental, Marine and Energy Research, National University of Ireland, Galway

²Institute of Agri-Food and Land Use, School of Biological Sciences, Queens University, Stranmillis Road, Belfast, BT9 5AG, UK

Corresponding Author Email: g.mccoy3@nuigalway.ie

Keywords: *Alexandrium*, microarrays, MIDTAL, ribosomal RNA, bloom dynamics, harmful algae, cell concentrations, signal intensity, molecular detection methods, toxins

Traditional methods of identification and enumeration of phytoplankton can be somewhat ambiguous when identifying specimens to species level. Molecular methods of detection and quantification provide the means of measuring the cellular DNA and RNA content to calculate the number of cells present. Blooms of *Alexandrium* have occurred annually during the summer months in the North Channel of Cork Harbour on the South Coast of Ireland. The intensity of the blooms has fluctuated over the past decades but typically averages around 50,000 cells per Litre. This study monitored an extensive bloom of *Alexandrium minutum* during the summer of 2011 with the use of the new MIDTAL (Microarrays for the Detection of Toxic Algae) microarray from initiation to termination in the North Channel of Cork Harbour. Microarray signal intensities and toxin results from the third generation MIDTAL microarray are compared against Light Microscopy counts. The main aim was to demonstrate the use of the microarray to aid national monitoring agencies and provide a faster and more accurate means of identifying and quantifying the harmful phytoplankton community in natural water samples.

Measurement and Modelling of Oxygen Transfer and Hydraulics in a Novel Passive Aeration Biofilm System

Noelle Jones¹, Edmond O' Reilly^{1,2}, Eoghan Clifford^{1,2}

¹ Department of Civil Engineering, National University of Ireland, Galway

² Ryan Institute for Environmental, Marine & Energy Research, National University of Ireland, Galway

Corresponding Author Email: n.jones2@nuigalway.ie

Keywords: Passive Aeration Systems, Pumped Flow Biofilm Reactor (PFBR), Wastewater Treatment Technology, Batch Biofilm Reactor, GPS-X, Oxygen Patch Sensor, Dissolved Oxygen

Novel biofilm-based passive aeration systems (PAS) have attracted recent attention as alternative energy efficient and low maintenance technologies for wastewater treatment. However the modelling of biofilm-based PAS offers unique difficulties for engineers and scientists. One such technology is the pumped flow biofilm reactor (PFBR); a batch biofilm technology. The PFBR employs a unique hydraulic regime which, while enabling aerobic, anoxic and anaerobic conditions to be sequenced, poses a particular challenge to modellers. Furthermore, as the technology employs passive aeration the determination of, and modelling of, oxygen transfer rates and the concentration profiles of oxygen within the biofilm can be difficult.

This study investigates a novel method of measuring oxygen concentrations at the substratum level (i.e. the base of the biofilm layer) using a 'RedEye^(TM)' Oxygen Sensor Patch. This could allow for improved descriptions of how oxygen transfers through biofilms and can test this methodology of measuring contaminant diffusion into biofilms using measurements at the substratum level. In parallel bulk fluid dissolved oxygen concentrations are measured. Thus, uniquely, both the bulk fluid and biofilm base dissolved concentrations are passively measured. The results are modelled using GPS-X (Hydromantis Inc.) software and calibrated against experimental data from the laboratory scale PFBR reactor.

An accurate measurement of oxygen diffusion is a necessary component in modelling any passive aeration system (PAS). In the case of the PFBR biofilm growing on media modules within the two reactors is aerated passively as wastewater is pumped alternately between the reactors during an aeration sequence. Thus the reactors alternately empty and fill during a typical aeration sequence, with the biofilm alternately exposed in turn to atmospheric air and wastewater. Anoxic/anaerobic conditions are achieved by keeping the biofilm media immersed in the wastewater.

The RedEye Oxygen Sensor Patch, deployed in-situ at the media surface (substratum) of a laboratory scale PFBR treating municipal synthetic wastewater over 3 weeks gives DO concentration data at the biofilm base. By carefully removing the oxygen sensor patches the thickness of biofilm that has colonised each patch can be estimated at the end of an experimental phase.

The overall aim of this project is to develop a predictive model for a new passive aeration system using the modelling package GPS-X. To help improve model accuracy the study also investigates the use of novel oxygen sensor patches for measuring oxygen concentrations at the base of biofilm layers in passive aeration biofilm systems. Once this is achieved the calibrated GPS-X model will enhance the understanding of the PFBR technology and indeed other passive aeration systems; thus leading to better designed and more cost-effective wastewater treatment systems. The study could improve methodologies for passively monitoring oxygen diffusion characteristics in biofilm systems thus improving the reliability and accuracy of predictive models.

Real time Control and Remote Monitoring of Small Scale Wastewater Treatment Plants

Shane Fox, Edmond O'Reilly, Eoghan Clifford

Civil Engineering, College of Engineering and Informatics; and Ryan Institute for Environmental, Marine and Energy Research, National University of Ireland, Galway

Corresponding Author Email: s.fox10@nuigalway.ie

Keywords: Small scale wastewater treatment, remote monitoring, real time control

Decentralised wastewater treatment plants are generally considered as plants that treat for communities between 50 and 5000 PE. Such treatment plants can suffer from inadequate supervision, fluctuating influent as well as stringent wastewater discharge limits. Many of these plants do not have permanent on-site operators and thus when problems occur they may not be identified for some time. As a result only 24% of these small scale wastewater treatment plants in Ireland are complying with their designated discharge limits (EPA, 2009). It has been shown that as much as 31% of Irish river water is deemed to be polluted with decentralised wastewater treatment plants being one of the contributors (EPA, 2010). In an attempt to mitigate these issues this research is examining the use of real time remote monitoring and control as a means of limiting discharge breaches from such facilities. Such a system delivers real time information on plant performance to a centralised office. This enables a single plant manager to monitor and control several systems simultaneously. When issues arise within a plant they can quickly be detected and resolved. This research will also include the development of a low cost robust real time control system. The technology will use electrodes measuring parameters such as pH, oxidation reduction potential, dissolved oxygen and conductivity as a means of varying treatment operations in response to fluctuating wastewater concentrations. A laboratory scale and an onsite pilot scale batch operated facility were established to conduct this research. These facilities will be used firstly to determine trends in wastewater treatment cycles and secondly to test and optimise developed solutions. The advantages of such a system include the significant reduction in discharge breaches due to enhanced maintenance; a cost effective maintenance system, and the protection and improvement of receiving water courses and thus human health.

EPA. 2009. *Urban Wastewater discharges in Ireland for population equivalents greater than 500 Persons.* Wexford : Environmental Protection Agency , 2009.

—. **2010.** *Water quality in Ireland 2007-2009.* s.l. : EPA, 2010.



POSTER PRESENTATION LIST

Name	Abstract Title	No.
CLIMATE CHANGE		
Gallagher John	The Hydro-BPT Project: Realising the True Potential for Energy Recovery in the Water Industry in Ireland & Wales	1
Vanegas Carlos	Isolation of Anaerobic Bacteria Capable of Degrading Seaweed Towards Biogas Production	2
Vanegas Carlos	Co-Digestion of Glycerol Derived from Biodiesel Production with Seaweed in a Two-Phase Anaerobic Digestion System	3
Pittam James	A Critical Investigation of the Incorporation of a Passive Retro-fit Strategy into Industrial Dockland Built Stock	4
Casells Carol	Methanogenic Community Composition in an Anaerobic Reactor Producing Biogas from Seaweed.	5
O'Driscoll Cian	The Performance Differential in Post-Occupancy Green Buildings: Considering Design Principles and the Human Factor	6
Smullen Emma	Biomass Bioconversion-a Comparative Analysis of Pre-Treatment Techniques for Willow and Hemp.	7
Geever Michael	Greenhouse Gas Measurements in Ireland as Part of the ICOS Infrastructure	8
Wall David	Biomethane From Co-Digestion of Grass and Slurry: A Sustainable Second Generation Biofuel	9
McKenneydy Janet	Monitoring the Anaerobic Digestion of the Brown Seaweed, <i>Ascophyllum nodosum</i> , Using Volatile Fatty Acid Profiles	10
ENVIRONMENT AND HEALTH		
Chen Xiaolin	Environmental Toxicity of ZnO Nanoparticles: Impacts on Lemna Minor	11
Golden Nessa	MAGNETIC SUSCEPTIBILITY AND METAL CONTAMINATION IN URBAN SOIL: THE IMPACT OF BONFIRES	12
Lee Chui-Sang	Methods to Estimate Infectious and Non-infectious Norovirus in Environmental Samples	13
ENVIRONMENTAL TECHNOLOGIES		
Daniels Emma	Effects of Water and Impregnation Methods on Amine Modification of Mesoporous Solids	14
Fitzhenry Kelly	Detection and Removal of Pathogenic Norovirus in Wastewater and Water Treatment Facilities.	15
Ware Aidan	The Potential of Biogas to Produce Electricity or Renewable Natural Gas for Transport in Ireland	16
Schaller Barbara	Direct Catalytic Conversion of Bio-methane to Methanol	17
Buckley Rachel	Buffering Mechanisms in Constructed Wetlands Treating Alkaline Leachate	18
Zacharska Monika	Catalytic Butanone Synthesis From Levulinic Acid Derived From Biomass	19
WATER QUALITY		
Boots Bas	µAQUA - Microarray Technology for Waterborne Pathogen Detection	20
McGlaude Declan	Investigation of the Anti-Microbial Activity of Graphene and Graphene Composites for Use in Drinking Water Treatment.	21
O'Loughlin Sinead	MAXIMISING WATER POTENTIAL: Benefits of Recycling and Reusing Rainwater	22
Esmonde Louise	Plant Selection for Use in a Submerged Aquatic Vegetation (SAV) Wetland under Temperature Conditions	23
McAleer Eoin	Nitrogen Attenuation Along Delivery Pathways in Agricultural Catchments	24
Hernan Robert	Effluent Toxicity in Ireland (1983-2013)	25
Ni Chualáin Gára	µAQUA – Standardisation and Validation of a Universal Microarray for Waterborne Pathogen Detection	26
McGrory Enda	Geogenic Metal Concentrations in Irish Drinking Water	27

ENVIRONMENTAL MANAGEMENT	
Fox	Aaron Microbial Mobilization of S and P in Biochar Amended Soils.
Byrne	Susan Attitudes to Recycling in Limerick, Ireland- Knowledge Action Gap
Byrne	Susan Valuation of the Sustainability of an Irish Rural Community using a Quantified Approach
Murphy	Eleanor Developing Water Footprinting Methodologies for Irish Milk Production
Harris	MaryAnn Control of Invasive Riparian Vegetation by Use of Innovative and Traditional Methods to Protect Users of Urban Public Parks in Dublin
Jordan	Siobhan Constructed Wetlands for the Treatment of Acid Mine Drainage
Jordan	Siobhan CALORIFIC VALUE OF SPENT MUSHROOM COMPOST AND ITS POTENTIAL AS A FUEL SOURCE TO PRODUCE THERMAL ENERGY IN BOILER S
Piterina	Anna Chemico-physical properties and mutagenic activity of biochars produced via pyrolysis of Irish agricultural residues and waste
Piterina	Anna Progress in the biological processing and environmental management of domestic sewage and waste in Ireland
O'Malley	Sarah Reconnecting children and nature? Mapping the evolution of environmental education in Ireland
ECO SYSTEMS SERVICES	
Kinwan	Laura Biomass Yield and Resistance to Weed Invasion Enhanced by Four-Species Mixtures in Intensively-Managed Grassland: A Three-Year Contin
Finn	John Plant Diversity Effects are Robust to Nitrogen Application and Cutting in Experimental Agronomic Grasslands
Lally	Richard The Effectiveness of Seed Coatings for the Establishment of Plant Growth Promoting Bacteria in Oilseed Rape an Agricultural Break Crop
BIODIVERSITY	
Paolacci	Simona Invasiveness of the Alien Species <i>Lemna minuta</i> in Irish Freshwater Systems
Kinsella	Chloe The Relationship Between Stormwater Pollution and Rocky Shore Assemblages.
Melody	Carol Southern Decomposer in Irish Soil
Prehn	Bror Productivity and Population Structure of the Kelp Species <i>Laminaria hyperborea</i> in Galway Bay
Moran	Samuel Development of Population-Specific Markers for European <i>Bombus terrestris</i> using the RAPD Approach
Byrne	Aoife Omega 3s Under the Seas: Increasing Bioactive Compounds in Seaweeds!
Kirke	Dara Physiological Responses of Intertidal <i>Ascophyllum nodosum</i> and its Free-Living Egg A. <i>Nodosum</i> Mackaii to Salinity Stress
Jagodzinski	Lucas Wood ash mediated growth promotion and toxicity – two sides to the same coin
MARINE & COASTAL PROCESSES	
McCoy	Gary An Evaluation of the Applicability of Microarrays for Monitoring Toxic Algae in Irish Coastal Waters
Murphy	Ciara Impacts of Changing Biodiversity on Ecosystem Functioning in Intertidal Sedimentary Systems.
Olbert	Agneszka Regional Modelling of the 21st Century Climate Changes in the Irish Sea
Croot	Peter Irish Society for Ocean Studies



POSTER PRESENTATION ABSTRACTS

(Listed by Theme)

The Hydro-BPT Project: Realising the True Potential for Energy Recovery in the Water Industry in Ireland & Wales

J. Gallagher¹, A. P. Williams¹, D. Styles¹, I. Harris¹, P. Coughlan², C. Power^{2,3},
L. Corcoran^{2,3}, A. McNabola³

¹ *School of Environment, Natural Resources & Geography, Bangor University, Wales, United Kingdom*

² *School of Business, Trinity College Dublin, Ireland*

³ *Dept. of Civil, Structural & Environmental Engineering, Trinity College Dublin, Ireland*

Corresponding Author Email: j.gallagher@bangor.ac.uk

Keywords: Energy Recovery; Micro-hydro Turbines; Water Industry; Life Cycle Assessment.

There is a need to increase renewable energy production to reduce dependence on environmentally-damaging fossil fuels. Globally, hydropower currently contributes to the majority of renewable energy production; however, it is only recently that the recovery of excess energy within water distribution networks and wastewater treatment facilities has been recognised as a potential source of electricity generation. The Hydro-BPT project aims to quantify this potential for energy recovery in the water industry for Ireland and Wales. The project proposes the installation of micro-hydro turbines at strategic locations within the water and wastewater networks to exploit otherwise wasted energy. This can help displace the energy requirements of the industry, with excess energy fed back into the electricity grid. This will enable the water industry to reduce its operating costs of supplying treated water and reduce their CO₂ emissions. The Hydro-BPT project is being carried in four stages (i) the engineering design and technical feasibility for installing micro-hydro systems in the water networks, (ii) mapping of viable sites for such systems in both Ireland and Wales, (iii) development of an organisational and business model for the implementation of this new technology and (iv) quantify the potential environmental impacts of the technology as energy resource and CO₂ emissions savings. The findings of the project will ultimately enhance the economic and environmental sustainability of the water industry.

Isolation of Anaerobic Bacteria Capable of Degrading Seaweed Towards Biogas Production

Carlos Vanegas, Peter McCormick, John Bartlett

Centre for Sustainability, Institute of Technology Sligo, Sligo, Ireland.

Corresponding Author Email: carlosvan_nl@yahoo.com

Keywords: *Laminaria digitata*, hydrolysis, anaerobic bacteria, biogas

The production of biofuels in recent years is of great importance due to the problems associated with climate change and the overuse of non-renewable sources such as fossil fuels. Seaweed has been the subject of intense research in Europe because of its potential as a sustainable source of renewable energy. Biogas can be produced throughout the anaerobic digestion (AD) process where the chemical constituents from the seaweed are converted, mainly, to methane and carbon dioxide. It is well recognised that one of the main limiting steps during the AD of different biomasses is the hydrolysis phase. Consequently, strategies to overcome this limitation are of a major necessity. One economical, straightforward and environmental friendly solution is to optimise the hydrolysis phase by inoculating the digester with microorganisms capable of breaking down the cell wall of seaweed most efficiently.

Therefore, this study aims to isolate culturable anaerobic bacteria capable of degrading the chemical components and the recalcitrant structure of *Laminaria digitata* towards improving the hydrolysis process during the AD of seaweed. Different potential anoxic inocula were plated in at 35°C in petri dishes containing only the seaweed as a base medium and incubated in anaerobic conditions. Pure cultures of the microorganisms were isolated and used for AD trials in 100 ml batch digesters. The effect on the production of biogas was compared to an adapted inoculum already producing biogas from the AD of *L. digitata*.

The results provide an initial evidence of a microbial adaptation of anaerobic culturable bacteria with respect to *L. digitata* hydrolysis.

