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**The 21st Irish Environmental Researchers Colloquium
(ENVIRON 2011) is organised in a partnership between the
Environmental Sciences Association of Ireland,
the Environmental Protection Agency and
University College Cork.**

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WELCOME TO ENVIRON 2011

Dear Delegate,

The ENVIRON 2011 Organising Committee extends a warm welcome to you to the 21st Irish Environmental Researchers' Colloquium and to University College Cork (UCC). UCC last hosted the ENVIRON colloquium in 2002 and we are privileged to have the honour of hosting the colloquium again in 2011. We are also very pleased to have the Environmental Protection Agency as a partner in the colloquium this year and are grateful for their financial and administrative support for the event.

As ENVIRON celebrates its 21st birthday in 2011, it is a tribute to Ireland's environmental research community and to past ENVIRON organisers that the event continues to provide a high-visibility platform for PhD students and postdoctoral researchers to present their research to a wide audience. Since its establishment in 1990 one of the main strengths of the colloquium has been that it attracts delegates from a wide variety of disciplines and backgrounds and, in a time when science and engineering are coming increasingly specialised, the colloquium provides a unique opportunity for specialist researchers to learn what is happening outside their own research area.

The theme of this year's colloquium is "Towards 2020: Environmental challenges and opportunities for the next decade" which reflects the many environmental targets that have been set for the year 2020 in areas of climate change, renewable energy, water protection and biodiversity. In relation to the latter, we are delighted to have Professor Michael Depledge (Former Chairman of UK Science Advisory Committee on the Environment & Climate Change) at ENVIRON 2011 to deliver the colloquium keynote address on "Health and the Value of Nature".

The colloquium plenary session has a number of high profile speakers who will address the colloquium theme of environmental challenges and opportunities for the next decade including Professor John Sweeney (NUI Maynooth), Ms Laura Burke (Director of EPA's Office of Climate, Licensing,

Research and Resource Use) and Mr John Mullins (CEO of Bord Gais). The research programme has 95 oral presentations and 60 poster presentations in the themes of water quality, energy and climate change, marine and coastal research, environmental management, environmental technologies, environment and health, and biodiversity and ecosystems. In addition, for the first year, poster presenters have the opportunity to make a 1 minute oral presentation on their poster during the oral sessions in the relevant theme.

The 2011 colloquium also sees an increase the number of workshops and seminars accompanying the programme with an emphasis on training and development for postgraduates in the environmental area. We are particularly pleased to have a link with the Environment Graduate Programme in the “Ocean Studies Workshop” which illustrates how the ENVIRON colloquium can support and benefit from the various graduate programmes currently being developed within Universities. Finally ENVIRON 2011 and the UCC 2011 Law and the Environment symposium have been deliberately scheduled together at the same time and location to allow delegates from both conferences to benefit from each other’s programmes.

The success of the ENVIRON 2011 colloquium depends on all who have contributed before and during the event and we extend a sincere thanks to all our sponsors, speakers, workshop presenters, chairs, UCC Buildings & Estates and of course our presenters who have made the event possible.

We sincerely hope that you have an educational and enjoyable time at ENVIRON 2011 and in Cork.

Dr. Paul Bolger, UCC ENVIRON 2011 Colloquium Convenor

On behalf of the ENVIRON 2011 Organising Committee

ENVIRON 2011 ORGANISING COMMITTEE

Conference Convenor

Dr. Paul Bolger, Environmental Research Institute (ERI), UCC

University College Cork

Dr. Fiona Cawkwell, Department of Geography/ERI

Dr. Debbie Chapman, School of Biological, Earth & Environmental Sciences/ERI

Dr. Maria Falaleeva, Coastal & Marine Resources Centre/ERI

Dr. Marcel Jansen, School of Biological, Earth & Environmental Sciences/ERI

Dr. Owen McIntyre, Faculty of Law/ERI

Dr. Jerry Murphy, Department of Civil & Environmental Engineering/ERI

Prof. John O'Halloran, School of Biological, Earth & Environmental Sciences/ERI

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Dr. Dean Venables, Department of Chemistry/ERI

Environmental Protection Agency

Dr. Brian Donlon

Dr. Shane Colgan

Environmental Sciences Association of Ireland (ESAI)

Ms. Sinead Macken, ESAI Conference Liaison

Dr Shirley Gallagher, GreenWorks Ireland

ESAI Council

Sincere thanks to Ms. Helen McMahon, Ms. Monika Trochim and Ms. Muireann Murphy for administrative support. Thanks to Dr Lisa Shiels for assistance in reviewing the colloquium abstracts and to Dr Max Kozachenko for assistance with cover design.

Last, but not least, thanks to students from UCC and Tralee IT who assisted “on-the-ground” during the conference to ensure the smooth running of ENVIRON 2011.

Thanks to ENVIRON 2011 Sponsors and Exhibitors



ENVIRON 2011 Principal sponsor



Sponsorship of Energy and Climate Change theme



Wine reception at Keynote address



Coffee break

ENVIRON 2011 Exhibitors



Cork Environmental Forum
www.cef.ie



Thanks to ENVIRON 2011 Prize Sponsors



Soil Science Society of Ireland



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of Wastes Management

Thanks to ENVIRON 2011 Workshop Sponsors



Ireland's EU Structural Funds
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ENVIRONMENTAL RESEARCH AT THE EPA

The Environmental Protection Agency's supports research across a broad range of priority environmental issues including Climate Change and Water Quality. The overall purpose of the research funding programme is to protect and improve the natural environment by addressing key environmental management issues through the provision of high quality scientific knowledge.

Research Reports...

The EPA publishes reports on completion of research projects which are available to download at www.epa.ie/downloads/pubs/research

On YouTube & SlideShare...

View EPA videos and presentations:

YouTube: www.youtube.com/EPAIreland

SlideShare: www.slideshare.net/EPAIreland

Secure Archive For Environmental Research Data...

SAFER-Data [<http://erc.epa.ie/safer/>] is a fully web-based interface to the EPA's Environmental Research Centre's Environmental Research Data Archive. It currently holds over 1,700 files for download and use by environmental researchers

ENVision...

An online viewer to allow access to environmental information by region. ENVision can be used to find information on Air Quality Water Quality and Industrial or Waste facilities currently licensed by the EPA.

Visit: <http://gis.epa.ie/>



ENVIRONMENTAL RESEARCH INSTITUTE

University College Cork

“Multidisciplinary environmental research for a sustainable future”



The Environmental Research Institute was established in 2000 with a mission to support Environment, Energy and Marine based research, training and education within UCC. The Institute brings together over 200 researchers with expertise in the biological, chemical and environmental sciences as well as environmental engineering, energy and environmental law. The main aims of the Institute are to foster collaborative, multidisciplinary environmental based research through a number of key research thematic areas; train post-graduate research students for careers in the environmental sciences and engineering and finally, where possible, to facilitate the transfer of technology to industry.

Research activities at the Institute are strategically focused on five thematic research areas:

1. **Sustainable Energy and Environmental Engineering:** Addresses key research areas covering energy/environment, energy end use and energy policy; special focus areas include wind, ocean, solar or biofuel-based energy together with studying efficient energy use in buildings (Lead PI: Dr Jerry Murphy).
2. **Environmental Chemistry:** Monitors and models the atmospheric chemistry of pollutants, develops techniques for detection of trace gases and develops catalysts for “green” chemistry & processing (Lead PI: Dr John Wenger).
3. **Environmental Microbial Genomics:** Aims to gain a fuller understanding of how microbes grow and interact in their various environmental niches; an approach which is fundamental to their exploitation for biotechnological applications (Lead PI: Prof. Alan Dobson).
4. **Biodiversity, Ecotoxicology & Sustainability:** Investigates the causes and consequences of biodiversity change in natural and managed ecosystems and carries out research into the mechanisms of biological action of chemicals and the development of biomarkers (Lead PIs: Dr Marcel Jansen & Prof John O’Halloran).
5. **Marine:** Addresses fundamental questions of marine and freshwater biology, fluid mechanics, hydraulic engineering, geology, and contributes to applied research in aquaculture and fisheries conservation (Lead PI: Prof John Benzie).