Co-Digestion of Glycerol Derived from Biodiesel Production with Seaweed in a Two-Phase Anaerobic Digestion System

Carlos Vanegas, Colm Henry, John Bartlett

Centre for Sustainability, Institute of Technology Sligo, Sligo, Ireland.

Corresponding Author Email: carlosvan_nl@yahoo.com

Keywords: *Laminaria digitata*, glycerol, biogas, biorefinery

Significant developments in the biofuel technology have enabled large scale commercialisation of biodiesel from oils. Glycerol is regarded as a waste-stream generated during biodiesel production. Although glycerol is used in the pharmaceutical industry, this is not always an economic option due to the high costs associated with crude glycerol post-treatment and purification.

Feasibility studies into the production of different biofuels such as bioethanol, biogas, butanol and biodiesel from seaweed have highlighted the importance of this feedstock and its integration in a biorefinery model to biofuel production.

As seaweed contain trace constituents necessary for microbial growth but lacks an optimal C:N ratio, co-digestion of crude glycerol, which appears to be a source of available carbon, with seaweed biomass, seems to be a promising recycling strategy to enhance production of biogas as a renewable source of energy.

Mindful of this, the aim of this project is to improve biogas production by co-digesting crude glycerol generated during the transesterification process of waste cooking oil with a native seaweed specie (*Laminaria digitata*). The experiment consists of 2L reactors filled with *L. digitata*, water and an inoculum (bovine slurry). Anaerobic digestion (AD) was carried in a two-phase AD system supplemented with crude glycerol and incubated at 35°C.

Initial results show that the addition of the crude glycerol contributed to a 46% increase in the cumulative biogas production and a 35% increase on cumulative methane yield when compared to a reactor without crude glycerol over an incubation period of 42 days.

The production of biogas from the AD of crude glycerol with seaweed seems to be a feasible process that could contribute to the establishment of an economical viable biorefinery model for the biodiesel industry.

A Critical Investigation of the Incorporation of a Passive Retro-fit Strategy into Industrial Dockland Built Stock

James Pittam, Dr Garrett O Sullivan, Marc O Riain

Department of Architecture, Cork Institute of Technology, Cork, Ireland.

Corresponding Author Email: james.pittam@cit.ie

Keywords: Retro-fit, sustainability, energy-efficiency, Passive-House, PHPP, EDPD

Energy performance in the buildings directive is off target, therefore the EPBD needs to refocus on retro-fit as an option. Buildings need to deliver greater amounts of energy savings in an 80% or net zero energy if we are to meet the EPBD targets. Bioclimatic and energy responsive architecture has to become a requirement in order to meet EPBD obligations by 2020. Low energy building design needs to be very performance specific.

The retro-fit approach used on the case study building follows a passive house methodology, adopting a thermal bridge free design. Two-dimensional building heat transfer modelling of construction details were calculated establishing accurate performance of thermal bridges which contribute to heat loss and gain; phi values (Ψ) were entered into PHPP (Passive House Planning Package) to calculate optimum results. PHPP was used to model the case study building (R & H Hall). Through a design process each design decision influenced the buildings energy performance; design informed simulation and vice versa.

By imputing various weather data sets into PHPP, it affected the buildings energy performance. One retro-fit model is not sufficient for all; hence each project design is premised on weather files produced for the site specific location. It identifies where the Retro-fit application needs to be modified for accurate energy consumption forecasting. Minor adjustments in design phase have detrimental effects on building energy performance

The results will give guidance on retro-fit offering a modular application. It will illustrate the impact of site specific climate data on building performance using simulation software in Ireland.

Methanogenic Community Composition in an Anaerobic Reactor Producing Biogas from Seaweed

Carlos Vanegas, Carol Cassells, John Bartlett

Centre for Sustainability, Institute of Technology Sligo, Sligo, Ireland.

Corresponding Author Email: c.cassells@hotmail.com

Keywords: Biogas, methanogenic, PCR, *Saccharina latissima*

As we fast approach an era for peak oil and climate change, the search for sustainable energy sources has been the subject of intensive study over the last decade. Significant advancements in the biofuel production technology have enabled large scale production of biofuels from different feedstocks. The technical potential of seaweed as a source of energy has been recognised given their ability to absorb carbon dioxide, its high energy content and the lack of water consumption or land competition with terrestrial biomass.

The use of anaerobic digestion (AD) to produce a renewable source of energy, such as biogas, has been the subject of investigation for many years. Biogas (methane) is produced by a diverse consortium of *Archaea* (methanogenic) found in anoxic environments and their monitoring during the AD process is of great importance. In order to improve biogas yields, the better recognition of the methanogenic composition in these systems is required. To date, there is no information on methanogenic communities engaged in producing biogas from the AD of seaweed as a renewable source of energy.

This study aims to investigate the shifts in methanogenic community from a 10L digester treating seaweed (*Saccharina latissima*) in co-digestion with bovine slurry. To overcome the constraints of microscopic and cultivation techniques, a molecular analysis based on qualitative PCR analysis of periodic samples taken from the digestate was used. *Archaea* primers targeting the presence of four different orders *Methanococcales*, *Methanobacteriales*, *Methanomicrobiales* and *Methanosarciniales* were examined. Findings from this investigation will advance the understanding of the relationships between methanogenic population and its potential to optimise biogas production from the AD of seaweed.

The Performance Differential in Post Occupancy Green Buildings: Considering Design Principles and the Human Factor

Cian O'Driscoll, Dr Garrett O' Sullivan, Dr Jim Harrison

Department of Architecture, Cork Institute of Technology, Cork, Ireland

Corresponding Author Email: cian.odriscoll@mycit.ie

Keywords: Energy usage, performance gap, architecture, building management, occupants.

It is now evident that green or sustainable energy efficient buildings outside of the residential remit rarely perform to the level of energy efficiency they have been designed to achieve. Organisations such as Carbonbuzz publish many of the results of such performance analysis. Focusing on CO₂ emissions and with data submitted from over 150 buildings from all sectors, a performance gap existed in every case. Many of the differences post occupancy were substantial. This research aims to deeper investigate the reasons why such differentials exist between pre-occupancy projected and post-occupancy actual energy usage. A better understanding of how users interact with modern green buildings is needed to highlight possible ways the relationship can become more harmonious and result in improved operational energy efficiency.

Establishing post-occupancy evaluation and feedback loops will prove essential in future sustainable construction projects. Within these evaluations participant observation will serve to inform certain behavioural patterns, while seeking to identify and understand the correlation between these patterns and energy usage. The area of unregulated plug loads alone can account for 15% of a typical office buildings energy consumption. The financial and environmental costs of these energy loads are substantial.

Given the infancy of Ireland's divulgence into sustainable green architecture, identifying any direct correlations between existing design principles, building management and user energy consumption, allows Ireland the chance to get it right first time. Irish designers and engineers can potentially pilot a renewed focus, a focus that sees sustainable design become a socio-technical process that embraces a more idiographic approach.

Biomass BioConversion-a Comparative Analysis of Pre-Treatment Techniques for Willow and Hemp

Emma Smullen¹, John Finnan² and Patricia Mulcahy¹

¹ *EnviroCore, Department of Science and Health, IT Carlow, Kilkenny Road, Co. Carlow, Ireland.*

² *Teagasc, Crop Research Centre, Oakpark, Co. Carlow, Ireland.*

Corresponding Author Email: emma.smullen@itcarlow.ie

Keywords: Willow, Hemp, Pre-treatment, Enzymatic Hydrolysis

Bioethanol produced from plant biomass is one of many renewable energy alternatives to fossil fuels. Typically lignocellulosic biomass contains between 56-72% fermentable sugars derived from the cellulose and hemicellulose fractions by dry weight. Lignocellulosic biomass requires a bioconversion step in order for the sugar polymers to be enzymatically hydrolysed into individual sugars. It is well established that there are many challenges associated with the bioconversion of plant lignocellulosics. These include pre-treatment technologies and development of relevant enzyme complexes for enzymatic hydrolysis.

Willow (*Salix*) a herbaceous crop and hemp (*Cannabis Sativa*) a fibrous crop were both selected to be used in the comparative analysis of pre-treatment techniques. Types of pre-treatments include, dilute acid and alkaline, hot water and ammonia fibre explosion, organosolvent and steam pre-treatment. Development of pre-treatment techniques using these crops has been previously unexplored with little information available. Barley straw an extensively studied biomass crop was used as an experimental standard in order to determine the effectiveness of selected pre-treatment techniques on willow and hemp both high yielding crops containing approximately 59% fermentable sugars.

Pre-treatment and enzymatic hydrolysis of samples was carried out to liberate the greatest amount of fermentable sugars, glucose, xylose, arabinose, mannose and galactose. Hydrolysates of each sample were then analysed on the ICS 5000 ion chromatograph. Ion chromatography is used to deliver a highly sensitive qualitative and quantitative sample analysis. The use of ion chromatography in this type of research is a relatively new idea, with previous research of pre-treatments being performed on HPLC instrumentation.

Achieving ideal conditions for each pre-treatment technique which will best represent the sample is a challenging objective. Being able to develop a comparative analysis of pre-treatment techniques for samples which have been previously unexplored will hopefully aid the development of a leading pre-treatment technique.

Greenhouse Gas Measurements in Ireland as Part of the ICOS Infrastructure

Michael Geever¹, David Dodd², Benoit Wastine³.

¹*Centre for Climate and Air Pollution Studies (C-CAPS), Ryan Institute for Environmental, Marine and Energy Research, National University of Ireland, Galway*

²*EPA, Clonskeagh, Dublin 14*

³*LSCE, Gif Sur Yvette, Paris*

Corresponding Author Email: michael.geever@nuigalway.ie

Keywords: Integrated Carbon Observation System, greenhouse gases, research infrastructure

ICOS (Integrated Carbon Observation System) is a new European Research Infrastructure for quantifying and understanding the greenhouse balance of the European continent and of adjacent regions. The main objectives of ICOS are to provide the long-term observations required to understand the present state and predict future behavior of the global carbon cycle and greenhouse gas emissions and to monitor and assess the effectiveness of carbon sequestration and/or greenhouse gases emission reduction activities on global atmospheric composition levels, including attribution of sources and sinks by region and sector. As a member of the ICOS research infrastructure, Ireland has implemented a network of greenhouse gas measurements, which has been operational since 2009. These measurements are managed by the Climate Change Division of the EPA, which also manages the Transboundary Air Pollution measurement and monitoring network. Greenhouse gas analyser instrumentation was installed in three stations, Mace Head, Carnsore Point and Malin Head, in 2009 to conduct continuous operational measurements of carbon dioxide, methane and water vapour. An overview of the measurement network including details of the instrumentation and operational parameters is presented. Preliminary results from the Irish stations is also presented showing mean levels of CO₂, CH₄ and H₂O and seasonal cycles.

Biomethane From Co-Digestion of Grass and Slurry: A Sustainable Second Generation Biofuel

David Wall^{1,2,3} Murphy J.D.^{1,2}

¹*Department of Civil and Environmental Engineering, University College Cork, Cork, Ireland*

²*Environmental Research Institute, University College Cork, Cork, Ireland*

³*Teagasc, Animal & Grassland Research and Innovation Centre, Grange, Co. Meath, Ireland*

Keywords: Grass, Slurry, Anaerobic Digestion

Grass is a low energy input perennial crop and an excellent feedstock for bio-methane production. Grass silage has a high solids content and a high specific methane capacity. Grassland represents 91% of Ireland's agricultural land, making it a plentiful resource. Much of the developing EU policies target a reduction in first generation biofuels based on food crops and encourages the use of second generation biofuels derived from non-edible crops such as grass biomethane. However, mono-digestion of grass can be unstable over time. Addition of slurry to the process can improve reactor performance by introducing essential trace elements. Two specific parameters will be investigated in this work; i) the feedstock ratio and ii) the organic loading rate (OLR). Information on the grass-to-slurry (G:S) feedstock ratio in co-digestion is somewhat limited and varied throughout literature. Biochemical methane potential (BMP) assays were undertaken to develop an optimum mixture. The BMP assays comprised of 100% grass, 100% slurry, 80%-20% G:S, 60%-40% G:S, 50%-50% G:S, 40%-60% G:S and 20%-80% G:S; all of which were run in triplicate. A BMP assay was also taken of a cellulose standard, again in triplicate to assess the health of the inoculum. Another critical parameter in AD system performance is the OLR. If the OLR is too high, it can lead to system failure through volatile fatty acid (VFA) accumulation and/or ammonia inhibition. Continuous 5 L reactor trials will be run with varying G:S ratios and increasing OLR over a number of hydraulic retention times (HRT). This work aims to give a better understanding of the potential application of farm co-digestion facilities in Ireland to meet renewable energy targets.

Monitoring the Anaerobic Digestion of the Brown Seaweed, *Ascophyllum nodosum*, Using Volatile Fatty Acid Profiles

Janet McKennedy

Dundalk Institute of Technology

Corresponding Author Email: janet.mckennedy@dkit.ie

As the price of oil soars and the problem of global warming becomes more evident, looking at alternative sources of fuel becomes more critical. Terrestrial options are limited by the need for food production. This has led to the exploration of marine algae as a renewable energy option.

In the investigation of the anaerobic digestion of algae the process was continually monitored by looking at the composition of the gas produced, the pH and the volatile fatty acid profile of the substrate on a regular basis.

The anaerobic digestion of the brown seaweed, *Ascophyllum nodosum* has been the primary focus of this work. The BM100 test, devised by the Energy Agency in the UK was used as a template for the anaerobic digestion setup. The experiment was performed at 35°C with waste water treatment plant sludge used as an inoculum.

The VFA (Volatile Fatty Acid) profile of the samples was evaluated using an optimised method on a Varian GCMS (Gas Chromatograph Mass Spectrometer) equipped with a Combi Pal Headspace. The gas composition was measured using an LMSxi Multifunction Gas Analyser which uses an infra red detector to determine the gas composition.

2 samples of *Ascophyllum nodosum* with varying polyphenol contents were digested in triplicate with interesting results. The production of methane or lack thereof was correlated to the individual VFA profiles and it was found that acetic acid provided a suitable indicator of methane production.

Environmental Toxicity of ZnO Nanoparticles: Impacts on *Lemna Minor*

Xiaolin Chen, John O'Halloran, Marcel A.K. Jansen

*School of Biological, Earth and Environmental Sciences, Enterprise Centre, Distillery Fields,
University College Cork, Ireland*

Corresponding Author Email: 111220211@umail.ucc.ie

Keywords: nano-ZnO, *Lemna minor*, acute toxicity.

Nanoparticles are particles that have at least one dimension in the range of 1~100 nm. Nano-ZnO (engineered) are used in a range of different applications including transportation, cosmetics, etc. It is anticipated that as a result of the extensive production and use, nano-ZnO will inevitably end up in the environment, with perhaps some possible impacts, which have yet to be determined. This project aims to determine the phytotoxicity of ZnO nanoparticles on *Lemna minor*, a model test species used in toxicity testing. . The acute toxicity of ZnO nanoparticles (0, 0.03, 0.3, 1, 10, 30 mg/l) was determined by measuring impacts on *Lemna minor* growth rate, root length, number of fronds and colonies, chlorophyll content and chlorophyll *a* fluorescence, using one week exposure experiments, according to OECD guidelines. To analyze the dynamics of nano-ZnO-induced phytotoxicity, effects on chlorophyll *a* fluorescence were measured daily, for up to 7 days. The results show that all endpoints are negatively affected under each treatment with nano-ZnO. The EC₅₀ value for the relative growth rate of *L. minor* was estimated to be 10mg/l.

Rapid inhibitory effects were found in "dynamic toxicity" test. Negative effects of nano-ZnO were found from day 1 onwards when *L. minor* plants were treated with 10, or 30 mg/l nano-ZnO.

Results from this study suggest that toxicity of ZnO nanoparticles varies with concentration and exposure time, which provides a reference for further investigation of nano-ZnO toxicity.