In addition the Institute has three constituent research centres

- The **Coastal and Marine Resources Centre (CMRC)**: Situated at the Haulbowline Naval Base, the CMRC investigates interactions between coastal-ocean resources and human populations, with particular focus on: seabed mapping and coastal processes, marine mammal-seabird studies & coastal zone management. Director: Mr Jeremy Gault.
- The **Aquaculture and Fisheries Development Centre (AFDC)**: Promotes and develops aquaculture and fisheries to enable these sectors to achieve their full socio-economic potential. Director: Dr Sarah Culloty
- The **Aquatic Services Unit (ASU)**: Conducts environmental research and consultancy specialising in the areas of water quality and environmental impact assessment. Manager: Mr. Ger Morgan

The Institute recently received funding through the HEA PRTL cycle 5 to extend its activities to integrate the Hydraulics and Maritime Research Centre (HMRC), Coastal and Marine Resources Centre (CMRC) and Sustainable Energy Research Group (SERG) together to work on scientific programmes that meet national objectives for ecologically sustainable ocean energy, renewable energy storage and grid integration and policy support & marine resource management. This will involve the creation of a state-of-the-art National Ocean Energy Test Facility (NOETF).

The success of research activity within the ERI was illustrated in 2009 where in an independent research quality review it received an overall assessment level of 5, with the panel concluding that research is of a “world leading” standard. To learn more about ERI research please visit <http://eri.ucc.ie>.



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DELEGATE INFORMATION

DELEGATE INFORMATION

Registration

The ENVIRON 2011 Registration Desk will be open in the Boole Lecture Theatre at the following times:

Wednesday 6 th April:	From 12.00am to 7.00pm
Thursday 7 th April:	From 8.30am to 6.00pm
Friday 8 th April	From 8.30am to 9.30pm

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 maps on the following pages show the location of key rooms being used for the conference. The oral sessions, trade exhibition and workshops are being held in the Boole Lecture Theatres (with the exception of the GIS workshop which will be held in the Department of Geography). The keynote address, poster sessions and lunches will take place in the Devere Hall of Áras Na Mac Léinn (The Student Centre).

Delegates giving oral presentations

After registering for the colloquium, delegates giving oral presentations should upload their presentation at the content management desk (located beside reception in the Boole Theatre). 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 room at least 5-10 minutes before the session begins.

Posters

The poster presentation area is in the Devere Hall in Áras Na Mac Léinn. When you arrive at the registration desk please indicate that you have a poster for presentation and the registrars will direct you to the poster

DELEGATE INFORMATION

presentation hall. Posters can be erected on Wednesday April 6th (15.00-19.00) or on Thursday morning, April 7th (8.00-11.00). All posters should be in place by **11 AM on Thursday, April 7th**. Each presenter is assigned a unique **poster ID number** (please check the abstracts in the Delegate Handbook to find 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 1 hour poster sessions throughout the colloquium; to ensure that colloquium delegates can meet poster presenters we would strongly encourage poster presenters to remain by their posters for these sessions to answer any questions. Conference staff will be available to help to erect posters.

Internet Access

Internet-enabled computers are available on the first floor of Áras na Mac Léinn, in the cafe space adjacent to the Devere Hall. A conference account has been created which should allow all delegates to log on using the following username and password. Please ask at registration desk in Boole for the username and password. Unfortunately non-UCC registered laptops cannot avail of the WiFi facilities.

Tea/Coffee and Lunch

Teas, coffees and lunches will be served either in the Devere Hall or in the Boole Theatre during workshop and colloquium conference breaks (please refer to colloquium programme). There is seating in the Devere Hall for lunch breaks and delegates can also use the seating area in the Oasis Cafe adjacent to the Devere Hall.

Bank

A branch of the Bank of Ireland is located in Áras na Mac Léinn (same building as the Devere Hall) with ATM facilities inside and also on the outside wall of the building. Further ATM facilities may be found by the main student restaurant, adjacent to the Boole Library.

Parking

Only very restricted parking is available on UCC campus, although there are two visitors' car parks in the near vicinity (the closest to the conference venues being Perrot's Inch off the Western Road). Pay-parking is available on adjacent streets (pre-bought parking discs are required, these may be obtained in the Áras na Mac Léinn stationery shop and at the Coffee Station café on the corner of Western Road and O'Donovan's Road). Please

DELEGATE INFORMATION

be warned that parking restrictions are severely enforced both on-campus and on the street, and illegally-parked cars are liable to be clamped or towed away.

Local transport

From the city centre, buses numbered 8 (marked Bishopstown) and 5 (marked Rossa Avenue) go past UCC. From the city centre bus numbers 226 and 249 depart the bus station for the airport, with departures at approximately half-hourly intervals during the day.

Restaurants/Cafes/Takeaways around UCC

The following is a list of places to eat around UCC for delegates on the Wednesday evening and for delegates who are not attending the colloquium dinner on Thursday. All phone numbers have the 021 prefix.

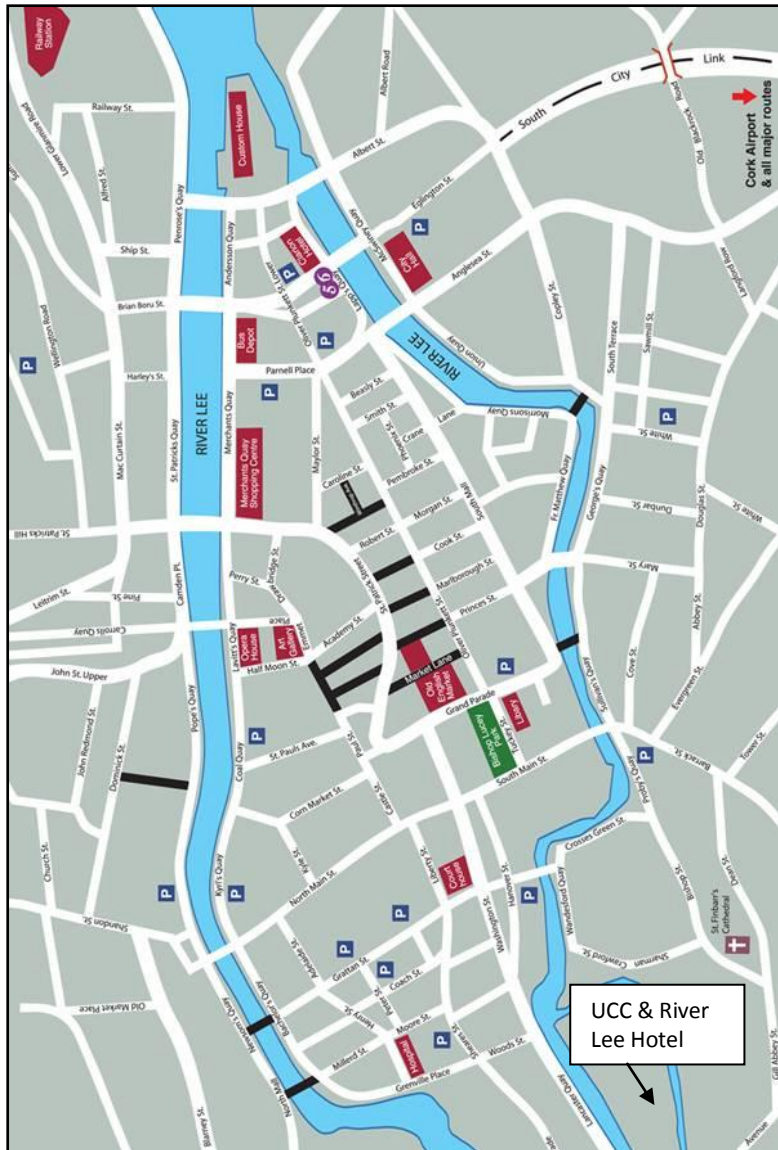
Banna Thai	15 Maylor Street; Thai	4251571
Domino's Pizza	26 Washington Street; Pizza	4222288
Eastern Tandoori	1/2 Emmet Place; Indian	4272232
Fenn's Quay	5 Sheare's Street; International Cuisine	4279527
Liberty Grill	32 Washington Street; International Cuisine	4271049
Market Lane	5/6 Oliver Plunkett St; International Cuisine	4274710
Milano	Oliver Plunkett Street; Italian	4273106
Panda Mama	14 Parnell Place; Chinese	4274779
Strasbourg Goose	17/18 French Church Street; European	4279534
Wagamama	4/5 South Main Street; Japanese	4278874