MAGNETIC SUSCEPTIBILITY AND METAL CONTAMINATION IN URBAN SOIL: THE IMPACT OF BONFIRES

Nessa Golden^{1,2}, Liam Morrison^{3,4}, Aaron Potito^{1,4}, Paul Gibson⁵, Chaosheng Zhang^{1,2}

¹*School of Geography and Archaeology, National University of Ireland, Galway,*

²*GIS Centre, Ryan Institute for Environmental, Marine and Energy Research, National University of Ireland, Galway*

³*Earth and Ocean Sciences, School of Natural Sciences, National University of Ireland, Galway*

⁴*Ryan Institute for Environmental, Marine and Energy Research, National University of Ireland, Galway*

⁵*Environmental Geophysics Unit, Department of Geography, National University of Ireland, Maynooth*

Little research has been carried out on the impact of bonfires on soils, particularly where materials containing metal components have been burned. In the present study, a total of 379 soil samples were collected from a traditional bonfire site in Galway City, Ireland. The bioavailable concentrations (EDTA extraction) of 36 elements (Cd, Ag, As, Au, Ba, Bi, Br, Ca, Cl, Co, Cr, Cu, Fe, Hf, Hg, I, K, Le, Mn, Mo, Nb, Ni, P, Pb, Rb, S, Sb, Se, Sn, Sr, Ta, Ti, V, W, Zn and Zr) were determined by Inductively Coupled Plasma – Optical Emission Spectrometry and Mass Spectrometry (ICP-OES and ICP-MS). Total metal concentrations were determined using Portable-X-ray Fluorescence (P-XRF). Soil magnetic susceptibility (MS) was measured using a Bartington MS2B sensor. Spatial trends of the elements and the MS measurements were examined using a Geographical Information System (GIS) and distribution maps identified both elevated total and bioavailable concentrations of Cu, Pb and Zn, which coincided with the location of previous bonfires and elevated MS. In addition, the effect of soil temperature (50°,100°,150°,200°,300°,400°,500°,600°,800°,1000° C) on the magnetic susceptibility properties of soil was investigated. The results of this study provide useful information on the bioavailability of metals in soils and the use of MS as a proxy indicator of soil quality, which may be used in the enforcement of policy controls regarding the burning of metal-containing materials in bonfires.

Methods to Estimate Infectious and Non-Infectious Norovirus in Environmental Samples

Chui-Sang Lee^{1,2}, Sinéad Keaveney², William Doré² and Vincent O'Flaherty¹

¹*Microbial Ecology Laboratory, Microbiology, School of Natural Sciences; and Ryan Institute for Environmental, Marine and Energy Research, National University of Ireland, Galway*

²*Marine Institute, Rinville, Oranmore, County Galway, Ireland*

Keywords: norovirus, gastroenteritis, shellfish, quantitative PCR

Norovirus is a pathogen that accounts for over 50% of all foodborne disease outbreaks, and over 90% of viral gastroenteritis cases worldwide (Patel et al., 2009). Filter-feeding bivalve shellfish can be contaminated with human norovirus (HuNoV) when grown in waters impacted by municipal wastewater, representing a significant public health risk. Current real-time PCR (qPCR) methods for the quantitative estimation of HuNoV concentrations in oysters do not distinguish between infectious and non-infectious virus particles (Rodriguez et al., 2008), and the difficulty in finding a suitable cell line for HuNoV has proven to be complex.

This project aims to identify, develop and validate an appropriate methodological approach for estimating the quantity of infectious HuNoVs in oysters. It will subsequently be used in an experimental setting to investigate the level of infectious and non-infectious HuNoV particles in oysters and municipal wastewater. This will provide a clearer understanding of the infectious risk associated with levels of HuNoVs detected in environmental samples.

To date we have identified a potential approach that uses long-range/short-range reverse transcription (loRT/sRT) to estimate virus infectivity based on genomic RNA integrity (Wolf et al., 2009). We are currently optimising this approach for HuNoV genogroups I and II (GI and GII) in conjunction with the norovirus surrogate F-RNA bacteriophage GA. As there are no infectivity assays available for HuNoV, we plan to use the GA infectivity assay together with real-time PCR to assess the correlation between the loRT qPCR signal and infectivity, as opposed to the sRT qPCR signal and infectivity. We will also compare the RT-qPCR results of both targets for HuNoV and GA before and after UV treatment of wastewater.

Patel, M.M., Hall, A.J., Vinjé, J., Parashar, U.D., 2009. Noroviruses: A comprehensive review. *Journal of Clinical Virology* 44, 1–8.

Rodriguez, R.A., Pepper, I.L., Gerba, C.P., 2008. Application of PCR-Based Methods To Assess the Infectivity of Enteric Viruses in Environmental Samples. *Applied and Environmental Microbiology* 75, 297–307.

Wolf, S., Rivera-Aban, M., Greening, G.E., 2009. Long-Range Reverse Transcription as a Useful Tool to Assess the Genomic Integrity of Norovirus. *Food and Environmental Virology* 1, 129–136.

Effects of Water and Impregnation Methods on Amine Modification of Mesoporous Solids

Emma Daniels, David Madden, Teresa Curtin

*Materials and Surface Science Institute and CES Department, University of Limerick, Ireland.
SFI-SRC in solar Energy Materials,*

Corresponding Author Email: emma.daniels@ul.ie

Keywords: CO₂ capture, impregnation, amine modification of mesoporous solids

Amine modification of mesoporous solids is a potential way of capturing CO₂. However, the presence of water during this modification step can significantly affect how amines bind to the surface of mesoporous solids. In this study mesoporous SBA-15 and AISBA-15 were used as supports, while (3-aminopropyl)triethoxysilane (APTES) was the amine employed. The presence of water during amine modification may result in the self condensation of silanes, thus limiting amine and CO₂ interaction. This was investigated in this study.

Another important factor is the modification procedure used. This study involved both wet and dry impregnation. Impregnation of amines results in the physical attachment of amine groups to the mesoporous surface. Dry impregnation involved using a of APTES and solvent, the volume of which was just enough to fill the pores of the supporting solid. Wet impregnation, on the other hand, involved the use of 25ml of solvent. Various APTES loadings were investigated, namely 10,20,40,50 and 70wt% on SBA-15 and AISBA-15. CO₂ adsorption studies were carried out on a testing rig with mass spectroscopy detection.

Detection and Removal of Pathogenic Norovirus in Wastewater and Water Treatment Facilities

K. Fitzhenry^{2,4}, M. Barrett^{1,4,5}, V. O'Flaherty^{1,4,5}, W. Dore², M. Cormican³, E. Clifford^{4,5}

¹ *Microbial Ecology Lab, School of Natural Sciences, National University of Ireland, Galway*

² *Marine Institute, Oranmore, Ireland*

³ *Centre for Health from Environment, Ryan Institute, National University of Ireland, Galway; and Medical Microbiology, UHG, Galway, Ireland*

⁴ *College of Engineering and Informatics, National University of Ireland, Galway, Ireland*

⁵ *Ryan Institute for Environment, Marine and Energy, National University of Ireland, Galway*

Corresponding Author Email: Maria.Barrett@nuigalway.ie

Keywords: norovirus, wastewater, tangential flow filtration, UV, tertiary treatment

Human pathogenic viruses (HPVs), namely human adenovirus (HAdV), Hepatitis A virus (HAV), human enterovirus (EV) and Norovirus (NoV) have been commonly linked to contaminated water supplies throughout Ireland. Infections caused by these HPV's include gastroenteritis, hepatitis and meningitis. Norovirus accounts for the vast majority of infectious intestinal diseases (IIDs) in Ireland inducing symptoms such as nausea, vomiting, abdominal cramps and diarrhoea. It is spread via the faecal-oral route, thus is present in human effluent and municipal wastewaters, with viral numbers as high as 10^{11} viruses/gram of faecal matter. The discharge of municipal wastewaters into aquatic environments can lead to NoV outbreaks by contaminating drinking water supplies and infiltrating food chains. Recent studies have shown that primary and secondary sewage treatment processes are not successful in removing pathogenic viruses and thus a tertiary disinfection step is required; these include ultra-violet radiation (UV), ozone and tangential flow filters (TFFs). The increasing use of Real-time qPCR to detect low viral copies has proved successful in detecting NoV in wastewater however it does not distinguish between infectious and non-infectious viruses. As Norovirus lacks a cell culture system it has been suggested that FRNA bacteriophages may be used as a surrogate indicator organism. An overlay plaque assay method is being employed as a separate measure to determine viability of the micro-organism. This project aims to monitor the removal/inactivation of NoV's from municipal wastewater effluent using UV and TFF as tertiary disinfection treatment systems. Sampling for viral analysis will be taken at four points - 1. raw in-flow, 2. pre-disinfection (UV/TFF), 3. post-disinfection (UV/TFF) and 4. prior to release, to evaluate NoV removal throughout the WWTP. Results and findings obtained in this study will help to form robust counter-measures in the effective removal of viable NoV from secondary effluent in WWTPs both nationally and internationally.

The Potential of Biogas to Produce Electricity or Renewable Natural Gas for Transport in Ireland

Aidan Ware, Niamh Power

Department of Civil, Structural and Environmental Engineering, Cork Institute of Technology, Cork, Ireland.

Corresponding Author Email: aidan.ware@mycit.ie

Keywords: anaerobic digestion, biogas, waste products, energy balance

The anaerobic digestion process degrades organic material in the absence of oxygen and produces a gas known as biogas. As biogas consists of methane, it can be used as an energy source. The **purpose** of this research is to determine the optimum waste product in Ireland for biogas production and determine the optimal usage of this energy.

The research involves a two pronged **approach**. Firstly laboratory testing which consists of; preliminary testing of wastes, including a variety of animal manure, slaughterhouse wastes and domestic/industrial organic wastes, to determine which wastes have the potential to produce significant quantities of biogas, followed by rigorous testing of the wastes which show the highest potential for biogas production. The second step is to carry out a life-cycle analysis energy balance to determine the optimum usage for the energy produced; combustion of the biogas for generation of electricity or up-grading the biogas for direct use in a combustion engine.

The **innovation** of this research is that the biogas yield of potential wastes, although significantly researched individually, have not been compared under the same process conditions.

The **relevance** of this research is directly related to The Renewable Energy Sources Directive (2009/28/EC) which set mandatory targets for Ireland, including a 10% share of transport energy from renewable sources. The EU recently released an update to this Directive and has limited the quantity of renewable transport originating from food crops to 5%. The press release states that there should be a move towards non-food crops and waste increasing the relevance of this research.

Direct Catalytic Conversion of Bio-Methane to Methanol

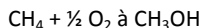
Barbara Schaller, Teresa Curtin and J.J. Leahy

*Materials and Surface Science Institute, Department of Chemical & Environmental Sciences,
University of Limerick, Ireland*

Corresponding Author Email: Barbara.Schaller@ul.ie

Keywords: methane, catalyst, oxidation, methanol, zeolite

The Biofuel directive of the European Commission requires that a minimum of 10 % of the transport sector should be covered by alternative fuels by 2020. Methanol is a flexible key component for several alternative fuels and is also used in other industries like in the plastic production application. A “dream” reaction of modern heterogeneous catalysis is the quantitative direct partial oxidation of methane to methanol:



Since methane is very symmetric, it has an extreme high C-H bond stability, which requires high activation energies.¹ Stopping the oxidation and releasing the formed methanol from the catalyst are still challenging problems. Currently, methanol and higher alcohols are synthesized via an indirect selective two-step process using syngas, which is costly and energy consuming.¹

The objective of this project is to develop a new catalytic method for the direct catalytic conversion of bio-methane to methanol. In nature, the C–H bond in methane can be oxidized in mild conditions using methane mono-oxygenase enzymes (MMO). There are two main enzyme families, one which contain copper (particular MMO) and the other iron (soluble MMO) complexes.² Indeed from current reported literature copper and iron catalysts supported by zeolites seem to be relatively promising for this partial catalytic oxidation reaction.

For our work copper and iron based catalysts were prepared through an aqueous ion exchange procedure using copper and iron salts. ZSM-5 with a SiO₂:Al₂O₃ ratio of 23:1 was used as the support. Atomic absorption was used to measure the exchanged metal content of the prepared copper catalysts. The performance of the prepared catalysts for the low temperature, low pressure conversion of methane was screened using off-line Gas Chromatography. Factors reported include influence of the catalyst, metal content and reaction temperature.

Funded by Earth and Natural Sciences Doctoral Programme.

References

1. P. G. Guido Fratesi, Stefano de Gironcoli, *J. Phys. Chem. C*, 2007, **111**, 17015-17019.
2. M. C. Alvarez-Galvan, N. Mota, M. Ojeda, S. Rojas, R. M. Navarro and J. L. G. Fierro, *Catalysis Today*, 2011, **171**, 15-23.

Buffering Mechanisms in Constructed Wetlands Treating Alkaline Leachate

Rachel Buckley, Teresa Curtin and Ronan Courtney

*Materials and Surface Science Institute, Department of Chemical & Environmental Sciences,
2Department of Life Sciences, University of Limerick, Ireland*

Corresponding Authors Email: Rachel.Buckley@ul.ie

Keywords: Wetlands, Alkalinity, pH, Water types, Carbonation, Soils

Constructed wetlands are an established treatment technology and there is a long history of using wetlands as a unit process in treating acid mine drainage, while recent research has highlighted the potential for wetlands to buffer highly alkaline (pH>12) drainage¹. The aim of this overall project is to assess the feasibility of a trial constructed wetland for reducing alkalinity of bauxite leachate from the bauxite residue disposal area (BRDA) on site in Aughinish Alumina.

The work presented here involved studying the fall in pH of various solutions, as a function of different parameters. These parameters included dilution with various water types, additives of calcium sources and acid, carbonation, temperature, soil types. A significant fall in the pH was observed using carbonation. This is believed to be partially due to the fact that the CO₂ forms carbonic acid in aqueous solution which neutralises the solution. The effect of addition of a combination soil (which contains organic matter) and an artificial soil (perlite) to the solutions being carbonated were also investigated.

References

1. Mayes, W. M., Batty, (2009) 'Wetland treatment at extremes of pH: A review', *Science of the Total Environment*, 407(13), 3944-3957.

Catalytic Butanone Synthesis From Levulinic Acid Derived From Biomass

Monika Zacharska, Kevin Reardon, J.J. Leahy, Dmitri A. Bulushev

Chemical and Environmental Science Department, University of Limerick, Limerick

Corresponding Author Email: Monika.Zacharska@ul.ie

Biomass has received considerable attention as a sustainable feedstock that can replace diminishing fossil fuels for the production of energy, especially for the transportation sector.

Levulinic acid (LA) is an important product of hydrolysis of biomass containing cellulose and can be produced at low cost and efficiently. LA is an interesting building block and can be converted to a variety of useful compounds. This project aims to establish new routes of catalytic conversion of LA to fuels, fuel additives and other useful chemicals. It has been demonstrated that LA can be converted by decarboxylation to form butanone in the presence of an appropriate catalyst [1]. It is reported that a conversion of 54% could be reached at 216°C.

The main objective of this work is to develop novel, cost effective, active, selective and stable catalysts for decarboxylation and decarboxylative coupling of LA. The catalysts for decarboxylation were synthesized by impregnation and then mentioned reactions were examined over these catalysts in a 4598-HP/HT autoclave mini-reactor (100ml, Parr Instrument). A 50 ml portion of 1%, 2%, 5% and 10% solution of LA in pure water was put into the autoclave. CuO, 3.5% Cu/MgO, 5% Cu/MgO, 5% Cu/MCM41, 1%Pd/C, 10% Pd/C and 4.2% Cu/ZSM5 were tested at 200°C, 250°C and 300°C, at 80 bars. The products were analysed by GC-FID and GC-MS. The expected product butanone was produced using all studied catalysts together with acetone (by-product). The fastest conversion was obtained over Cu/MgO catalysts. The obtained fuel additives may be used as "green chemistry" solvents. If the process could be carried out with high conversions and selectivities, the butanone formed could then be hydrogenated to give 2-butanol, thus, further improving the fuel properties. Butanol is an alcohol that can replace gasoline. At 85% strength it can be used as a fuel in cars designed for gasoline without additional changes to the engine. It is superior fuel comparing to ethanol with a high energy density (29.2 MJ/L) which is only slightly lower than that of gasoline (32 MJ/L) and it is suitable for distribution through existing pipelines for gasoline. Also shown in the patent literature [2] is that two molecules of LA can be coupled to give a tri-ketone which could be further hydrogenated to alcohol in the same way as butanone. The proposed objectives for the future work are to explain the reaction mechanism on the best catalysts in order to improve the yields of butanone and to characterize the best catalysts.

This work is carried out as a part of Earth and Natural Sciences (ENS) Doctoral Studies Programme, funded by the Higher Education Authority (HEA) through the Programme for Research at Third Level Institutions, Cycle 5 (PRTL-5), co-funded by the European Regional development Fund (ERDF). This publication has emanated from research conducted with the financial support of Science Foundation Ireland under Grant Number 11/RFP.1/CAP/3253.

References:

- [1] Pine LA, Esso Research and Engineering Company, inventor Decarboxylation. US Patent 3476803. 1969.
- [2] Hussmann GP, Amoco Corporation, inventor Preparation of dialkyl ketones from aliphatic carboxylic acids. US patent 4754074. 1988.