UCC campus & location of main ENVIRON 2011 venues/parking



DELEGATE INFORMATION

Map of Cork City





ENVIRON 2011 PROGRAMME

ENVIRON 2011 PROGRAMME, WEDNESDAY, APRIL 6 TH	
12:00 pm - 7.00 pm	Registration (<i>Boole</i>)
Workshops	
9:30 am – 5:00 pm	Ocean Studies Workshop (<i>Boole 6</i>)
1:30 pm - 5:00 pm	Geospatial Technologies Workshop (<i>Computer lab, Geography Dept</i>)
2:00 pm – 5:00 pm	Science Communication Workshop (<i>Boole 1</i>)
2:00 pm – 5:30 pm	3 rd Annual Postgraduate Research Symposium on Environmental Law (<i>Boole 2</i>)
7:00 pm - 7:45 pm	Wine Reception (<i>Devere Hall</i>) - Sponsored by Cork Convention Bureau
7:45 pm – 8:00 pm	Welcome by Dr Shirley Gallagher - Chairperson of the Environmental Sciences Association of Ireland (<i>Devere Hall</i>)
8:00 pm	Keynote Address: Professor Michael Depledge (<i>Devere Hall</i>)

ENVIRON 2011 PROGRAMME, THURSDAY, APRIL 7 TH				
8:00 am	Registration (<i>Boole</i>)			
9:00 am	Welcome: Dr Paul Bolger (Conference Convenor) and Dr Michael Murphy, President, University College Cork			
9:10 am - 11:00 am	ENVIRON 2011 Plenary Session (<i>Boole 3</i>) Guest Speakers: Professor John Sweeney, Dr Laura Burke, Mr John Mullins Chair: Dr Jerry D. Murphy			
11:00 am – 11:30 am	Tea/Coffee (<i>Boole</i>) - Sponsored by the Aquatic Services Unit, UCC			
11:30 am - 12:40 pm	Session 1 (<i>Boole 1</i>) Water Quality	Session 2 (<i>Boole 2</i>) Biodiversity & Ecosystems	Session 3 (<i>Boole 5</i>) Energy & Climate Change	Session 4 (<i>Boole 6</i>) Environmental Management
12:40 pm - 1:20 pm	Lunch (<i>Devere Hall</i>)			
1.15 pm - 2.00 pm	Poster Session 1 (<i>Devere Hall</i>)		AGM of the Environmental Sciences Association of Ireland (<i>Boole 5</i>)	
2:00 pm - 3:10 pm	Session 5 (<i>Boole 1</i>) Environmental Technologies	Session 6 (<i>Boole 2</i>) Water Quality	Session 7 (<i>Boole 5</i>) Marine & Coastal Research	Session 8 (<i>Boole 6</i>) Environment & Health
3:10 pm - 4:00 pm	Coffee & Poster Session 2 (<i>Devere Hall</i>)			
4:00 pm - 5.15 pm	Session 9 (<i>Boole 1</i>) Environmental Technologies	Session 10 (<i>Boole 2</i>) Biodiversity & Ecosystems	Session 11 (<i>Boole 5</i>) Water Quality	Session 12 (<i>Boole 6</i>) Energy & Climate Change
7:15 pm	Wine Reception (<i>The River Lee Hotel</i>)			
8:00 pm	Conference Dinner (<i>The River Lee Hotel</i>)			

ENVIRON 2011 PROGRAMME, FRIDAY, APRIL 8 TH				
8:30 am	Registration Desk (<i>Boole</i>)			
9:00 am - 10:30 am	Session 13 (<i>Boole 1</i>) Environmental Management	Session 14 (<i>Boole 2</i>) Biodiversity & Ecosystems	Session 15 (<i>Boole 5</i>) Marine & Coastal Research	Session 16 (<i>Boole 6</i>) Energy & Climate Change
10:30 am - 11:30 am	Tea/Coffee & Poster Session 3 (<i>Devere Hall</i>)			
11:30 am - 12:45 pm	Session 17 (<i>Boole 1</i>) Environmental Technologies	Session 18 (<i>Boole 2</i>) Environmental Management	Session 19 (<i>Boole 5</i>) Environment & Health	Session 20 (<i>Boole 6</i>) Water Quality
12:45 pm - 1:45 pm	Lunch, Prizes and ENVIRON 2011 Close (<i>Devere Hall</i>)			
2:00 pm - 4.30 pm	Life Coaching Workshop (<i>Boole 6</i>)			

Thursday April 7th (11.30-12.40) Oral Presentation Sessions (Sessions 1-4)

Session 1 (<i>Boole 1</i>) Water Quality	Session 2 (<i>Boole 2</i>) Biodiversity & Ecosystems	Session 3 (<i>Boole 5</i>) Energy & Climate Change	Session 4 (<i>Boole 6</i>) Environmental Management
<i>Opening Chair Address</i> Mr Peter Webster , EPA	<i>Opening Chair Address</i> Professor John Breen , UL	<i>Opening Chair Address</i> Dr Margaret Desmond , EPA	<i>Opening Chair Address</i> Dr Brian Donlon , EPA
Bad Biology, Good Chemistry: Contrasting evidence for water quality recovery in Northern Irish streams Barry, C.D. (AFBI)	Modelling Eurasian Badger (Meles meles) populations in response to management practices in the Republic of Ireland Byrne, A.W. (NBDC)	A long relative humidity series for Armagh Observatory: Its consequences for atmospheric warming during the 20 th century and the underlying causes of the Great Potato Famine in Ireland Butler, C.J. (Armagh Observatory)	Assessing impacts of the infilling of wetlands in Galway with C&D waste using invertebrate bioindicators, biomonitors and hydrological parameters. Staunton, J. (NUIG)
Quantifying flows along pollutant pathways in Irish catchments O'Brien, R. (TCD)	Red Squirrels of Raven Point: A Priority for Protection Carr, W. (UCD)	Environmental policy: process or project based approach McGloughlin, J.S. (NUIM)	Design out waste in construction Dowd, D. (GMIT)
Assessment of groundwater vulnerability to pollution in Ireland based on the COST-620 pan-European approach Pavlis, M. (UCD)	Trophodynamics of the regional scale ecosystems of the N.E. Atlantic: Are they out of control? McGinty, N. (Ryan Institute)	Carbon Footprint: can it ever be more than just a number? Making measurement & communication more meaningful Ryan, B. (UCC)	Eco-Industrial Initiatives: Concept, Definitions, Typologies and Models of Development O'Culain, D. (UCC)
Poster oral presentations WQ1: Hickey, J. WQ2: Veerkamp, V. WQ3: Fenech, C. WQ4: Sanawar, H. WQ5: O'Flaherty, E. WQ6: McCabe, P.	Poster oral presentations BE1: Boyle, P. BE2: Sun, J. BE3: Perrin, P.M. BE4: Nairn, R. BE5: Skerritt, T. BE6: Hochstrasser, T.	Poster oral presentations ECC1: Hernon, A. ECC2: McKennedy, J. ECC3: Mooney, E. ECC4: Muniraj, I. ECC5: O'Dwyer, A. ECC6: Carpenter B.	Poster oral presentations