μAQUA - Microarray Technology for Waterborne Pathogen Detection

Bas Boots, Ciara Ní Chualáin and Nicholas M. Holden.

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

Corresponding Author Email: b.boots@ucd.ie

Keywords: water quality, pathogen detection, microarrays, oligonucleotide probes

The simultaneous detection of waterborne pathogens using a high-throughput, molecular biology based method will significantly reduce labour and cost for routine water quality monitoring. Currently, most detection techniques allow the detection of single or small select groups of pathogens. The FP7 project μAQUA aims to develop a universal microarray to simultaneously detect pathogenic protozoa, bacteria, algae, viruses and microbially produced toxins from environmental and drinking water samples. The specific contribution from UCD focuses on waterborne pathogenic protozoa, including *Cryptosporidium*, *Giardia*, *Entamoeba* and *Naegleria*.

Currently, over 450 different oligonucleotide probes have been identified and checked for specificity, covering a wide range of waterborne microbial pathogens. Most target the phylogenetically important small and large subunit ribosomal genes. For example, the 18S rRNA gene of *Cryptosporidium* spp. has been incorporated, and combined with using a hierarchical approach, this allows distinction between different clades down to species level (e.g. *C. parvum*). In addition, species-specific, functional genes are included to enhance the sensitivity of the microarray; for example, those encoding for *Cryptosporidium* Oocyst Cell Wall Protein (COWP).

Total RNA is obtained from environmental water samples and hybridised onto the chip following standardised protocols. Microarrays operate under stringent physical and chemical conditions (hybridising temperature, labelling of fragments, absence of inhibiting compounds) with the oligonucleotide probes being optimised to allow efficient simultaneous hybridisation.

The application of microarray technology is not limited to monitoring of water quality. It may also be applied to estimate gene flow and the distribution of species spatially and temporally aiding predictions of future outbreaks. Validation of the probes on the microarray is done using traditional methods on environmental water samples. The final product will be a modern tool for monitoring water quality, with the potential to replace currently employed methods.

Investigation of the Anti-Microbial Activity of Graphene and Graphene Composites for Use in Drinking Water Treatment

Declan McGlade¹, Kieran Nolan², Jenny Lawler¹, Anne Morrissey³, Bríd Quilty¹

¹*School of Biotechnology, Dublin City University, Dublin 9, Ireland.*

²*School of Chemical Sciences, Dublin City University, Dublin 9, Ireland.*

³*Oscail – DCU Distance Education, Dublin City University, Dublin 9, Ireland.*

Corresponding Author Email: Declan.mcglade2@mail.dcu.ie

Keywords: Graphene, Water treatment, Anti-Microbial, Membrane Filtration

Access to potable drinking water is an issue worldwide, particularly in developing countries and even rural areas of water-rich countries such as Ireland. Incidences like the recent cryptosporidium contamination of drinking water in Galway for example, have led to demands of more stringent regulation and review of current water treatment systems. As many new water treatment technologies seek to move away from the standard model of clarification, filtration and chlorination; graphene displays potential as a carbon contactor (CC) or functional membrane surface within a hybrid membrane process (HMP) for the facilitation of micro-organism removal. Graphene is a flat monolayer of carbon atoms and is the base structure for other well-known graphitic materials such as fullerenes, carbon-nanotubes and graphite. Graphene exhibits several interesting characteristics including electrical & thermal conductivity, high tensile strength (1Tpa) and opacity as an atomic monolayer. This has led to extensive use of graphene in many areas including, more recently, water treatment. The mechanical nature of graphene's anti-microbial activity (damage to the bacterial cell membrane) shows potential for the chemical-free/reduced treatment of potable water supplies. There are however conflicting reports on the anti-microbial efficacy of graphene. The anti-bacterial activity of graphene, graphene oxide and its composites will be explored and the mechanism of activity investigated.

MAXIMISING WATER POTENTIAL: Benefits of Recycling and Reusing Rainwater

Sinead O'Loughlin¹, Josephine Treacy¹, Frank Houghton²

¹*Department of Applied Science, Limerick Institute of Technology.*

²*Department of Humanities, Limerick Institute of Technology.*

Fresh water is a resource that needs to be protected and preserved for future generations. Many freshwater sources are being polluted or overly utilised. The European Environment Agency (EEA) with the help of the Water Framework Directive has established clear limits constituting the quality of water in terms of grades. The aim of the strategy is for all fresh water sources to achieve "good status" by 2015. This poster will investigate legislative requirements and report on the achievable grades of freshwater sources

Fresh water is a renewable source, 3% of total global water is freshwater with only 1% available for use the remainder being locked in ice caps or inaccessible groundwater. EEA statistics show that 20 % of water used by households or businesses receiving a public water supply is actually consumed. The other 80 % is returned to the environment, primarily as treated wastewater.

The poster will promote recycling of water for domestic agricultural and industrial use. The poster will display the natural rainwater cycle to emphasise the importance of protecting water from pollutants.

The benefits of recycling water, both economically and environmentally will be investigated. New technologies available to aid water recycling will be explored. With the proposed introduction of charges for water usage this information could prove invaluable.

Plant Selection for Use in a Submerged Aquatic Vegetation (SAV) Wetland under Temperate Conditions

Louise Esmonde, Professor Nick Gray

Botany Department, Trinity College, Dublin 2, Ireland.

Corresponding Author Email: lesmonde@tcd.ie

Keywords: wastewater, submerged aquatic vegetation wetland, submerged macrophyte, relative growth rate

Constructed wetlands and the utilization of plants in the treatment of wastewaters is seen as a sustainable and low carbon alternative to conventional treatment solutions.

Submerged Aquatic Vegetation (SAV) wetlands utilize the ability of submerged macrophytes to remove nutrients and metals from the water phase to treat wastewater.

They also provide a substrate for heterotrophic bacteria which facilitates removal of dissolved and colloidal organic matter. This study uses the relative growth rates (RGR) of a number of submerged macrophyte species as an aid in selecting the best species for use in a SAV wetland. Species with higher RGR will have greater biomass production and a greater contact area with the wastewater therefore improving the treatment potential of the wetland. The RGR biomass and shoot length of the submerged macrophyte species *Myriophyllum spicatum*, *Elodea canadensis* and *Ceratophyllum demersum* were measured over a thirty day period in a controlled laboratory environment. Shoots of each species were grown in different concentrations of Hoagland growth medium (0, 5, 10, 25 and 50%) in the presence and absence of a rooting medium. The highest RGR were observed at low to medium strength growth solution. RGR was found to be in the order: *Elodea canadensis* > *Myriophyllum spicatum* for planted specimens and *Myriophyllum spicatum* > *Elodea canadensis* > *Ceratophyllum demersum* for unplanted specimens. At higher concentrations plant decay or dead was observed in all species. This limits the use of these species in nutrient rich wastewaters and suggests that SAV wetlands are best suited to the tertiary treatment of final effluent. In comparisons of planted and unplanted shoots *Elodea canadensis* had a higher growth rate when planted while *Myriophyllum spicatum* grew best when unplanted which is important when considering wetland design. Research is on-going into the nutrient and metal reduction in wastewater using these macrophytes.

Nitrogen Attenuation Along Delivery Pathways in Agricultural Catchments

Eoin McAleer^{1,2}, Catherine Coxon¹, Per Erik Mellander², Alice Melland²,
Paul Murphy² and Karl Richards³

¹*Geology Department, School of Natural Sciences, Trinity College, Dublin 2.*

²*Agricultural Catchments Programme, Teagasc, Environment Research Centre, Johnstown Castle, Wexford.*

³*Crops, Environment and Land Use Programme, Teagasc, Environment Research Centre, Johnstown Castle, Wexford.*

Keywords: Nitrogen flux; saturated zone; nitrogen attenuation; hyporheic zone

Nitrate is regarded as one of the dominant contaminants affecting surface water and groundwater quality worldwide. With the enactment of the EU Nitrates Directive (1991) into Irish law, the risks to water quality associated with farmland activities must be reduced while also maintaining agricultural productivity. The Agricultural Catchments Programme (ACP) aims to provide a scientific evaluation of the effectiveness, or possible need for modification, of the National Action Programme measures under the Nitrates directive. These measures are implemented through the Good Agricultural Practice for Protection of Waters Regulations (2010). In order to facilitate this objective, a detailed conceptual understanding of the fate of agriculturally derived nitrogen as it travels through the subsurface is required. This research project is being undertaken from 2012 to 2016 in two intensively managed catchments in Co. Wexford and Co. Cork. Both catchments are dominated by well drained soils and relatively permeable geology but have contrasting prevailing land-uses: tillage in Co. Wexford and dairy grassland in Co. Cork. The focus of this work is to quantify the flux of nitrogen through the saturated zone, from the top of an intensively monitored hillslope transect, to its base where it intersects with the stream hyporheic zone. Each hillslope borehole consists of three piezometers all equipped with an instrument recording and logging groundwater piezometric level. This information, in conjunction with monthly low flow groundwater sampling and analysis, will provide a nitrogen flux dataset with a high degree of temporal accuracy. In addition, the nitrogen assimilatory capacity of both the aquifer system and hyporheic zone will be quantified. This will be achieved by undertaking dissolved gas sampling and isotopic tracer analysis on the boreholes and also, potentially, within the hyporheic zone.

Effluent Toxicity Testing in Ireland (1983-2013)

Robert Hernan, Kathleen O'Rourke

Shannon Aquatic Toxicity Laboratory, Enterprise Ireland, Shannon Town Centre, Co.Clare, Ireland

Corresponding Author Email: robert.hernan@enterprise-ireland.com

Keywords: toxicity testing, wastewater effluents, toxic units, species sensitivity

In Ireland the EPA, as part of their IPPC programme, regulate industrial effluent discharges. In the case of complex (non-simple) effluents, the EPA requires a combination of toxicity testing and the traditional substance by substance analysis. Approximately 25% of all licenses have a toxicity clause. Toxicity testing is carried out on a final effluent sample to either marine or freshwater fish/crustacean/algae/bacteria. Discharges to WWTP also require a respirometry test.

The EPA has assigned a toxicity emission limit value of no more than 10 toxic units (TU) i.e. $E(L)_{50} < 10\%$ vol./vol. to most effluent discharges. In 2011, 90% of the samples tested were within the 10 TU limit. Between 1991 and 2011, greater than 70% effluents were within the 10 TU limit however between 1985 and 1990, greater than 50% effluents were over the 10 TU limit.

In 2011, *S. costatum* and *T. battagliai* were the most sensitive test species with fish the least sensitive. In general we have found that the fish tests, rainbow trout and turbot, are the least sensitive test species. Other species including *Lemna minor* and *Crangon crangon* have also exhibited low sensitivity to effluents. The marine alga, *Skeletonema costatum*, is the most sensitive.

In 2011, 35% of effluent samples tested discharged to freshwaters, 34% to WWTPs and 31% to coastal waters. In recent years increasing numbers of discharges are going to tertiary WWTPs.

Domestic wastewaters are licenced by the EPA through Wastewater Authorisation (WWDA'S) since 2008. Approximately 20% of large wastewater treatment plants (population equivalent >200) require toxicity testing. Initial testing shows these are mostly non-toxic.

μAQUA – Standardisation and Validation of a Universal Microarray for Waterborne Pathogen Detection

Ciara Ní Chualáin, Bas Boots and Nicholas M. Holden.

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

Corresponding Author Email: ciara.nichualain@ucd.ie

Keywords: water quality, pathogen detection, microarrays, ultrafiltration, validation

To address the challenges of emerging pathogens and their continuous surveillance in drinking water, a panmicrobial microarray is currently under development. The FP7 μAQUA project aims to develop a microarray to simultaneously detect and differentiate major waterborne pathogens independently of traditional methods which rely on cultivation, microscopy or biochemical characterisation. A universal, standardised method comprising sample collection, concentration, RNA extraction and microarray detection is described. Primary concentration of large volumes of water is achieved by ultrafiltration through a tangential-flow, hollow-fibre filter capable of simultaneously recovering viruses, bacteria, protozoa and cyanobacteria. This filter allows particles smaller than its molecular weight cutoff to pass through the membrane, while microorganisms are retained within. Microorganisms are subsequently eluted from the hollow-fibre filter and further concentrated by sequential filtration through filters of decreasing pore size (20 – 0.1 μm). Total RNA is extracted from the filters, directly labeled and hybridised to the microarray allowing for an unbiased representation of community composition. This obviates other amplification techniques which are sensitive to co-extracted compounds which can inhibit enzymatic activity. A hierarchical set of probes spotted on the microarray allows the identification of species at different taxonomic levels. To validate the microarray, seasonal samples are collected from streams, rivers, lakes and marine habitats in Europe known to contain pathogenic microorganisms. Traditional analysis and microarray analysis are performed on each sample in parallel, identifying and enumerating all organisms targeted on the microarray. Following validation, the μAQUA microarray will be applied as a water quality monitoring tool to a range of environmental samples from Ireland, France, Germany, Italy, Bulgaria and Turkey for a period of 24 months. Successful validation of this universal microarray will facilitate its incorporation into an automated, user-friendly, commercial device suitable for semi-continuous water monitoring.

Geogenic Metal Concentrations in Irish Drinking Water

Enda McGroary¹, Barbara Petrunic¹, Monica Lee², Taly Hunter-Williams²,
Tiernan Henry¹ and Liam Morrison¹

¹*Earth and Ocean Sciences; and Ryan Institute for Environmental, Marine and Energy
Research, National University of Ireland, Galway*

²*Groundwater Section, Geological Survey of Ireland, Dublin, Ireland*

Keywords: groundwater, metals, arsenic, GIS

Worldwide reports of geogenic arsenic and metal contamination in groundwater are steadily increasing with more sophisticated analytical methodology and rising health concerns. In Ireland both surface water and groundwater are used for public and group scheme supplies, with a heavy reliance on groundwater for private supplies. Surface waters are at greater risk of microbial and event-based contamination, while groundwater usually contains greater levels of dissolved naturally-occurring elements. This results in the risk of potential exposure to, and the associated health risks of, arsenic and other metals such as iron, selenium and antimony. The cause of elevated metal concentrations in various water bodies has not been studied systematically and in detail in Ireland, but it is expected that geological formations are a major geochemical control. To address this knowledge gap, a national survey was undertaken in association with the Geological Survey of Ireland (GSI) and the 29 local County Councils to identify and locate reported elevated incidences of arsenic and other dissolved metal concentrations in groundwater. This study aims to assess all available metal data in Irish drinking water on a national scale and within a geological framework. Using Geographic Information Systems (GIS), the metal concentrations were plotted on bedrock geology maps and aquifer vulnerability maps to determine and evaluate spatial relationships. From the maps, all occurrences of elevated groundwater arsenic concentrations were within fractured sedimentary bedrock, particularly shale, sandstone (high arsenic content) and limestone. A national arsenic map is also presented with the highest aqueous arsenic concentration at 21.02 mg L⁻¹ (possibly anthropogenic). The highest concentration, potentially geogenic origin was 9.59 mg L⁻¹. Arsenic mobilization mechanisms can be tentatively ascribed to areas with the required geochemical data, such as reductive dissolution in areas of Co. Kerry. This GIS based study links arsenic concentrations above the maximum allowable concentration (MAC) for arsenic at 7.5 µg L⁻¹ to geology. The next step will be to conduct detailed geochemical, hydrogeological and speciation studies of sites of interest to determine exact mobilization mechanisms.

Microbial Mobilization of S and P in Biochar Amended Soils

Aaron Fox¹, Witold Kwapinski² and Achim Schmalenberger¹

University of Limerick, Life Sciences¹, Chemical and Environmental Sciences², Limerick

Key-words: Plant growth promotion Nutrient-mobilising Bacteria

Biochar has exhibited many potential agricultural benefits, such as plant growth promotion effects, increased soil water retention and neutralisation of acidic soil pH. Its impact on microbial-mediated macronutrient bio-availability, however, is largely unknown. This is particularly the case with sulfur (S) and phosphorous (P). Plants rely on microorganisms to mineralize organic and inorganically bonded S and P for their own requirements.

Replicate pot experiments of ryegrass *Lolium perenne* var. Malambo, spring barley *Hordeum vulgare* var. Sy taberna and tomato *Lycopersicon esculentum* were established. Pot soils were treated with 1 or 2% biochar (w/w, made from *Miscanthus giganteus*, pyrolysed at 600°C) or were kept biochar-free as a control. Biochar amendments resulted into a significant growth promotion effect with all plants tested. All combinations of plant and biochar treatments showed a “liming effect” in the pot soils in the form of raised pH and trends towards increased soil water retention were identified in connection with the addition of biochar. From rhizospheric soil extracted from each plant replicate, Most Probable Number analysis was conducted and Colony Forming Units were established using minimal media to grow bacteria capable of mobilising a) S from aromatic sulfonates, b) P from phosphate-esters, c) P from phosphonates, and d) P from tricalcium-phosphates. Greater abundance of S and P mobilising bacteria were associated with both biochar treatments against the control treatment for each plant.