Thursday April 7th (14.00-15.10) Oral Presentation Sessions (Sessions 5-8)

Session 5 (<i>Boole 1</i>) Environmental Technologies	Session 6 (<i>Boole 2</i>) Water Quality Chair: Dr M. Prendergast, NUIG	Session 7 (<i>Boole 5</i>) Marine & Coastal Research	Session 8 (<i>Boole 6</i>) Environment & Health
<i>Opening Chair Address</i> Dr John Hanrahan , Glantreo	Fenton's and photo-Fenton's oxidation for removal of APIs from aqueous solution Deegan A. (DCU)	<i>Opening Chair Address</i> Mr Jeremy Gault , UCC	<i>Opening Chair Address</i> Dr Enda Cummins , UCD
Development of microelectrochemical sensors & portable instrumentation for remote sensing of pollutants in port waters Herzog, G. (UCC)	Continuous flow solar oxidation and removal of arsenic (SORAS) from drinking water O'Farrell, C. (TCD)	A critical examination of the EC guiding principles for marine spatial planning through their application in the Clyde MSP Project Flannery, W. (NUIG)	Risk ranking of antimicrobial residues in the environment Harris, S.J. (UCD)
Sensing of nitrate using polypyrrole nanowires modified with copper nanoparticles McCarthy, C. (NUIM)	Comparison of SBR and Intermittently Aerated SBR Technologies in Nutrient Removal from Domestic Wastewater Henry, L.H. (NUIG)	The Ecosystem Approach to Fisheries Management in Ireland; Challenges and solutions from the Beaufort programme Reid, D.G. (MI)	Secondary wastewater treatment reduces total E. coli including antimicrobial resistant E. coli prior to discharge Morris, C. (NUIG)
Mesoporous solids for low temperature carbon dioxide adsorption Reimann W.R. (UL)	Treatment of Piggery Wastewaters Using Aerobic Woodchip Biofilter Carney, K. (NUIG)	Future Proofing of Coastal Flood and Erosion Defence Structures Long, E.J. (UCC)	The aqueous environment as a source of vancomycin resistant enterococci Morris, D. (NUIG)
Poster oral presentations ET1: Ahmad, A. ET2: Casey, A.M. ET3: Imran, S. ET4: Keane, D. ET5: Madden, D. ET6: Downey, P.	Poster oral presentations WQ7: O'Dwyer, R. WQ8: Anders, Y.A. WQ9: McCullagh, M.A. WQ10: Gordon, G. WQ11: Zhang, M..	Poster oral presentations MCR1: O'Donoghue, A. MCR2: Foley, L.	Poster oral presentations EH1: Clarke, D. EH2: Paschero, A. EH3: Cormican, S. EH4: Connole, L. EH5: O'Keefe, C.

Thursday April 7th (16.00-17.15) Oral Presentation Sessions (Sessions 9-12)

Session 9 (<i>Boole 1</i>) Environmental Technologies Chair: Dr J. Hanrahan, Glantreo	Session 10 (<i>Boole 2</i>) Biodiversity & Ecosystems Chair: Dr M. Jansen, UCC	Session 11 (<i>Boole 5</i>) Water Quality Chair: Dr D. Chapman, UCC	Session 12 (<i>Boole 6</i>) Energy & Climate Change Chair: Dr P. Dykes, SEAI
Conceptual design approaches for small scale onsite wastewater treatment units & experimental model challenges for nutrient reduction Bekele, T.H. (DkIT)	Saltmarshes on peat substrate on the southwest coast of Ireland: edaphic parameters and <i>Halimione portulacoides</i> distribution Cott, G.M. (UCC)	A SaaS Early Warning System for Drinking Water Treatment Plants in the Republic of Ireland Franclin Foping, S. (UCC)	Biomethane and biodiesel from energy crops in Ireland: a technical and economic appraisal Deasy, E. (CIT)
Impact of on-site wastewater treatment for small community developments on groundwater quality Morrissey, P.J. (TCD)	New survey techniques and a preliminary classification of Irish sea cliff vegetation Delaney, A. (BEC Consultants)	The assessment of the impact of acid mine drainage on surface waters from an abandoned Cu-S mine in SE Ireland using Lemna minor Egan, L.A. (TCD)	An investigation into biomethane development and its potential contribution to the Irish transport sector Goulding, D.J. (CIT)
Nutrient retention in an integrated constructed wetland used to treat domestic wastewater Dzakpasu, M. (DkIT)	Distribution, Conservation Status and Impacts on Annex I grassland habitats in Ireland: results of the Irish Semi-natural Grassland Survey Devaney, F.M. (BEC)	The impact of herbage re-growth interval on phosphorus loss in overland flow post slurry application McConnell, D.A. (AFBI)	Farmers' perspectives for the development of a bioenergy industry in Ireland Augustenborg, C.A. (UCD)
Co-Treatment of Acid Mine Drainage with Municipal Wastewater Using the Activated Sludge Process Hughes, T.A. (TCD)	Differential decomposition patterns of marine and terrestrial biomass in a coastal lagoon Lettice, S.L. (UCC)	Field investigation into the effects of OSWTS on surface water quality Rafferty, P. (DkIT)	Influence of the addition of different carbon rich bulking agents and composting on the characteristics of pig manure char Troy, S. (Teagasc)
Remediation of acid mine drainage through constructed wetlands; A green house trial Holland, L.B. (DkIT)	Pollination service provision: Co. Armagh apples as a case study McKendrick, L. (QUB)		Optimisation of Seaweed Biomass Pre-treatments: an eco-friendly approach Vanegas, C. (Sligo IT)