Very little is known about the potential role of bacteria colonizing the char. These results suggest that increased numbers of S and P mobilising bacterial colonizers in biochar amended soil could be beneficial for plant growth through enhanced nutrient mobilisation.

Attitudes to Recycling in Limerick, Ireland- Knowledge Action Gap

Susan Byrne, Bernadette O'Regan

*Centre for Environmental Research, Department of Chemical and Environmental Science,
University of Limerick, Limerick, Ireland*

Corresponding Author Email: susan.byrne@ul.ie

Keywords: recycling, waste collection services

Recycling across Ireland has increased incrementally since the introduction and implementation of the Landfill Directive 1999/31/EC, July 2001; the WEEE directive 2002/96/EC, August 2005 and the Waste Framework Directive 2008/98/EC December 2008. As a result of the implementation of the aforementioned directives the volume of waste sent to landfill has fallen, household composting increased and recovery of municipal waste recyclables continues to improve. The improvements witnessed, are in part achieved as a result of the introduction of the 2-bin and 3-bin collection service. The improvement of facilities at recycling centres and bring banks has also been instrumental in the gains achieved in recycling rates.

NIMBYism however, remains a constant impediment to procuring suitable sites for the recycling receptacles. It is not unusual for people to seek convenience whilst not wanting the associated problems on their doorstep. NIMBYism is something that most individuals are guilty of and it is considered to be quite normal.

The structural difficulties associated with recycling rates are the first that need to be confronted. By altering the landscape, behaviours can be changed and improved. In the instance of bring banks and the social problems that are associated with them such as fly-tipping, changing the visual aspect of the receptacles and their positioning may improve recycling rates and reduce the number of instances of fly-tipping and littering.

This paper presents the results of 509 questionnaires distributed to nine primary schools actively participating in the Green School Programme. The questionnaires were analysed in an attempt to get an understanding of the motivations and the deterrents surrounding household recycling of waste. From the analysis recommendations are made to reduce the social problems associated with bring banks and to increase the percentage of householders availing of waste collection services.

Valuation of the Sustainability of an Irish Rural Community using a Quantified Approach

Susan Byrne, Bernadette O'Regan

*Centre for Environmental Research, Department of Chemical and Environmental Science,
University of Limerick, Limerick, Ireland*

Corresponding Author Email: susan.byrne@ul.ie

Keywords: carbon accounting; material flow; energy saving policies

Reducing dependence on fossil fuel derived energy has been the focus of the Ballynagran Energy Plus+ Community Project since its inception in November 2010. Funding for this ambitious project has been secured from Wicklow County Council in association with Greenstar Ltd.

A Material Flow and Carbon Accounting study of this rural area is being conducted to enable the calculation of current energy and resource use. The study will measure the quantity of resources that are used and produced within the study area and evaluate the sustainability of this Irish rural community. To enable consumers to become energy sufficient, information needs to be available, not only on current usage levels but on where potential energy savings can be made. Only then can energy saving policies be effectively devised and implemented.

The aim of this research is to employ the Sustainability Evaluation Metric for Policy Recommendation (SEMPRe), developed by the CER with funding from the EPA, to evaluate and predict the impacts of policy implementation. Sustainability indicators for the project have been chosen based on the objectives of the Ballynagran Energy Plus+ Community Project.

Agenda 21, states that "one of the fundamental prerequisites for the achievement of sustainable development is broad public participation in decision-making", to this end the Ballynagran Energy Plus+ Community committee members are actively encouraging and promoting sustainable living practices within their community through regular newsletters and information days. The monies received through the landfill levies are being pumped back into the community to improve the quality of life for local residents. Long term, the objective of the project is to produce renewable energy, in excess of what is required by the community, locally in order to become an Energy Plus+ Community.

Developing Water Footprinting Methodologies for Irish Milk Production

Eleanor Murphy^{1,2}, John Upton¹, James Humphries¹, Pdraig French¹, Nicholas Holden², Thomas Curran²

¹*Livestock Systems Research Department, Animal & Grassland Research and Innovation Centre Teagasc, Moorepark, Fermoy, Co.Cork.*

²*School of Biosystems Engineering, University College Dublin, Belfield, Dublin 4.*

Corresponding Author Email: john.upton@teagasc.ie

Keywords: water footprinting, life cycle, sustainability, milk production

Freshwater makes up 3% of the global water supply while agriculture accounts for 70% of freshwater use in the world. Freshwater can no longer be considered a local resource due to the international trade in water-intensive goods. In Ireland, government strategies such as Food Harvest 2020 aims for a 50% rise in milk production through sustainable expansion however this expansion will invariably result in a significant increase in freshwater utilisation.

Sustainability indices of the future will need to be cognisant of environmental issues such as biodiversity, energy use, carbon emissions and water consumption. The development of a 'Water Footprint' methodology provides an opportunity to quantify the water requirement of Irish milk production. The concept was introduced as a means to calculate a consumption-based indicator of freshwater use, assessing both direct and indirect water use taking into account all water required along the life cycle of product. In relation to milk production it takes stock of the water requirements of grass and supplementary feed, drinking water and other water uses. This approach is important because hotspots of water use along the production chain can be identified.

This study aims to quantify the Irish milk production water footprint as a means of increasing the sustainability of the dairy industry by minimising freshwater use. Data will be collected from 25 commercial dairy farms for one year. This data will be used to develop a cradle to farm-gate water footprint model. This detailed approach will give an understanding how and where water is utilised on both daily and seasonal time horizons. Finally conservation strategies for fresh water use will be modelled and implemented.

Control of Invasive Riparian Vegetation by Use of Innovative and Traditional Methods to Protect Users of Urban Public Parks in Dublin

Maryann Harris,

Parks and Landscape Services Division, Dublin City Council, Civic Offices, Wood Quay, Dublin 8

Corresponding Author Email: maryann.harris@dublincity.ie

Keywords: invasive species, giant hogweed, public parks, riparian vegetation

Giant hogweed (*Heracleum mantegazzianum*) is a threat to park users' health, by causing severe skin burns. It was first introduced into Ireland in the late 19th century in the River Tolka at Glasnevin and is still invasive here through the catchment. The threat of invasive species here is cited in the City's Biodiversity Action Plan (DCC, 2008). A traditional management regime of herbicide application annually, similar to that for the Mulkear catchment (Caffrey, 2001), has been in place since 2007 in Dublin City at selected locations (zoned public open spaces and parks) along the River Tolka. The existing banks of the river had sparse riparian vegetation due to previous land management regimes and concerns about antisocial behaviour. Habitat and flora/fauna surveys undertaken by Dublin City Council and Inland Fisheries Ireland suggested high biodiversity potential is attainable although there was degradation of habitat (Keeley, 2010; Tubridy, 2010). The construction of a new public park along a section of the River Tolka afforded an opportunity to pilot a new approach under Renew4GPP, an EU LIFE Project (LIFE09 ENV/BE/000406), the objective of which is to enhance green public procurement (GPP) by demonstrating to municipal authorities the ecological advantages of three, high-quality, innovative landscaping products based on 100% renewable resources. Biodegradable weed control matting was installed in 2012 in areas of exposed soil and planted through with increased density of native riparian species to provide habitat and replace invasives such as giant hogweed and Himalayan balsam (*Impatiens grandulifera*). In other areas, a second type of matting is used for seeding with native wildflower/grass mixes. It is fire-retardant to resist vandalism and secured to prevent loss through flooding. Monitoring will continue until 2015, but preliminary results indicate that it is preventing soil loss during flooding, resisting burning and reducing maintenance requirements.

Caffrey, J.M. (2001) The Management of Giant Hogweed in an Irish River Catchment in *J. Aquat. Plant Manage.* 39 (2001): 28-33.

Dublin City Council (DCC) (2008) Dublin City Biodiversity Action Plan p. 25, 43.

Keeley, B. (2010) Fauna survey of Cardiffsbridge Park. Unpublished study for DCC.

Tubridy, M. (2010) Strategic green network habitat study. Unpublished study for DCC/Heritage Council.

Constructed Wetlands for the Treatment of Acid Mine Drainage

L.B. Holland and S. N. Jordan

Dundalk Institute of Technology

Corresponding Author Email: siobhan.jordan@dkit.ie

Keywords: Spent mushroom compost; remediation

Acid mine drainage (AMD) is created as a result of intense quarrying of mining sites and occurs as a result of a complex chemical reaction of water and iron sulphide. It is also recognized as having a low pH and containing high concentrations of sulphur and heavy metals. The aim of this research was to determine if spent mushroom compost (SMC) could be used to remove metals and sulphur contaminants from water and to identify how much pollutant can be removed by SMC, in an attempt to create an alternative management strategy of SMC. This will also aid in reducing the challenges associated with AMD. Three wetlands were established, which consisted of four containers connected in series. SMC was added to each container and flooded with simulated acid mine drainage (SAMD), where sufficient contact was made to achieve metal removal. Results to date show that SMC has an exceptional buffering capacity against the acidic mine drainage having maintained a pH in the range of 5-7 in all cells, with the exception of the receiving cells. Further results on the removal of zinc and copper, indicate that the SMC wetland has the ability to remove upward of 95% of zinc and copper particulates from solution, with reductions in iron and sulphate also being achieved over an extended period of time. It is anticipated that this wetlands system may provide a long-term waste management option for SMC in Ireland, in addition to providing a cost-effective alternative to treating AMD when compared to conventional remediation techniques.

CALORIFIC VALUE OF SPENT MUSHROOM COMPOST AND ITS POTENTIAL AS A FUEL SOURCE TO PRODUCE THERMAL ENERGY IN BOILER SYSTEMS

Farrell, M.P., Gilleran, C.T. and Jordan, S.N.

Dundalk Institute of Technology

Corresponding Author Email: siobhan.jordan@dkit.ie

Keywords: Spent mushroom compost; calorific value

Ireland produces 292,000 tonnes of spent mushroom compost (SMC) per annum. SMC consists of straw, poultry manure and gypsum and at present the majority of SMC is land spread as a fertiliser. SMC has high salinity, relatively high phosphorus and low available nitrogen levels which limits its use through land application. Potential production of bioethanol is reduced due to low levels of carbohydrates found in SMC as is biodiesel production due to negligible lipid content. However, in laboratory trials, combustion of SMC produces heat energy comparable to that of some pine woods species. Results from this present study show that *heat of combustion* for six samples of SMC averaged 22,000 J/g of heat energy. While independent studies show wood to have an average of 15,000 J/g this is, however, a general value for wood and the value is dependent on the species used. SMC is considered a by-product of the mushroom industry and as such, has little inherent value today. This makes it a very cheap and plentiful resource, should a viable use be found. However, SMC contains a high percentage of moisture and this must be removed prior to combustion. SMC on a dry weight basis contains up to 30% inorganic solids (ash) and this can give rise to further issues. Treated (dried) SMC could be used on-site, in boiler systems to supply the heating or electrical energy required by the mushroom grower. As energy costs continue to rise, this potential use of SMC in boiler systems could be advantageous.

Chemico-physical properties and mutagenic activity of biochars produced via pyrolysis of Irish agricultural residues and waste

Anna V. Piterina^{a,b} and Michael H. Hayes^c

a- Competence Centre for Biorefinery and Bioenergy (CCBB), Ireland

b- Materials and Surface Science Institute (MSSI), Ireland

c- Carbolea, Chemical and Environmental Science Department

Corresponding Author Email: anna.piterina@ul.ie

Keywords: biochar, pyrolysis residues, waste disposal, soil, mutagenicity

It is growing number of recent development in technologies and procedures within industrial biorefinery and bioenergy processes that can benefit society by significant improvement in procedures within chain of smart waste disposal and sustainable agriculture. Biochar as one important by-product of *biorefinery processes*. *Its production and applications are emerging globally as novel industrial and commercial sector*, however, the quality and chemical properties of such products will depend on the processes employed and the compositions of the substrates used. It is of high importance to develop and validate series of suitable protocols for the ecological monitoring of quality and properties of pyrolysis products named as "BIOCHARS", and to initiate an establishment regulatory constrains and procedures which required to be implemented in product characterization chain. Here, we examined suitability of Ames test to analyse mutagenic activity of DMSO biochar extracts using two bacterial models (*S. typhimurium* strains **TA 98** and **TA 100**) and established which tester strain which is most sensitive to recovered mutagenic compounds and condition of metabolic activation (**S9**). Developed testing protocols as described shown to be suitable for sensitive screening and detection of the mutagenic residuals within the other type biochar products produced on research and industrial scale in Ireland.

Progress in the biotechnological processing and environmental management of domestic sewage and waste in Ireland

Anna V. Piterina^{a,b,c}, John Bartlett^d, and Tony J. Pembroke^{b,c}

a) Competence Centre for Biorefinery and Bioenergy (CCBB); Ireland

b) Molecular Biochemistry Laboratory, CES department, UL, Limerick, Ireland

c) Materials and Surface Science Institute (MSSI)

d) Institute of Technology, Sligo

Corresponding Author Email: anna.piterina@ul.ie

Keywords: ATAD, microbial consortia, efficient waste processing, biosolids

10 years research study offers a significant advancement to the prior body of knowledge and tools regarding microbial consortia within the extreme environmental niche of full scale autothermal thermophilic aerobic digester known worldwide for excellent stabilization and processing domestic and animal waste. For the first time to date, the efficiency of molecular techniques such as genera-specific PCR-DGGE to monitor biodiversity indexes within the ATAD ecosystem were evaluated and microbial dynamics in response to elevated temperatures and high pH during processing examined. We have demonstrated that diversity recovery is a feature of the optimisation of the molecular approaches used and is essential for optimum species identification in extreme environments. The community associated with ATAD thermophilic stage (23hrs) were analysed via PCR, clone library, phylogenetic analysis and systematic comparative analysis of all organism identified to date within other worldwide ATAD systems. The list of organisms and techniques identified and collected will be of great help for further exploitation, recovery of organisms, and their utilisation for ATAD bioaugmentation and ATAD performance. The particular findings in regard to cellulose degraders, metal reducing anaerobes, capnophiles (CO₂ utilization) and symbiotic organisms within tested ATAD systems are extremely innovative and will undoubtedly trigger new academic and industrial research

**Reconnecting children and nature?
Mapping the evolution of environmental education in Ireland**

Sarah O'Malley PhD candidate

School of Political Science and Sociology, Room 331, Áras Moyola, NUI, Galway

Corresponding author email: s.omalley5@nuigalway.ie

Keywords: Environment, nature, education, sustainability

There is currently a limited amount of published research and information available that examines the status of environmental education in Ireland. In the past children learned about nature through informal means including exploration, adventure and enjoyment. Today these informal ways of learning about nature are being replaced by formal means in conjunction with social and physical changes on the landscape. Unlike before children are now more likely to learn about nature through media outlets or structured, organised supervised programmes, lessons and intermittent outings primarily within mainstream education. Many conventional environmental education programmes advocate the efficient, evidence-based management of natural resources to solve environmental problems rather than promoting a holistic engagement with broader sustainability. Drawing on a range of data sources, the research addresses the question: How and to what extent does environmental education influence people's relationship with the natural environment? The poster presents the research process and recommends a more reflexive and self-critical environmental education approach that considers wider social conditions that fuel and accelerate the growing (dis)connect between children and the natural environment.

Biomass Yield and Resistance to Weed Invasion Enhanced by Four-Species Mixtures in Intensively-Managed Grassland: A Three-Year Continental-Scale Field Experiment

Laura Kirwan¹, John A. Finn², John Connolly³, Caroline Brophy⁴, Maria Teresa Sebastià⁵, Aslaug Helgadóttir⁶, Andreas Lüscher⁷

¹Waterford Institute of Technology, Cork Road, Waterford, Ireland

²Teagasc, Environment Research Centre, Johnstown Castle, Wexford, Ireland

³School of Mathematical Sciences, University College Dublin, Dublin 4, Ireland

⁴Dept. of Mathematics and Statistics, National University of Ireland Maynooth, Co. Kildare, Ireland

⁵Dept HBJ, ETSEA, Universitat de Lleida, Av. Rovira Roure 191, 25198 Lleida, Spain

⁶Agricultural University of Iceland, Keldnaholti, 112 Reykjavik, Iceland

⁷Agroscope Reckenholz-Tänikon Research Station ART, 8046 Zurich, Switzerland

Corresponding Author Email: lkirwan@wit.ie

Keywords: diversity effect, forage yield, agronomic mixtures, transgressive overyielding, sustainable intensification

A continental-scale field experiment across 31 sites was used to compare the biomass yield of monocultures and four-species mixtures of agronomic species. Each of the four species in the experimental design represented a distinct functional type derived from two levels of each of two functional traits, nitrogen acquisition (N₂-fixing legume or non-fixing grass) crossed with temporal development (fast-establishing or temporally persistent). Relative abundances of the four functional types in mixtures were systematically varied at sowing to vary the evenness of the same four species in mixture communities at each site. Across multiple years, the total yield (including weed biomass) of the mixtures exceeded that of the best monoculture (transgressive overyielding) in about 60% of sites, with a mean yield ratio of mixture to best-performing monoculture of 1.07 across all sites. Analyses based on yield of sown species only (excluding weed biomass) demonstrated considerably greater transgressive overyielding (significant at about 70% of sites, ratio of mixture to best-performing monoculture = 1.18). Mixtures were substantially more resistant to weed invasion over at least three years. Within each year, there was a highly significant relationship ($p < 0.0001$) between sward evenness and the diversity effect. Across sites with three complete years of data (24 of the 31 sites), the effect of interactions between the fast-establishing and temporal persistent trait levels of temporal development was highly significant and comparable in magnitude to the effects of interactions between N₂-fixing and non-fixing trait levels of nitrogen acquisition. The results are relevant for agricultural practice, and show how grassland mixtures can be designed to improve resource complementarity, increase yields and reduce weed invasion.

Plant diversity effects are robust to nitrogen application and cutting in experimental agronomic grasslands

Timothée Carnus T.^{1,2}, John Connolly², Laura Kirwan^{1,3} and John A. Finn¹

¹Teagasc, Environment Research Centre, Johnstown Castle, Co. Wexford, Ireland

²School of Mathematical Science, University College Dublin, Dublin 4, Ireland

³Waterford Institute of Technology, Cork Road, Waterford, Ireland

Corresponding Author Email: lkirwan@wit.ie

Keywords: mixtures, monocultures, evenness, yield, legume

The replacement of nitrogen fertiliser with nitrogen derived from N₂ fixation offers important economic and environmental advantages. Here, we investigated whether more diverse plant communities in intensively managed agricultural grasslands were more productive than their constituent monocultures under different regimes of environmental pulse (cutting) and press (nitrogen-fertilisation) perturbation. We investigated the effects of plant diversity of grasses and legumes, nutrient application and cutting on ecosystem function (aboveground biomass and weed invasion). We varied resource levels (two levels of nitrogen fertiliser) and cutting severity (two levels of cutting height) across a gradient of plant diversity (four species: *Lolium perenne*, *Phleum pratense*, *Trifolium pratense* and *Trifolium repens*) and relative abundance (varying species proportions) over a period of three years. Aboveground biomass was on average 16.5% higher in mixtures than in monocultures. On average, the yield benefits due to increasing evenness of four species mixtures were at least as big as the effects of increasing nitrogen by 150 kg ha⁻¹ yr⁻¹. On average, mixtures were significantly more resistant to weed invasion than monocultures. These results indicate the potential of grass-legume mixtures to provide yield benefits at moderate levels of nitrogen application.

The Effectiveness of Seed Coatings for the Establishment of Plant Growth Promoting Bacteria in Oilseed Rape an Agricultural Break Crop

Richard Lally, Antonio Sergio Moreira, Paul Galbally, Kieran Germaine, David Ryan, David Dowling

EnviroCORE Research Centre, Institute of Technology, Carlow, Kilkenny Road, Carlow

Keywords: Microbiology, plant growth promotion, crop research

Modern agriculture has been challenged with complex spraying strategies in order to adhere to environmental regulations. Plant growth promoting bacteria (PGPB) are being utilised to promote crop yields and have been shown to increase plant biomass and benefit plants resistance to disease and harsh environmental conditions. The environmental advantages of PGPB also make them suitable candidates for the bioremediation of soils, waterways and other environmental systems. It is important to establish PGPB at an early stage of a plants life cycle to help benefit its health and maximise growth. This poster will outline the steps taken to establish PGPB in the seedling of an oil seed rape (OSR) crop, using both a formulated glycerol coating and a commercial coating for the seeds containing target PGPB. *Pseudomonas fluorescens* (F113) is a PGPB which has shown significant plant growth promoting traits. Recently the entire genome of F113 has been sequenced by EnviroCORE. Using glycerol, a coating was formulated containing the target PGPB F113 and was sown in a greenhouse pot trial and a field trial. A commercially coated seed with the incorporated F113 target strain was also planted in a greenhouse pot trial and a field trial. The developing plants were sampled by removing as much of the root as possible. The samples were analysed using a real time PCR assay. The primers used for the amplification were Sequence Characterised Amplified Region (SCAR) markers, for species specific detection of F113. The root sections were examined using 'SCAR markers' to determine whether F113 was present. The results presented will compare the application of a commercial coating and a cheaper laboratory formulated coating with the presence of F113 being an indication of the viability of the coatings. This poster will also discuss the use of various seed coatings as tools in establishing PGPB in agricultural crops.

Invasiveness of the Alien Species *Lemna minuta* in Irish Freshwater Systems

Simona Paolacci, Simon Harrison, Marcel A.K. Jansen,

University College Cork

Corresponding Author Email: spaolacci@ucc.ie

Keywords: Lemnaceae, Alien Species, Invasiveness, Eutrophication

Lemna minuta Kunth is an invasive aquatic plant native of temperate regions of North and South America that has been spreading in Europe and is listed as established species in the Invasive Species Ireland Amber List. This study aims to assess whether a competitive dynamic occurs between *L. minuta* and the congeneric species *Lemna minor*. *L. minor* is native throughout Europe, and is widely spread in freshwater ponds and slow-moving streams. A series of experiments were performed to identify differences in responses between the two species grown in medium with different nitrate, ammonium and/or phosphate (eutrophic/oligotrophic) concentrations and with different initial pH (3, 4, 5, 6, 7, 8 and 9). Growth of the two species was analysed separately and in mixed cultures. The pH of the medium was measured every two days. The final biomass and the number of fronds were determined after 7 days and the Relative Growth Rate (RGR) was calculated.

Lemna minuta has a higher RGR and a higher frond production rate both in oligotrophic and in eutrophic medium. The difference in RGR between the two species is greater at high nutrient concentrations. Growth of *L. minuta* was faster at every initial pH value, except at pH 3 at which both species did not grow. Both *L. minuta* and *L. minor* reached the maximum RGR at initial pH-values ranging between 6 and 7. These data suggest that a simple difference in RGR might have given *L. minuta* a potential competitive advantage over *L. minor*.

The Relationship Between Stormwater Pollution and Rocky Shore Assemblages

Chloe Kinsella, Tasman Crowe

*UCD School of Biology and Environmental Science, University College Dublin, Belfield,
Dublin 4, Ireland.*

Corresponding Author Email: Chloe.Kinsella@ucdconnect.ie

Keywords: stormwater, marine biodiversity, intertidal assemblage, climate change

Increased levels of anthropogenic stressors in the marine environment are leading to complex changes in its diversity and functioning. Stormwater has been identified as an anthropogenic stressor which negatively impacts water quality, but its ecological effects remain unclear. This study aimed to identify the relationship between stormwater pollution and rocky shore assemblages. In April 2012, intertidal assemblages were sampled on rocky shores at a range of distances (0m, 10m, 20m, 60m, and 100m) from three stormwater outfalls north of Dublin. Preliminary results show that, in general, biodiversity increased with increasing distance from the stormwater outfall. For most variables, the relationship was non-linear in all three locations, with a step up in diversity between 20m and 60m. Multivariate analysis identified significant differences in assemblage structure between 0m and 100m, and 10m and 100m, at all three locations. Pollutants such as metals and polycyclic hydrocarbons may be the cause of reduced diversity in assemblages closer to the stormwater outfall. With the likelihood of increased rainfall in future years due to a changing climate, stormwater output is predicted to increase. The findings of this survey, along with planned experimental stormwater simulations in the field, may be used to improve the effectiveness of stormwater management and remediation approaches to benefit ecosystem functioning and provision of ecosystem services.

Southern Decomposer in Irish Soil

Carol Melody^{1,2} and Olaf Schmidt^{1,2}

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

² UCD Earth Institute, University College Dublin, Belfield, Dublin 4, Ireland.

Corresponding Author Email: carol.melody@ucdconnect.ie.

Keywords: decomposers; ecological niche; soil carbon; soil macrofauna; species introductions

According to ecological niche theory, invading species only become established if introduced propagules survive stochastic mortality and can exploit resources unconsumed by resident species. Because their transportation is not controlled by plant health or biosecurity regulations, soil macrofauna decomposers, including earthworms are probably introduced frequently into non-native soils. Yet even with climatic change, exotic earthworm species from southern Europe have not been reported to become established in previously glaciated areas of northern Europe that already have trophically differentiated earthworm communities of 'peregrine' species. We discovered established populations of the earthworm *Proselodrilus amplisetosus* (Lumbricidae), a member of a genus endemic to southern France, in six habitats of an urban farm in Dublin, Ireland, about 1000 km north of the genus's endemic range. Not only was *P. amplisetosus* the dominant endogeic (geophagous) earthworm species in two habitats, it also occupied a significantly different trophic position from the resident species, as evinced by stable isotope ratio analysis. The suggested ability of this non-native species to feed on and assimilate isotopically more enriched soil C and N fractions that are inaccessible to resident species portends potential implications of decomposer range expansions for soil functioning including C sequestration. The public interest generated by the establishment of this exotic species attests to the increasing interest and concern environmental invasions have for the general populace.

Productivity and Population Structure of the Kelp Species *Laminaria Hyperborea* in Galway Bay

Bror Prehn and Dagmar B Stengel

Botany and Plant Science, School of Natural Sciences; and Ryan Institute for Environmental, Marine and Energy Research, National University of Ireland, Galway

Corresponding Author Email: b.prehn1@nuigalway.ie

Key words: seaweed, kelp, productivity, environment, sustainability

Kelps (brown macroalgae belonging to the Laminariales) form extensive subtidal forests which support a large biodiversity by providing habitats, food, and shelter to marine biota. Ireland's abundance of rocky exposed shores facilitates large stands of *L. hyperborea* but these are poorly characterised; currently there are no data on kelp productivity, biomass, recruitment, or the even distribution and extent of kelp forests. *L. hyperborea* forests are commonly monospecific and found on rocky exposed shores below the low water mark. Although at this time kelps are not commercially harvested in Ireland, they are of considerable interest to the seaweed industry, and any potential future harvesting needs to be sustainable in the long-term.

Using *in situ* and laboratory studies, this project assessed productivity and population structure of the keystone kelp species *Laminaria hyperborea*. Age class distribution of the species from different locations and at varying depths in Galway Bay was investigated with the aid of SCUBA; individual kelps were aged, weighed and measured. *In situ* productivity of the photosynthetic performance of algae was investigated by underwater chlorophyll fluorescence measurements. *In vitro* (culture) experiments were conducted to quantify the effects of temperature and UV radiation on different age groups of *L. hyperborea*. Measurements of chlorophyll fluorescence, growth rates and CO₂ exchange were used to assess productivity responses to different treatments. Results show that age has a significant impact on productivity, and population structure is thus a key feature when attempting to predict kelp *in situ* productivity.

This research provides some first baseline data on *L. hyperborea* productivity in Ireland. Outputs include data on population structure and *in situ* productivity with possible implications for climate change impacts. Such information will help form the basis of any environmental impact assessment prior to potential future kelp harvesting, and is essential to protect these important marine habitats and ensure sustainability.

Development of Population-Specific Markers for European *Bombus terrestris* using the RAPD Approach

Moran S., Kakouli-Duarte T.

Molecular Ecology and Nematode Research Group, EnviroCORE, Institute of Technology Carlow, Kilkenny Road, Carlow, Co. Carlow

Corresponding Author Email: morans@itcarlow.ie

Keywords: Conservation genetics, molecular ecology, RAPD, climate change

In recent decades, significant declines in bumblebee populations, both in terms of abundance and distribution, have been noted in North America, Asia and Europe (Goulson *et al.*, 2005; Fitzpatrick *et al.*, 2006; Williams & Osborne, 2009). A number of causes have been proposed including the impact of increased urbanisation on food and habitat availability, changes in farming practices and exposure to pesticides and parasites (Goulson *et al.*, 2005; Carvell *et al.*, 2006; Fitzpatrick *et al.*, 2006; Otti & Schmid-Hempel, 2007; Benjamin & McCallum, 2008). An additional factor is the pressures posed by climate change. As bumblebees play an essential role as pollinators, both in ecosystems and commercially, their decline has the potential to cause serious impact on both an ecological and a human level.

In the context of climate change, population-specific markers could allow researchers to keep track of migration due to changes in the local environment, a trend which has been observed for some species (Houghton *et al.*, 2001; Hughes, 2002; Menendez, 2007; Gienapp *et al.*, 2008). In this study, 20 RAPD primers are being tested against several European populations of *Bombus terrestris* with the aim of detecting reproducible population-specific markers. Following preliminary tests, in which 10 samples, each from a different population, are being checked against each of the 20 primers, a subset will be selected on their ability to yield reproducible polymorphism.

Omega 3s Under the Seas: Increasing Bioactive Compounds in Seaweeds!

A. Byrne, M. Schmid and D.B. Stengel

Botany and Plant Science, School of Natural Sciences; and Ryan Institute for Environmental, Marine and Energy Research, National University of Ireland, Galway

Corresponding Author Email: a.byrne18@nuigalway.ie

Key words: seaweed, bioactive compounds, fatty acids, omega-3, food, health

As seaweeds are naturally rich in a wide array of bioactive compounds such as polyunsaturated fatty acids, pigments and phycobilins, there is a growing interest in their commercial utilization as a valuable source in human food and health markets. Particularly their unique fatty acid profile rich in ω -3 fatty acids as eicosapentaenoic acid (EPA) makes them a potential vegetarian, and more sustainable, alternative to ω -3s usually sourced from fish. Yet in order to use seaweeds in the most economic way, food industries will require consistent, high-quality seaweed biomass at low cost from sustainable sources. While healthy to humans, in seaweeds bioactive compounds are metabolites with specific physiological functions that allow the algae to tolerate and respond to environmental stresses, such as high light or low temperature events. These mechanisms need to be more fully understood to facilitate the culture of seaweeds for specific applications as healthy foods ingredients, functional foods or pharmaceuticals.

In order to progress in this area, in this project commercially interesting and edible Irish red seaweeds were investigated under different experimental setups. Species included the common *Palmaria palmata*, also known as "Dilisk" or 'Dulse', which is already commercially utilized. Species of red algae were cultured under different light, nutrient and temperature conditions, and growth and physiology monitored. Stress responses, and bioactive production and profiles, were measured throughout the experiments using fluorescence, HPLC and GC techniques. Impacts of different culture conditions were compared and potential controlling factors identified. Results from this study provide baseline data for future algal cultivation and a rationale for potential selective collection of red algae from wild stocks to assure high-value biomass for applications in the health and food markets.

Physiological Responses of Intertidal *Ascophyllum Nodosum* and its Free-Living Ecad *A. Nodosum Mackaii* to Salinity Stress

D.Kirke, U. Nitschke and D.B. Stengel

Botany and Plant Science, School of Natural Sciences; and Ryan Institute for Environmental, Marine and Energy Research, National University of Ireland, Galway

Corresponding Author Email: kirkedara@hotmail.com

Keywords: seaweed, salinity, stress, mannitol, *Ascophyllum nodosum* ecad *mackaii*

The intertidal seaweed *Ascophyllum nodosum* (Fucales) forms, under rare environmental conditions, a free-living variant (or 'ecad') which is characterised by a distinctly different morphology. The environmental and physiological control of this ecad formation is poorly understood but is considered to be related to salinity regimes and silt contents prevailing in some enclosed, sheltered habitats. The impact of salinity stress on cellular metabolism of the 'normal' morphological form of *A. nodosum* and the ecad *A. nodosum mackaii* was analysed here, with particular reference to photosynthetic performance and the accumulation of the compatible solute, mannitol. Samples were collected from a population in Connemara, western Ireland, and exposed to different salinity regimes in culture. Different parameters evaluating photosynthetic performance of samples were recorded after 1h (short-term response) and after 72h (long-term response) using a PAM-2000 chlorophyll fluorometer (Heinz Walz GmbH, Effeltrich, Germany). Associated changes in mannitol contents were analysed via HPLC.