Session 13 (<i>Boole 1</i>) Environmental Management Chair: Dr T. Curran, UCD	Session 14 (<i>Boole 2</i>) Biodiversity & Ecosystems Chair: Dr P. Perrin, BEC Consult.	Session 15 (<i>Boole 5</i>) Marine & Coastal Research Chair: Prof. M. Johnson, NUIG	Session 16 (<i>Boole 6</i>) Energy & Climate Change Chair: Mr J. Walsh, Cork City Co.
A metric to evaluate policies to enhance Irish urban sustainability Fitzgerald, B.G. (UL)	Climate change impacts on the distribution and ecology of montane plant communities in western Ireland Hodd, R.L. (NUIG)	Into the wild: documenting and predicting the spread of Pacific oysters (<i>Crassostrea gigas</i>) in Ireland Kochmann, J. (UCD)	A Techno-Environmental Assessment of Combined Offshore Wind and Wave Energy Platforms O' Sullivan, K. (UCC)
Results from a Quantitative Evaluation of Policies to Enhance Sustainability in Irish Settlements O'Doherty, T. (UL)	Genetic diversity & phylogeography of the endemic groundwater amphipod <i>Niphargus kochianus irlandicus</i> McInerney C.E. , (UU)	Sustainability and Welfare in Crustacean Fisheries; the case of the Edible Crab, <i>Cancer Pagurus</i> McCambridge, C. (QUB)	The impacts of incorporating large-scale offshore wind generation into the future Irish Electricity System McGarrigle E. (UCC)
Cycling Ireland to Work: Sustainable job creation through the construction of a National Cycling Network Manton, R. (NUIG)	Groundwater as an ecological supporting condition in raised bogs and the implications for restoration Regan, S. (TCD)	An investigation of the genotoxic impact of the marine biotoxin okadaic acid, on three different bivalve species McCarthy, M. (UCC)	The Design and Optimisation of a Water Vortex Hydropower Plant Mulligan, S. (ITS)
Impact of phosphate fertilizer input on the microbial community of pasture soil Tan, H. (UCC)	Assessment of evolved volatile organic compounds, as indication of Sphagnum Growth and Biomolecular Content Flanagan, A. (LIT)	Effects of increasing densities of invasive oysters (<i>Crassostrea gigas</i>) on the structure & functioning of estuarine ecosystem Green, D. UCD	Benefit Analysis of Pumped Storage in the Single Electricity Market Fogarty, B. (LIT)
Assessment of Impacts of Forest Operations on the Environment Finnegan, J. (NUIG)	Upland commonages in Connemara: can biodiversity be used to inform sustainable agri-environmental policy? Canning, B. (NUIG)	PISCES: Translating EU maritime policy into practical outputs for multiple sectors spanning Ireland, the UK, France and Spain womey, S. (UCC)	An analysis of hydrological model uncertainty at the local stage of a climate change impact assessment in the Suir catchment Murphy, N. (NUIM)
Active Degraded Raised Bog- How Effective are Restoration Strategies? Hynds, J. (ITS)		Developing Local Coastal Adaptation Strategies to Climate Change across North West Europe Gault, J. (UCC)	Long-term organic matter dynamics and greenhouse gas balance of an Irish grazed grassland Hochstrasser, T. (UCD)

Friday April 8th (11.30-12.45) Oral Presentation Sessions (Sessions 17-20)

Session 17 (<i>Boole 1</i>) Environmental Technologies Chair: Dr S. Colgan, EPA	Session 18 (<i>Boole 2</i>) Environmental Management Chair: Dr F. Cawkwell, UCC	Session 19 (<i>Boole 5</i>) Environment & Health Chair: Dr D. Sheehan, UCC	Session 20 (<i>Boole 6</i>) Water Quality Chair: Dr N. O'Leary, UCC
Green roofs: An environmental opportunity for the next decade Adley, C.C. (UL)	Characterising landcover using vegetation seasonality profiles determined from satellite imagery Scarrott, R. (UCC)	Indoor / outdoor air quality relationship in an urban environment: Dublin case studies Challoner, A. (TCD)	Investigation of bacterial pathogen sources and transfer hydrodynamics in rural catchments Murphy, S. (NUIG)
Applying biomimetic design to the development of sustainable antifouling for ocean monitoring technology Sullivan, T. (DCU)	An assessment of the potential of satellite borne radar to detect peatland subsidence over a raised bog in Ireland Wheeler, J. (CMRC)	Risk Ranking of Pesticides Used in Irish Agriculture Labite, H. (UCD)	The effect of anoxia and anaerobia on ciliate communities in biological nutrient removal systems using lab-scale SBRs Dubber, D. (TCD)
Succession of fungal community structure and properties of spent mushroom compost associated with varying composting methods Farrell, M. (DkIT)	GIS hazard assessment of landslides in Ireland Dao, L.G. (NUIG)	Adsorption isotherms of fungicide chlorothalonil in Irish soils Piowarczyk, A. (UCD)	Foaming Scum Index (FSI) - A new tool for the assessment and characterisation of biological mediated activated sludge foams Fryer, M. (TCD)
Effect of organic loading rates on anaerobic co-digestion of solid fraction of pig manure and grass silage Xie, S. (NUIG)	Some Aspects of Spatial Data Analyses in Environmental Monitoring Zhang C. (NUIG)	Development of a toxin screening multi-parameter on-line biochip system Moore, E.J. (UCC)	Detection of parasitic protozoans and indicator bacteria in two wastewater treatment plants in NW Ireland McTiernan, F. (IT Sligo)
Biological treatment of methane using a novel biofilm technology Kennelly, C. (NUIG)		Early Warning Signal Analysis in Drinking Water Treatment Plants Operations Imran, S. (UCC)	A Stormwater Sampling Protocol for Monitoring of Sediment Transport in an Urban Catchment Morgan, D.T. (TCD)



KEYNOTE ADDRESS

PLENARY SESSION

OPENING CHAIR PRESENTATIONS

KEYNOTE ADDRESS

“Health and the Value of Nature”

Professor Michael Depledge

Date: Wednesday April 6^h, 8 AM

Venue: Devere Hall

Professor Michael Depledge is an expert in ecotoxicology and medical toxicology. He advises the United Nations and World Health Organization (WHO) on marine pollution issues, working in Brazil, India, China and Vietnam and several other countries to deploy the Rapid Assessment of Marine Pollution program for the UN's Global Oceans Observing System. He served as the Chief Scientist of the UK's Environment Agency from 2002-2006, developing their first Science Strategy and creating a Europe-wide strategic partnership among EU Member State environment agencies. He is currently Chair of the Advisory Board of the European Centre for Environment and Human Health which has recently been established in Truro, Cornwall. Professor Depledge is a Commissioner of the Royal Commission on Environmental Pollution that advises the UK Parliament, is Chair of the European Commission's Advisory Group on the Environment (DG-Research), a founding board member of Natural England, and an Honorary Professor of the University of Oxford and of Imperial College, London. He has been an Honorary Visiting Scientist at Harvard School of Public Health.



ENVIRON PLENARY SESSION

Towards 2020: Environmental challenges & opportunities

Date: Thursday, April 7th, 9.15-11.00 AM **Venue:** Boole 3

Speaker: Professor John Sweeney, ICARUS Director, NUI Maynooth

Title: *Climate change in Ireland: The Challenges and Opportunities of Adaptation*

Biography: Professor John Sweeney has been a researcher in various aspects of climatology and climate change in Ireland for over 30 years. He has served a number of national and international academic bodies and currently leads a number of research projects examining various aspects of climate change in Ireland. He was a Review Editor and Contributing Author of the Fourth Assessment Report of the Intergovernmental Panel on Climate Change (IPCC) and is currently President of An Taisce, the National Trust for Ireland.



Speaker: Ms Laura Burke, Director of EPA's Office of Climate, Licensing, Research and Resource Use

Title: *Environmental Research - Informing Environmental Policy*

Biography: Laura Burke joined the Environmental Protection Agency in 2004, as the Director of the EPA's Office of Communications and Corporate Services. She took over the position of Director of the EPA's Office of Climate, Licensing, Research and Resource use in August 2008. She is a graduate chemical engineer of University College Dublin and holds a MSc from Trinity College Dublin. Prior to joining the EPA she worked in the private sector primarily in the area of Waste Management.