For both *A. nodosum* and its ecad *mackaii*, mannitol accumulation increased over time from their initial, natural levels *in situ*, with all samples exposed to any of the three salinity levels exhibiting an increase in mannitol content after 72h. Highest mannitol levels were present, for both *A. nodosum* and its ecad *mackaii*, in algae submerged to the lower salinity of 20S_A after 72h. At high salinity of 50 S_A, both morphological types contained the lowest concentrations of mannitol after both 1h and 72h, with the lowest levels measured after 72h. As rETR_{max} values of all samples exposed to 20 S_A salinity was highest, results may suggest that mannitol was accumulated as a result of exposure to favourable conditions (and thus enhanced photosynthesis) as mannitol is the main photosynthetic product of brown algae but further work needs to address potential interactions with effects of submergence.

Wood ash mediated growth promotion and toxicity – two sides to the same coin

Lucas S. Jagodzinski*, Frank van Pelt', Marcel Jansen*, John O'Halloran*

* School of Biological, Earth and Environmental Sciences, University College Cork;

' Department of Pharmacology and Therapeutics, University College Cork

Author for correspondence: l.jagodzinski@ucc.ie

Wood ash arising from industrial scale furnaces burning untreated wood fuel exclusively has been suggested for recycling as a soil ameliorant based on its content of the plant macronutrients potassium and phosphorus. Wood ash however is currently classified as waste and contains heavy metals and organic contaminants. While their concentrations may be restricted by utilizing untreated wood fuel and ensuring its complete combustion respectively these compounds remain present in the ash. Thus candidate ashes have to be assessed for growth promotion potential as well as toxicity threshold before their use in the environment may be considered. The aquatic macrophyte *Lemna minor* (Alismatales, Araceae) served as model plant for both toxicity testing and assessing growth potential and was exposed to two different solid wood ash types (native bottom and fly ash, 0.625 g/L to 160 g/L) and corresponding leachate (0.625 g ash eq./L to 80 g ash eq./L). The ash investigated in this study originated from *Picea sitchensis* (sawdust, bark and wood chips) sourced in Munster and was fired at approximately 800 °C in a rotating grate furnace with a 3.5 MW thermal output. Growth bioassays were carried out in a static system under eutrophic and ultra-oligotrophic conditions for a 7 d period adapting OECD standard procedure 221.

No significant growth promoting effect was detected in standard full medium for either ash type while both wood ashes increased biomass growth rate and yield significantly when present in concentrations up to 5 g/L to ultra-oligotrophic medium. Solid fly ash and leachate were more toxic than bottom ash under all conditions studied, e.g. the calculated concentration causing 50% inhibition of growth against the control value (IC_{50}) is 2.4-fold higher for solid bottom ash (50.9 g/L) than for solid fly ash (21.1 g/L). IC_{50} values obtained in ultra-oligotrophic conditions are generally lower than those in full medium for a given ash type. Ash leachate furthermore appeared more toxic than solid ash introduced into the test system.

An Evaluation of the Applicability of Microarrays for Monitoring Toxic Algae in Irish Coastal Waters

Gary R McCoy¹, Nicolas Touzet ², Gerard TA Fleming¹, and Robin Raine¹

¹*The Ryan Institute for Environmental, Marine and Energy Research, National University of Ireland, Galway, Ireland*

²*School of Science, Department of Environmental Science, Institute of Technology, Sligo, Ireland*

Corresponding Author Email: g.mccoy3@nuigalway.ie

Keywords: Microarrays, Hierarchical probes, ribosomal RNA, HABs, Environmental monitoring, Cell concentrations

The applicability of microarrays to monitor harmful algae across a broad range of ecological niches and toxic species responsible for harmful algal events has been one of the key tasks in the EU seventh Framework Programme (FP7) funded Microarrays for the Detection of Toxic Algae project. The technique has a strong potential for improving speed and accuracy of the identification of harmful algae and their toxins to assist monitoring programmes. Water samples were collected from a number of coastal sites around Ireland, including several that are used in the Irish National Phytoplankton and Biotxin Monitoring Programme. Ribosomal RNA was extracted from filtered field samples, labelled with a fluorescent dye, and hybridised to probes spotted in a microarray format on a glass slide. The fluorescent signal intensity of the hybridisation to >120 probes on the chip was analysed and compared with actual field counts. There was a general agreement between cell counts and microarray signal. Results are presented for field samples taken from a range of stations along the Irish coastline known for harmful algal events during the first field trial (July 2009-April 2010).

Impacts of Changing Biodiversity on Ecosystem Functioning in Intertidal Sedimentary Systems

Ciara Murphy¹, Dr. Tasman Crowe¹, Dr. Carlos Rocha², Dr. Evelyn Doyle¹,
Prof. Nicholas Clipson¹

¹*School of Biology and Environmental Science, University College Dublin.*

²*Centre for the Environment, Trinity College Dublin*

Keywords: *Crassostrea gigas*, intertidal sediment, microbial ecology, biogeochemistry, invasive species

It is generally accepted that biodiversity influences ecosystem functioning. Microorganisms are a key driver of ecosystem processes, but it is not fully understood how environmental changes impact on the composition and functioning of microbial communities. The objective of this study is to test whether invasive species, in this case the invasive oyster *C. gigas*, alter microbial community composition and function in marine intertidal sediments, together with their biogeochemistry. A mesocosm experiment was conducted comparing marine intertidal sediment in the presence and absence of the invasive oyster, *C. gigas*. Microbial community composition was assessed using TRFLP of the 16S rRNA gene. Ammonia and TON concentration of pore water of the sediment was used as an indication of biogeochemical activity. Preliminary results indicate that sediment in the presence of the invasive oyster had significantly increased concentrations of ammonia, specifically in the top 5mm of the sediment, possibly due to increased organic matter deposition by the oysters.

Regional Modelling of the 21st Century Climate Changes in the Irish Sea

Agnieszka I. Olbert¹, Michael Hartnett¹, Tomasz Dabrowski², Stephen Nash¹

¹*Civil Engineering, College of Engineering and Informatics; and Ryan Institute for Environmental, Marine and Energy Research, National University of Ireland, Galway, Ireland*

²*Marine Institute, Rinville, Oranmore, Co. Galway, Ireland*

In this research an assessment of the complex evolution of climate change signals in the Irish Sea over the 21st century is undertaken. Potential impacts of climate change on the local hydrography are explored and interrelationships between fundamental oceanographic shelf sea phenomena investigated. A regional ECOMSED ocean model is used to downscale a 120-year period (1980-2099) of the SRES A1B scenario experiment from a global ocean model. A detailed regional analysis shows that local climate changes may be significantly different from the expected global changes.

This research suggests that in the future the Irish Sea will be warmer with sea surface temperature increase of around 1.9°C. Maxima and minima annual temperatures will occur around 2 weeks later each year relative to the present climate. Geographically, shallow waters along the coastline and in the eastern Irish Sea will exhibit strongest warming due to increased heat uptake during summer and autumn and reduced heat loss in spring and winter. Warming in the deep channel in the western Irish Sea will be generally weaker with seasonal variability subdued due to a large heat storage capacity. The warming will be largely stored in the surface layer of the water column leading to strengthening of stratification and a considerable decrease in the thickness of the mixed layer. The western Irish Sea gyre will become stronger and result in substantial reinforcement (>30%) of southward currents along the east coast of Ireland. Net northward flow in future climate will be maintained at the current annual rate. Steric sea level is projected to rise by 0.31m during the 21st century, leading to an overall projected sea level rise of approximately 0.47m.

Future changes to oceanographic parameters, flushing times and hydrodynamics of the Irish Sea are likely to alter the habitat and distribution of marine species; the finding of this research are therefore of great interest to ecologists and the fishery industry.

Irish Society for Ocean Studies

Peter Croot^{1,2}, Sarah Knight², Glenn Nolan³, Damien Guihen⁴

¹*Earth and Ocean Sciences, National University of Ireland, Galway, Ireland*

²*Ryan Institute for Environmental, Marine and Energy Research, National University of Ireland, Galway*

³*Marine Institute, Rinville, Oranmore, Co. Galway, Ireland*

⁴*British Antarctic Survey*

Ireland has 220 million acres of seabed territory – making it one of the largest seabed territories in Europe¹. With a marine resource more than 10 times the size of our land area on our doorstep, it is no wonder that there are so many research institutes, community organizations, and individuals in Ireland that are dedicated to learning about and preserving the sea around us.

The Irish Society for Ocean Studies is a newly-formed organisation that is being established to bring together all those on the island of Ireland who are engaged in the study of the oceans. We are keen to get representation from marine research institutes, organisations and interested individuals across Ireland.

While ISOS will cater particularly for students of ocean studies of all kinds – from the disciplines of natural science, to engineering, economics and the humanities - membership is open to all those interested or involved with the ocean. We also plan to seek members from community groups and those involved in projects to protect the oceans around Ireland, as we would see ISOS as offering a platform for communication and collaboration between all those who study, protect, and love the sea.

The society is in the early stages of formation - to date we have approximately 100 students, researchers, teachers and members of the public who have registered their interest on our website.

Later this year we will hold the first of our national annual colloquiums, where members can present their research, their ideas, and network with other students and researchers from across the country.

If you are interested in joining ISOS visit www.isos.ie for more information.

¹ <http://www.marine.ie/home/community/education>



Annual Review 2012

CHAIRPERSON'S ADDRESS:

From Dr. Paul Bolger



The Environmental Sciences Association of Ireland (ESAI) was established in 1991 to “facilitate communication and interaction between persons interested in the environment through colloquia, seminars, workshops and publications”. The association currently has over 500 members. Its activities are funded through an annual membership fee (€50 annually with a €25 concessionary rate for students). In attending the ENVIRON colloquium you are automatically entitled to a year’s free membership of the association. The Association activities are strongly directed by the ESAI Council. We are currently fortunate to have a hard-working, enthusiastic & committed Council who deserve credit for their efforts that they have made to sustain and develop the association over the past year. We are always looking for new members to join the ESAI Council so, if you are interested, please come along to our AGM which takes place at 1.30 PM on Thursday, January 31st in the Bailey Allen Hall.

The ESAI Council held a strategy workshop in April 2012 with the aim of reviewing the Association’s activity and with an eye to potentially developing additional events/activities that would benefit ESAI members and enhance the association. The workshop resulted in the ESAI Council committing to carrying out a number of new initiatives in 2012 (developing stronger links with other associations, hosting additional workshops around relevant environmental topics and holding a careers fair at ENVIRON 2013). I am pleased to say that we are making progress on all these initiatives as outlined in more detail below.

Workshops

In July, Mr Alan Berry (ESAI Council) facilitated a free guided tour of the RV Celtic Explorer for ESAI members as part of the Dublin City of Science festival. ESAI members were guided around the vessel by Marine Institute personnel and ship’s officers, offering a unique chance to see the inner workings of the vessel and interact with scientists and crew. The RV Celtic Explorer is the National Platform for Offshore Marine Research in Ireland. The ship is a highly sophisticated research vessel fully equipped with state-of-the-art scientific instrumentation, laboratories and IT equipment used for fisheries research, environmental monitoring, seabed mapping, oceanography, etc.

In September the ESAI co-hosted a workshop on the “*Treatment and Monitoring of Landfill Gas*” with the Chartered Institute of Waste Management and Cork City Council at the Life-

time Labs in Cork city. The workshop was followed by a field visit to the Kinsale road landfill site. The workshop, organised by Mr Kevin Ryan (ESAI Council), was attended by 50 delegates and was an excellent example of sharing good environmental practice combined with some novel research in the area of landfill gas monitoring.

Links to other professional environment organisations

Given the many environmental events calling on the attentions of environmental professionals the ESAI has been exploring and pursuing links with other professional associations working in the environmental area in Ireland with a view to collaborating rather than competing. These efforts are proving fruitful. In December 2012 the Association signed a Memorandum of Understanding with the Chartered Institute of Waste Management (CIWM). CIWM is the professional body which represents waste and resource professionals working in the sustainable waste and resource management sectors worldwide. The MOU will include commitments between the two organisations to run joint seminars/workshops, offer cross membership discounts for events/training courses and agree to promote each other's associations and activities. We look forward to a fruitful relationship with CIWM in the coming years and thank them for their past support of the ESAI.

Career Expo

The ESAI will hold the first Career Expo at this year's ENVIRON colloquium. Delegates will be able to meet representatives from NGOs, environmental consultancies, research institutes, and semi-state bodies to discuss job opportunities, internships, post-doctorate and PhD programmes and receive career advice. The career expo takes place on Thursday (January 31st) from 14:00-17:30 in the Bailey Allen Hall and provides a great opportunity for colloquium delegates to explore career options within the Irish environmental sector. Thanks to Cara Augustenborg and Aoife Delaney for their hard work in organising this event.

In addition to the above "new" initiatives the ESAI also held its 2011 ESAI photo-competition which had a high number of entries. To encourage a wide range of entries the theme of this year's competition was simply "The Environment". Congratulations Nick Warinton for his winning entry and thanks to Damian Howard for his work in organising and promoting this competition. The Association has also produced two newsletters in 2012 under the skilled editorship of Dr John Wann and Mr Timothy O'Sullivan. These newsletters can be downloaded from the ESAI website. The Association continues to maintain an active Facebook and LinkedIn page (ably administrated by Alan Berry); we would encourage all dele-

gates to join these groups to keep up-to-date on ESAI activities and environmental events/news.

The ESAI became a company in 2008 in order to apply for funds from the Irish Environmental Network (IEN). The Association was unsuccessful in receiving funds from the IEN and the ESAI returned to the status of Association in 2012 which is more suited to the aims and decision-making structures of the organisation.

Nuala Murphy is stepping down as ESAI Treasurer in 2013. Nuala has been a fastidious “minder” of ESAI funds over the past number of years and has been instrumental in putting in place new accounting procedures and we would like to sincerely her for dedicated work as Treasurer. Finally as always we are indebted to Sinead Macken for her work as ESAI Administrator in 2012.

Dr Paul Bolger

Paul Bolger is manager of the Environmental Research Institute at University College Cork. He has been on the ESAI Council since 2007, served as treasurer from 2008-2009, vice-chair in 2010 and was conference convenor at the 2011 ENVIRON in University College Cork.

ESAI GOALS AND OBJECTIVES 2012:

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 environment 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.

Photographer: Michael Yu



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.
- Networking at your finger tips by featuring in a Directory of Expertise on the ESAI website.
- Access to ESAI listserver
- Reduce isolation
- 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.
- Member presence in the online Directory of Expertise on www.esaiweb.org.
- Sponsorship opportunities

Keeping you Informed

The ESAI website – www.esaiweb.org – has now become a valuable resource for environmental professionals in Ireland. The new events area offers a snapshot of what is happening in the industry nationwide. The website is designed by AttikDesigns.

Social Networking

Network with the growing number of environmental science researchers and practitioners who have joined our online discussion fora on LinkedIn and Facebook. Updates from the ESAI and our members are posted on a daily basis advertising upcoming events, courses, career opportunities, links to matters of national and international interest to the environmental science community.

You can join us on:



<http://www.linkedin.com/in/esaiweb>



<http://www.facebook.com/esaiweb>

CONTACT DETAILS

ESAI Chairperson

Paul Bolger

Environmental Research Institute,

UCC, Lee Road, Cork

Email: chairperson@esaiweb.org

Tel: +353 (0)21 4901933

Website: www.esaiweb.org

ESAI Administrator

Sinead Macken

Stonehaven, Moy Road, Kinvara, Co. Galway

Email: administrator@esaiweb.org

Tel: + 353 (0)86 8071498

Website: www.esaiweb.org

2012 EVENTS:



Venue for Environ 2012: University College Dublin

7th-9th March: Environ 2012;

22nd Annual Environmental Researchers Colloquium hosted by UCD

7th March:

Introduction to Life Cycle Analysis *Workshop*

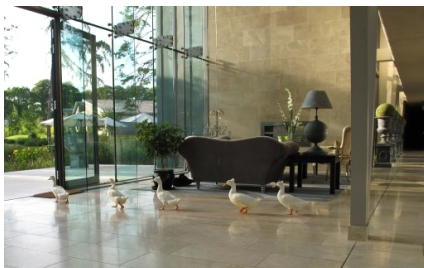
Effective Scientific Communication *Workshop*

CV Preparation and Interview Strategy *Workshop*

7th March:

Environ 2012, UCD

Launch ESAI 2012 Photography Competition “The Environment”



*“Ducks marching through a luxury
hotel into a summers evening”
Gerry Sugrue, 2011 Winner*

www.esaiweb.org

2012 EVENTS ctd.:

8th March: ESAI AGM

Environ 2012, UCD



18th June:

Issue 24 Summer 2012 Ezine



12th July:

Members Tour of
National Research Vessel,
CelticExplorer

September 21st:

Treatment and Monitoring of Landfill Gas Workshop

Jointly Hosted with CIWM, Cork City Council and ESAI, Cork

2012 EVENTS ctd.:

October 8th

Launch of Environ 2013 in Ryan Institute, NUI Galway

October 30th:

10% Discount offered to ESAI members for the 10th National Waste Summit, RDS

November 13th:

Cork Film Festival Tickets,
ESAI Members Competition

“Trashed” Documentary



November 19th:

10% Discount offered to ESAI members registering for Environmental Science and Social Policy Diploma in UCC

26th November:

Issue 25 Winter 2012 Ezine



www.esaiweb.org

nviron 2012

ENVIRON 2012

The 22nd Irish Environmental Researchers' Colloquium (ENVIRON 2012) was held in University College Dublin (UCD) from Wednesday, March 7th - Friday March 9th, 2012. UCD last hosted the ENVIRON colloquium in 2006 and were very pleased to welcome the colloquium again to coincide with the year long celebration of Dublin City of Science 2012.