ENVIRON PLENARY SESSION

Speaker: Mr John Mullins, Chief Executive and Member of the Board of Bord Gáis

Title: *Environmental Challenges – A Real Business Opportunity*

Biography: John Mullins was appointed Chief Executive and Member of the Board of Bord Gáis in October 2007. Prior to joining Bord Gáis John held the position of Chief Executive with Bioverda, part of the NTR Plc Group. He worked previously as a Business Development Director at Greenstar, European Investments Director at ESB International Investments and as Senior Manager in Corporate Development at ESB. He also held the position of Senior Consultant in the energy area with PricewaterhouseCoopers in London. John holds both a Bachelors and Masters degree in Engineering from University College Cork and an MBA from the Michael Smurfit Graduate School of Business.



Plenary Chair: Dr Jerry D. Murphy, University College Cork

Biography: Dr. Jerry D Murphy has a Degree in Civil Engineering, a Masters Degree (Anaerobic Digestion) and a PhD (energy from wastes). He is the lead PI in Bioenergy and Biofuels research in the ERI. He has represented Ireland on International Energy Agency Bioenergy Tasks for biofuels and biogas. He has published 40 peer review journal papers in the last six years.



PARALLEL SESSION OPENING CHAIRPERSONS

Opening Chair: Mr Peter Webster, Environmental Protection Agency

Session Theme: Water Quality

Session: Session 1, April 7th, 11.30

Location: Boole 1

Peter Webster is the Regional Chemist at the EPA's Cork laboratory in Inniscara overseeing operations including analysis of stack emissions, waters & wastewaters. Following seven years in the electroplating and refractories industries, Peter graduated in Chemistry from Herriot Watt University (Edinburgh). He joined the EPA in 1996 and has over fifteen years experience in the UK water industry. He holds Diplomas in both Water and Environmental Management, and Business Management. He is a Chartered Chemist, Member of the Royal Society of Chemistry and Member of the Chartered Institute of Water and Environmental Management.



Opening Chair: Professor John Breen, University of Limerick

Session Theme: Biodiversity & Ecosystems

Session: Session 2, April 7th, 11.30

Location: Boole 2

Professor John Breen is a zoologist who graduated from UCC with BSc in 1972 and PhD in 1976 in ecological entomology (wood ants). After a year at the University of Bergen, Norway and a post-doc in TCD, he moved to Limerick. He is now an associate professor in the Department of Life Sciences at the University of Limerick. He is involved in biodiversity, especially bumblebees and ants, and beekeeping research.



PARALLEL SESSION OPENING CHAIRPERSONS

Opening Chair: Dr Margaret Desmond, Environmental Protection Agency

Session Theme: Energy & Climate Change

Session: Session 3, April 7th, 11.30

Location: Boole 5

Dr Margaret Desmond is a climate change research specialist in the EPA's Climate Change Research Programme. A graduate from UCC, her main areas of expertise are climate change impacts, vulnerability and adaptation. She is currently leading on the national climate change information system. She is a member of the EU expert Knowledge Base-Working Group for climate change impacts and adaptation. She was the lead author of 'A Summary of the State of Knowledge on Climate Change Impacts for Ireland'(2009). She is also following developments in relation to climate change and water at the EU and national level.



Opening Chair: Dr Brian Donlon, Environmental Protection Agency

Session Theme: Environmental Management

Title: Environmental Research at the EPA

Session: Session 4, April 7th, 11.30

Location: Boole 6

Brian Donlon 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 NUIG (6 years) as PhD student and Post-Doc researcher on treatment of industrial (distillery and pharmaceutical) and agricultural wastewaters primarily using anaerobic treatment methods. Brian joined the Environmental Protection Agency in February 1996 and worked for nine years in IPPC licensing and enforcement at Senior Inspector Level. Since 2005 Brian has been the Research Manager with the EPA on the STRIVE Research Programme. Brian is the National Delegate for the European Commission's 7th Framework Programme on Environment.



PARALLEL SESSION OPENING CHAIRPERSONS

Opening Chair: Dr John Hanrahan, Chief Technical Officer, Glantreo Ltd

Session Theme: Environmental Technologies

Title: Commercialisation of environmental technologies

Session: Session 5, April 7th, 14.00

Location: Boole 1

Dr John Hanrahan is currently Chief Technical Officer (CTO) of Glantreo Ltd. The goal of Glantreo is to commercialize academic research, particularly in the area of materials science and environmental technologies. This includes performing fundamental research breakthroughs and leveraging grants from the European Union, Enterprise Ireland and Cork City Enterprise Board. Dr Hanrahan led the effort to transfer Glantreo's patented technology (sub2silaTM) to a client site in the US. With more and more stringent environmental policies there is now, more than ever, a greater demand for technology based solutions to help meet these policy demands. Areas that need particular technological solutions are CO₂ capture and storage, wastewater treatment and environmental pollutant detection. Environmental technologies should be at the forefront of Ireland 'knowledge based' economy.



Opening Chair: Mr Jeremy Gault, Coastal & Marine Resources Centre

Session Theme: Marine & Coastal Research

Title: The prospects for Marine Research

Session: Session 7, April 7th, 14.00

Location: Boole 5

Jeremy Gault qualified as an engineer and worked in industry before returning to research initially in marine resource management and subsequently geomorphology and coastal erosion management. He joined the Coastal & Marine Research Centre (CMRC) in University College Cork as a researcher in 2002 and subsequently became a project manager. He became Deputy Director in 2006 and took up the role of Centre Director in June 2010. He has over fifteen years experience working in the field of coastal and marine research and is currently responsible for over twenty national and EU FP7 and INTERREG funded research projects.



PARALLEL SESSION OPENING CHAIRPERSONS

Opening Chair: Dr Enda Cummins, University College Dublin

Session Theme: Environment & Health

Title: Environmental influences on health

Session: Session 8, April 7th, 14.00

Location: Boole 6

Dr. Enda Cummins holds a BAgrSc and MEngSc from UCD, Ireland. He did his PhD in the Biosystems Engineering department focusing on environmental risk assessment. He is currently a lecturer in the School of Agriculture, Food Science and Veterinary Medicine. He lectures undergraduate and postgraduate courses in computer modelling and risk analysis. His research interests include: nanotechnology, risk analysis, systems modelling, environmental contamination and consequences for human health.





WORKSHOPS AND TRAINING SEMINARS

WORKSHOPS AND TRAINING SEMINARS

Ocean Studies - Avenues for Employment; Creating a Career from Studies of the Sea



Environment Graduate Programme (EGP), the Coastal & Marine Resources Centre (CMRC/ERI) UCC and the Irish Society for Ocean Studies (ISOS).

Presenters: David Murphy, Dr. John Joyce, Ms. Grainne Lynch, Karin Dubsky, Daniel Norton, Dr. Colin Brown

Date/Time: Wednesday, April 6th, 9.30 AM

Location: Boole 6

Description:

This practical day-long workshop focuses on acquiring the knowledge and life skills needed to create a successful career in a range of disciplines of ocean studies. Beginning with a broad overview of the choices available to graduates by a well-known marine figure, the workshop explores the possibilities around careers in education and outreach, sustainability and economics, marine transport consultancy and environmental and biodiversity protection, as well as discussions on essential life skills for work at sea and understanding the European research funding system. The afternoon of the workshop takes participants on a practical field trip to the shores Myrtleville in Cork Harbour for practical demonstrations and discussions on coastal zone management and life in the intertidal zone.