The colloquium was well attended, with almost 300 delegates over the three days. As always, the organisers aimed to keep registration fees affordable. With that in mind, the registration fees included ESAI membership for one year, as has been the tradition. Presenters on waste topics also received free membership of CIWM. ENVIRON 2012 featured a new Student Discount Registration Fee (Group of 10) which was particularly aimed at Undergraduate and Taught Masters Students, who may be interested in deepening their knowledge of environmental issues and perhaps, considering a career in research. This attracted several groups of students through the generous support of the programme co-ordinators.

The theme for ENVIRON 2012 was "Our Environment: Integrating Today's Research with Tomorrow's Actions". The theme challenged delegates to consider how ongoing research can influence many overarching areas into the future such as environmental quality, policy, legislation, society and the economy. In order to engage fully with the theme, each presenter was asked to address how their research related to the theme in their abstract submission and concluding slide in their oral presentation.

The conference began on the Wednesday with a series of workshops. Ms. Fionnuala Murphy and Ms. Mingjia Yan of UCD Biosystems Engineering presented an Introduction to Life Cycle Assessment, an interactive session which was aimed at beginner level. Mr. Mark Cumiskey of UCD Career Development Centre hosted a workshop on CV Preparation & Interview Strategy, which was well attended by a cross section of delegates. An Effective Scientific Communication session was then co-presented by Dr. Padraig Murphy of Dublin City University and Dr. Brian Quinn of Galway-Mayo Institute of Technology; it featured various communication means such as oral and written forms and the process of getting a paper published.



Q & A Debate Panelists L-R: Paul Bolger (Chairperson ESAI), Dick Warner (Writer), Mary Kelly-Quinn (UCD), Frank McDonald (Irish Times), Micheal Ewing (Environmental Pillar), Tom Curran (Environ 2012 Host), Michael Phillips (Dublin City Council).

Later that evening, a Q&A discussion was held at the conference hotel, Stillorgan Park Hotel, on the theme “Water, water everywhere but not a drop to drink”. The panel included Dr. Mary Kelly-Quinn (Senior Lecturer, UCD), Mr. Michael Ewing (Environmental Pillar), Mr. Michael Phillips (Dublin City Engineer), and Mr. Dick Warner (Columnist & Broadcaster). The speakers covered a broad range of issues on sustainable water management including water quality and supply challenges, the need to involve people in governance, and the innate human attraction to water. The session was chaired by Mr. Frank McDonald (Irish Times), who also gave some thoughtful insights. There was an excellent attendance at the event and the audience asked a wide variety of questions, and indeed provided some interesting views of water issues, both current and historic. This was undoubtedly one of the highlights of the colloquium and it was particularly pleasing that many members of the public took the opportunity to attend this free event.

The UCD President, Dr. Hugh Brady, officially opened ENVIRON 2012 on the Thursday. He highlighted the importance of the work of the scientific community and wished all delegates well. The plenary session addressed the theme of “Our Environment: Integrating Today’s Science with Tomorrow’s Actions”. The panel included Mr. Michael Hamell (DG Environment, European Commission), Mr. John O’Dea (Dept. Manager, High Potential Start-Ups, Enterprise Ireland), Dr. Laurence Gill (Senior Lecturer & Head of Civil Engineering, TCD), and Dr. Kevin O’Connor (Senior Lecturer, UCD) alongside Chairman, Prof. Frank Convery of UCD Earth Institute. The discussion focussed on how science can be used as the basis of developments in

policy and commercial activity. Michael Hamell and John O’Dea emphasised the importance of science at EU policy level and the commercial potential of scientific activity, respectively. Dr. Gill showed how his work on domestic effluent treatment systems led to national guidelines in the area. Dr. O’Connor outlined the steps he took to commercialise his research on biodegradable plastics.



Environ2012 Plenary Session L-R: Kevin O’Connor (UCD), Tom Curran (Environ 2012 Host), Michael Hamell (DG Environment, European Commission), Frank Convery (UCD Earth Institute), Hugh Brady (UCD President), Laurence Gill (TCD), John O’Dea (Enterprise Ireland)

The colloquium dinner took place on the Thursday at the conference hotel, Stillorgan Park Hotel and was followed by a street dance performance and a disco. The ENVIRON 2012 colloquium closed on the Friday afternoon with a prize-giving ceremony and an announcement that the 23rd Irish Environmental Researchers’ Colloquium (ENVIRON 2013) will take place at NUI Galway.

Sincere thanks to all who contributed to ENVIRON 2012 and many congratulations to the prizewinners. Look forward to seeing you at the next colloquium at NUI Galway.

Dr. Tom Curran was the Convenor of the ENVIRON 2012 Colloquium

Student Prize Winners 2012

There were 130 presentations in total made at the Environ 2012 colloquium and the ESAI ran their annual student competition, judging all student talks and presentations, making the difficult decision to find the best posters and talks. The ESAI would like to thank the many judges that assisted with the competition. The winning student presentations chosen by the ESAI were as follows:



ESAI Best Overall Oral Presentation went to Wayne Fogarty, NUI Maynooth for his talk “Novel Ionic liquids for the absorption and sequestration of CO₂” (pictured on left).

ESAI Best Overall Poster Presentation was awarded to Inga Reich, NUI Galway, with her poster entitled “The Impact of forestry management practices on the distribution of the Kerry Slug”.

In the forestry section the **Best Forestry Oral Presentation** was presented to Karen Moore, TCD, for her talk on her research “Factors influencing the ground vegetation diversity of two successive rotations of non-native conifer plantations”. **Best Forestry Poster Presentation** was given to Farhana Afroze, UCD with her poster entitled “Seed dormancy in Rowan and its implications for nursery operations and natural regeneration”.

Best Soils Presentation went to Anthony Kerebel, UCD for his talk on “Farmer evaluation of slurry spreading conditions compared to predictions from the Hybrid Soil moisture Deficit Model”. Rosalyn Thompson, UCC, received the prize for **Best Biodiversity Presentation** for her talk on “Assemblage structure of plant communities along the road corridor developing a sustainable stable system”. Finally, **Best Waste and Resource Management Presentation** was awarded to Aoife Quinn, UCD based on her talk “Reclaimed asphalt: environmental assessment of a valuable resource”.

Our sponsorship for prizes was greatly appreciated with €1,750 to present to students this year. Many thanks to the continued support from our sponsors Dept. Of Agriculture, Food and the Marine, the Soil Science Society of Ireland and the Lifetime Lab in Cork, the Chartered Institution of Waste Management and Aulino Wann & Associates.

Sinead Macken, ESAI Administrator



Winning photography “Warning Waves” Nick Warinton, Co. Wicklow

The theme of the 2012 ESAI Photography competition was **“The Environment”**. The competition was opened to all amateur photographers on the 7th March 2012. The winning photograph entitled “Warning Waves” was taken by Nick Warinton from Bray, Co. Wicklow.

The winning photographer received a framed copy of their photograph together with a €200 voucher for photographic equipment, kindly sponsored by the Environmental Research Institute at University College Cork.

The two runners up in the competition, entitled “Birds and the Shipwreck” by Leo Murphy, and “Energy from Waste” by Ultan Downes, both received a €50 voucher for photographic equipment and one year membership to the ESAI. Photographs were judged on picture quality, composition, and appropriateness of caption (2012 Judge was Mick Quinn, Professional Photographer and Chairman of Judging for the Irish Professional Photographers Association)



2nd Place:

Birds and the Shipwreck”

Photographer: Leo Murphy

3rd Place:

“Energy from Waste”

Photographer: Ultan Downes



The winning photographs will be displayed in the Photo Competition Gallery section of the ESAI website at <http://www.esaiweb.org/gallery/photo-competition>. All photographs entered to the competition can be viewed on our Facebook page at: <http://www.facebook.com/esaiweb>

ESAI INCOME AND EXPENDITURE ACCOUNT

For the year ended 31 December 2012

Opening balance as at January 1st 2012 3220.65

	€	€
<u>Income</u>		
Membership	3527.07	
Membership (Environ)	9700.00	
Environ 2013	14755.00	
Environ 2012	31248.49	
Environ 2012 Sponsorship Cork Co Co/ESAI/CIWM workshop	9860.00 2435.00	
Total Income	71525.56	
<u>Expenditure</u>		
Environ 2013	2,457.72	
Environ 2012 Cork Co Co/ESAI/CIWM Workshop	32,602.87 1,217.95	
Web Design/Software	2,692.19	
Administration	8,736.60	
Travel	646.04	
Accountacy & Audit	2,598.60	
Bank charges & fees	1,500.80	
E-zine	840.00	
Insurance	575.00	
General Exp	139.46	

Total Expenditure	€54,007.23	
Excess income over expenditure		17518.33
Balance		20738.98
Balance on 31/12/2012		20738.42
Outage		0.56

*The draft set of ESAI accounts for the year ending 31/12/2012 have been prepared by the ESAI treasurer and are subject to review by an independent accountant.



Photographer: Paddy Tubbritt

ESAI COUNCIL MEMBERS 2012:

Chairperson

Dr Paul Bolger

Email: chairperson@esaiweb.org

Vice-Chairperson

Currently Vacant

Honorary Secretary

Mr Alan Berry

Email: secretary@esaiweb.org

Honorary Treasurer

Ms Nuala Murphy

Email: treasurer@esaiweb.org

Honorary Editor

Mr John Wann

Email: editor@esaiweb.org

Assistant Editor

Mr Timothy Sullivan

Email: timothy.sullivan2@mail.dcu.ie

Conference Coordinator 2012

Dr Tom Curran

Email: conference@esaiweb.org

Conference Coordinator 2013

Dr Martina Prendergast

Email: martina.prendergast@nuigalway.ie

Membership Officer

c/o Ms Sinead Macken / Administrator

Email: administrator@esaiweb.org

Webmaster

c/o Dr Adrian Corcoran [attikdesigns.ie]

Email: webmaster@esaiweb.org

Regular Members

Mr Kevin Ryan

Dr Shane Colgan

Ms Aoife Delaney

Mr John Gallagher

Mr Joe Noonan

Dr Cara Augustenborg

Mr Damian Howard

Dr PJ Purcell

Index of Presenters (Oral & Poster)

Abberton, C.	129	Forde, D.	89
Alam, M.S.	110	Fox, A.	181
Allen, E.	57	Fox, S.	149
Boots, B.	173	Gallagher, J. (Oral)	135
Boyle, P.	94	Gallagher, J. (Poster)	154
Brady, A.M.	145	Galvin, S.	53
Brechon, A.	72	Gaughan, P.	132
Brophy, C.	112	Geever, M. (Poster)	161
Buckley, R.	171	Geever, M. (Oral)	101
Byrne, A.	199	Gilmore, L.	141
Byrne, S. (Poster)	182	Golden, N.	165
Byrne, S. (Poster)	183	Guiheneuf, F.	66
Byrne, S. (Oral)	126	Hamilton, J.	99
Carpenter, B.	59	Harris, M.	185
Cassells, C.	158	Hawthorne, D.	136
Ceburnis, D.	109	Hayes, M.	97
Chen, X.	164	Hernan, R.	178
Clarke, D.	106	Hernandez-Kantun, Jazmin	116
Cogan, D.	77	Hynes, S.	88
Corcoran, M.	108	Hynes, T.	85
Daniels, E.	167	Jagodzinski, L.	201
Devaney, J.	102	Jones, N.	148
Devaney, M.	91	Jordan, S.	186
Dolan, D.	100	Jordan, S.	187
Donnelly-Swift, R.	98	Joyce, A.	104
Dooley, A.	87	Kavanagh, S.	56
Dowling, A.	55	Keegan, M.	130
Dubber, D.	127	Keegan, M.	131
Duff, A.	92	Kennelly, C.	146
Dunphy, N.	61	Kilory, K.	76
Dwyer, N.	143	Kinnane, O.	121
Egan, P.	125	Kinsella, C. (Poster)	195
Elliot, Z.	90	Kinsella, C. (Oral)	113
Esmonde, L.	176	Kirke, D.	200
Feighan, J.	111	Kirwan, L.	86
Fenech, C.	137	Kirwan, L.	191
Finn, J.	192	Knight, S.	205
Firth, L.	63	Lally, R.	193
Fitzhenry, K.	168	Lee, C.-S.	166
Fitzsimons D'Arcy, L. (Oral)	52	Ludden, C.	54
Fitzsimons D'Arcy, L. (Poster)	142	Lutts, S.	96

Index of Presenters (Oral & Poster) cont'd

MacSweeney, R.	128	Paolacci, S.	194
Madden, D.	133	Pape, J.	71
Manton, R.	83	Pilla, F.	122
Manton, R.	118	Piterina, A.	188
Massey, J.	70	Piterina, A.	189
McAleer, E.	177	Pittam, J.	157
McAteer, P.	82	Prehn, B.	197
McAuliffe, F.	144	Quinn, B.	134
McCarthy, F.	103	Rau, H.	74
McConigley, C.	80	Reich, I.	64
McCoy, G.	202	Reynolds, J.	60
McCoy, G.	147	Richter, A.	65
McDermott, A.	95	Sadegh Askari, M.	138
McGlade, D.	174	Schaller, B.	170
McGrath, J.	117	Schmid, M.	105
McGrory, E.	180	Sheehan, R.	123
McKennedy, J.	163	Sherriff, S.	75
McNabola, A.	120	Smullen, E.	160
Meehan, S.	139	Staunton, J.	81
Melody, C.	196	Vanegas, C.	155
Moran, S. (Poster)	198	Vanegas, C.	156
Moran, S. (Oral)	67	Vaughan, A.	79
Morrissey, J.	62	Wall, D.	162
Murphy, C.	203	Walsh, A.	68
Murphy, E.	184	Ware, A.	169
Murphy, G.	73	Wilson, A.	93
Murphy, J.	114	Zacharska, M.	172
Ni Chualáin, C.	179	Zimmerman, J.	84
Norton, D.	140		
Nyhan, M.	51		
Nzeteu, C.	58		
O'Connor, P.	119		
O'Doherty, T.	69		
O'Driscoll, C.	159		
O'Dwyer, J.	78		
O'Flynn, C.	124		
Olbert, A.	204		
O'Loughlin Irwin, S.A.	115		
O'Loughlin, S.	175		
O'Malley, S.	190		
Onzivu, W.	107		

About the Ryan Institute

The Ryan Institute brings together researchers within the National University of Ireland, Galway to contribute to some of the most important national and international, long-term, environmental, marine and energy research issues. Food and energy security, climate change and increasing competition for natural resources require solutions based on integrated scientific, technical, economic and policy research. Ryan Institute research in these areas, along with the activities of state agencies, civil society and the private sector, is used to support resource-efficient, economically resilient and socially cohesive regional and national development.

Our Areas of Research

Our location near the Atlantic Ocean is a strong driver of the research priorities within the Institute.

Our emphasis is on:

- Understanding and prediction of climate, ecological, terrestrial and marine system changes
- Innovation in energy-efficient technologies, bioenergy and marine renewable energy
- Research in biodiversity, biodiscovery and aquaculture
- Technologies for monitoring, modelling and mitigation of environmental pressures, especially those associated with water resources
- Human health in the built and natural environment
- Provision of scientific and technical information to guide socioeconomic and policy decisions

Our Research Community

We have a core group of development, administrative and technical staff to support Ryan Institute researchers, resulting in an effective structure for encouraging collaboration, supporting inter-disciplinary and inter-institutional research, and assisting with outreach activities.

The Institute's facilities are spread over two buildings on the NUI Galway Campus (Orbsen Building and Martin Ryan Building/Annexe), and four off-campus facilities (Mace Head Atmospheric Research Station, Carna Aquaculture Research Facility, Carron Field Research Station, and Finavarra Field Research Station). The off-campus facilities provide platforms for effective marine, terrestrial and atmospheric field studies.



Notes

Notes

Notes

Notes