10:00 Introduction: Dr. Colin Brown Ryan Institute Director, National University of Ireland, Galway

10:10 Keynote Address: Dr. Valarie Cummins, Coastal & Marine Resources Centre, University College Cork

10:30 Dr. John Joyce, Marine Institute. *The Sea and the SESE Curriculum*

10:55 Dr. Tom Doyle & Dr. Michelle Cronin. *Life Skills for Survival at Sea*

11:20 David Murphy, AquaTT *Show me the Money – A “Life Skill” for survival in*

WORKSHOPS AND TRAINING SEMINARS

Research

11:45 Daniel Norton, Socio-Economic Marine Research Unit, NUIG. *Valuing Marine Eco-System Services*

12:10 Grainne Lynch, Nautical Enterprise. *Working in a Maritime Transport Consultancy*

12:35 Karin Dubsky, Marine Biologist & National Co-ordinator for Coast Watch Ireland. *The NGO Perspective*

13:00 Lunch

14:00 Afternoon excursion to Myrtleville in Cork Harbour. The field trip will be co-ordinated by a number of experts in the marine and is designed to give attendees an appreciation for working in the field. Accompanying attendees will be: Dr. Stefan Gray, CMRC, UCC. Coastal Zone Management, Dr. Pauhla McGrane, GMIT. Marine Biology. Conor Ryan, GMIT. Marine Zoology. Dr. Sarah Knight, NUIG and Dr. John Joyce, MI. Marine Outreach and Education.

This workshop is organised by the Environment Graduate Programme (EGP), the Coastal & Marine Resources Centre (CMRC) UCC and the Irish Society for Ocean Studies (ISOS), in association with the ESAI.

The Environment Graduate Programme is Ireland's inter-institutional structured PhD programme which was funded under Programme for Research in Third-Level Institutions.

The Irish Society for Ocean Studies (ISOS www.isos.ie) is a new networking organisation representing all those engaged in the study of the oceans on the island of Ireland.



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WORKSHOPS AND TRAINING SEMINARS

Speakers Biographies:

David Murphy has been the General Manager of AquaTT since 2000, a not for profit spin-off company of UCC/NUIG/GMIT, set up in 1992. David has a BSc. in Marine Biology/Oceanography but since graduating has solely specialised in applied science in the Marine sector. David's areas of expertise and day to day work include funding procurement, scientific project management, knowledge management, stakeholder facilitation, communication and knowledge transfer. In the past two years alone David has led AquaTT to join consortiums securing European Research grants valued at ~€20M of which the value to Irish Companies and Universities is >€4M.



Dr. John Joyce over his thirty-five year career in Irish marine science John has brought a variety of life-skills to bear on his work in university research and teaching, in industry and in the semi-State sector. His current role with the Marine Institute focuses on communications via the media, on outreach and the education sector through the "Explorers" Primary School Marine Education Programme.



Ms. Grainne Lynch is a Development Manager in Nautical Enterprise Centre Ltd. Nautical Enterprise is a strategic consultancy that conducts research within large-scale European projects in the area of maritime transport and logistics. As development manager, Grainne is responsible for identifying, obtaining and managing research projects related to IT, managing software product development and IT infrastructure. Her current focus is on realising the EU vision of paperless freight transport that contributes to a cleaner environment, security of energy supply, transport safety and security.



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Karin Dubsky is a Marine Biologist & National Co-ordinator for Coast Watch Ireland. Karin is an Environmental Scientist who has worked on Coastal Zone Management and on waste issues as a consultant, university lecturer and environmental group representative throughout Europe and the US. She is a member of staff in Trinity College Dublin, Civil and Environmental Engineering faculty.

Daniel Norton is a researcher at the SEMRU in NUIG. He has a B.E. from NUIG, a P. Grad. Dip. in environmental engineering from TCD, a M. Eng. Sc. in wastewater engineering and a M. Econ. Sc. in environmental economics from NUIG. He has previously worked as an engineer in the area of planning, water supply schemes, environmental permits and wind farms with EAEC Ltd and has worked as research assistant for the Department of Economics in NUIG on biodiversity and tourism in the West of Ireland. His current research involves the use of benefit transfer non market valuation technique to estimate the value of achieving “good ecological status” in Irish water bodies.



Dr. Colin Brown is the Director the Ryan Institute, NUI Galway institute for marine, environment and energy research. Previously he was a lecturer at the University's department of Earth and Ocean Sciences where his work involved teaching and research in Geophysics.



WORKSHOPS AND TRAINING SEMINARS

Geospatial technologies – their value for your real world applications

Presenters: Dr Fiona Cawkwell, Andy Day

Date/Time: Wednesday, April 6th, 1.30 PM

Location: Computer Lab, Geography Department

Description:

The geospatial technologies of Geographical Information Systems (GIS) and Remote Sensing (RS) are increasingly being used for capture, analysis and presentation of spatial data for a variety of environmental applications. Two linked workshops will be offered by Compass Informatics and UCC on some of the tools, real world applications and coming updates within GIS and RS software, with live demonstrations and some hands-on applications, as well as invaluable information on where to source existing data and acquire new data. The workshops will focus on Irish environmental issues with an emphasis on practical solutions using GIS and RS, and will include demonstrations of field computing systems. Some tangible evidence of cost savings and return on investment from adoption of these technologies will also be presented



Speakers Biographies:

Dr Fiona Cawkwell studied for a BSc in Geography at Edinburgh University, Scotland, followed by an MSc in Remote Sensing at University College London, England, and in 2003 she was awarded a PhD from Bristol University, England, on the topic of climate change and the Greenland Ice Sheet. Between 2001-03 she also taught Remote Sensing, GIS and Global Environmental Change at Bristol University before moving to Edmonton, western Canada, for 2.5 years to undertake postdoctoral research into climate change in the Canadian Arctic. Fiona joined the Geography Department at University College Cork in January 2006 where she teaches and researches a range of topics including remote sensing, geomorphology, glaciology and



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climate change. Fiona leads the Remote Sensing component of the UCC MSc Applied Science (GIS and Remote Sensing) and she has supervised undergraduate and postgraduate dissertations on a number of topics. She has also obtained grants from the Environmental Protection Agency, Friends of the Irish Environment and the British National Space Centre to conduct her own research. Fiona was part of a small group of Irish researchers who set up the Irish Earth Observation Symposium series, and she co-organised the annual meeting in Cork in 2008. In September 2010 Fiona convened an international conference on Remote Sensing at UCC, and is on the Council of the UK Remote Sensing and Photogrammetry Society.

Andy Day. Following a natural science degree from TCD and a 1st class masters from NUI Maynooth in GIS & remote sensing Andy has been working with Compass Informatics for 4 years with 6 years working experience in GIS with a particular emphasis on environmental applications. He has completed successful projects both for State Agencies (EPA, GSI, CFB, Pobal, SEAI, NTA) and local authorities (Fingal, DCC, Meath CoCo, Cork CoCo, Sligo CoCo) with projects ranging from data capture to data modelling to data dissemination. Through these projects he has developed a robust knowledge of hardware and software packages that compliment his core GIS skills. Recently he has project managed the implementation of a number of webmapping systems notably for SEAI (<http://maps.seai.ie/bioenergy>) and Pobal (<http://maps.pobal.ie>).



WORKSHOPS AND TRAINING SEMINARS

Science Communication Workshop

Presenters: Professor William J. Reville, Dr Brian Quinn

Date/Time: Wednesday, April 6th, 2.00 PM

Location: Boole 1

Description:

A half day workshop on science communication shall be held on Wednesday 6th April as part of Environ 2011. It is intended that this workshop shall introduce younger scientists to various aspects of communicating science to both the general public and a more scientific audience. The workshop is broken down into two sections as detailed below. This half of the workshop will discuss the importance of communicating science to the public and will outline some effective presentation techniques and some pitfalls to avoid. The professional demeanour of the scientist often gets in the way of effective communication with the public. It is important to come across, not only as a scientific expert, but as an otherwise ordinary person with typical everyday interests and preoccupations. The importance of telling a story, expressing opinions, appropriate use of humour, and of being sensitive to everyday public understanding of concepts such as 'guarantee', 'safe', 'theory' and so on, will be emphasised. Writing, publishing and presenting science is of obvious importance for scientists to communicate their results with both their peers and the wider community. It is also your currency as a scientist and the yardstick by which you are evaluated. For many young scientists starting out, the prospect of writing your first publication or making a scientific presentation can be a daunting one. The idea behind this talk is to give an understanding and insight into the basic principles to adhere to and pitfalls to avoid when writing your first publication or when presenting your results. The talk shall be divided onto two sections. The first shall cover platform presentations to both a scientific and non-scientific audience. What is the difference between these audiences? How to pitch your talk at the right level? The structure, content and focus of the talk as well as tips on how best to present it. The second aspect of the presentation shall contain an insight into how to write your first peer reviewed scientific publication, offering practical tips on how best to structure your paper. How long should your paper be? The logical progression through the paper and identify the most basic mistakes (e.g. simple grammar). We shall investigate the review process of a peer reviewed journal, explain impact factors, why the choice of journal is so important and finally look at examples of good and awful scientific writing in order to illustrate these points.

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Speakers Biographies:

William Reville took his BSc and PhD degrees at UCD. He has worked at UCC since 1975 and is now Professor of Biochemistry, University Radiation Protection Officer and University Public Awareness of Science Officer. From 1976 until 2005 he was Director of the University Electron Microscopy Unit. His principal research interest is protein turnover in skeletal muscle. Professor Reville

writes the Science Today column in The Irish Times, a column he started in January 1995. Prior to that he wrote a science column in The Cork Examiner for several years. In 1999 he published a selection of his Irish Times columns in a book 'Science Today: Understanding the Natural World'. He contributes regularly to radio and TV programmes.



Dr Brian Quinn is the Director of the Irish Centre for Environmental Toxicology (ICET) a collaborative research centre established between the Galway-Mayo Institute of Technology (GMIT), Athlone Institute of Technology (AIT) and the National University of Ireland Galway (NUIG), hosted in the new research facilities in GMIT. Brian is an environmental toxicologist and is currently Principle Investigator of an EPA funded DERP project investigating the ecotoxicological effects of novel contaminants (pharmaceuticals) in the environment by developing novel biomarkers in bivalve mussels. Previously Brian completed his PhD in Trinity in 2002 and a post-doc with Environment Canada.



WORKSHOPS AND TRAINING SEMINARS

3rd Annual Postgraduate Research Symposium on Environmental Law

Date/Time: Wednesday, April 6th, 14.00

Location: Boole 2

Time	Speaker and Presentation title
14.00	Dr. Owen McIntyre, Faculty of Law, University College Cork Welcome and Opening Remarks
14.15	Mr. John McNally, Ph.D. Candidate, Faculty of Law, UCC: "An Immeasurable Mistake? Can the EU Emissions Trading Scheme be Saved from Itself?"
14.45	Ms. Aine Moloney, LL.M. Student in Environmental Law and Sustainable Development, Queen's University Belfast: "Environmental Governance in Northern Ireland"
15.15	Tea / Coffee
15.45	Mr. Ondotimi Songi, LL.M Candidate, Energy Law & Policy, CEPMLP, University of Dundee: "Towards Public Interest Litigation in Environmental Protection in Nigeria"
16.15	Mr. Fariborz Safari, Ph.D. Candidate, Faculty of Law, UCC: "The Interaction / Interrelationship between State Sine Delicto and Civil Liability for Vessel-source Environmental Pollution"
16.45	Ms. Phyllis Comerford, Ph.D. Candidate, Faculty of Law, UCC "A court against whose decisions there is no judicial remedy under national law? Exploring the Article 267(3) referral obligation in the context of judicial review under Irish planning legislation"
17.15	Concluding Remarks
17.30	Close

WORKSHOPS AND TRAINING SEMINARS

Coaching – What is it and How it can Help us Reach our Potential!

Presenters: Ailbhe Harrington

Duration: 2.5 hours

Date/Time: Friday, April 8th, 2.00 PM

Location: Boole 6

Description:

“..the urge to expand, extend, develop, mature – the tendency to express and activate all the capabilities of the organism, or the self...This tendency may become deeply buried...(but) it exists in every individual, and awaits only the proper conditions to be released and expressed.” Rogers (1967:351). Coaching is a growing field and increasingly recognised by individuals and organisations throughout the world. Coaching is future orientated and aims to help people when they feel stuck and want to bring about personal change in their lives and work, to shift their perspective, reflect on their choices and realise their individual potential. Coaching is a series of conversations where the coach acts as a thinking partner, supporting, encouraging and challenging the client on their learning journey. In these changing times students, individuals, managers and leaders within educational, organisational and community settings will benefit greatly from this developmental approach. What can I expect in a coaching meeting? The Coach will take the time to get to know who you are, what is important in your life, your working role, business or organisation. They will be curious about what makes you tick, what concerns you may have and what might be holding you back from achieving what you want. They will do this by asking helpful questions and sometimes challenging your thinking about issues. They will do this in a supportive and encouraging way with the focus being on *your* needs. The coach will encourage you to set out some clear objectives for yourself that will help you to achieve the growth and learning you desire. Description of coaching from a client after two coaching meetings *“.. it was almost like having a companion on the journey of self discovery, to understand for oneself how I can achieve the ambition that I have and make it reality..”*

This two and a half hour workshop will provide you with a flavour of how this approach helps us to reach our potential and an opportunity to develop your capacity to listen to and appreciate what is important for yourself and others. It will involve some input, practical activities, and an experience of a short coaching demonstration.

- What is coaching and how is it different to counselling, consulting and therapy?

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- Understanding the role coaching can play in the development of self and others
- The Person Centred Approach – Carl Rogers
- Support and Challenge Skills: 3 Levels of Listening – Practical activity; Asking the right questions rather than focusing on getting the right answer – Brainstorm
- Practical Demonstration of Coaching
- Skill Development Activity
- Review

Speaker Biography:

Ailbhe Harrington specialises in designing and facilitating leadership, team development, stress management, personal effectiveness, leader as coach training and 1:1 coaching to the private, public and voluntary sectors. Her focus is on facilitating individuals to develop self awareness, becoming more insightful, thereby moving to a place of choice and responsibility. In turn, they are better equipped to contribute fully to the multiple demands of their busy careers. She is very aware of her role as a facilitator in terms of creating a safe learning environment where people are able to take every opportunity to learn experientially. She is highly experienced in managing group dynamics, being emotionally aware of what needs to be addressed in groups so they function effectively. The foundation of her coaching philosophy holds that each of us have within us the resources for self understanding and change; with the right conditions we can tap into these resources and reach our full potential. Furthermore, as all things are connected, as one person changes the whole system changes. Ailbhe is a Professional Certified Coach (PCC) with the International Coach Federation and is the programme leader and trainer on an ICF/HETAC Level 7 Certificate in Coaching Skills with Coaching Development & Tipperary Institute. She has worked as an executive coach, trainer and facilitator with a diverse range of clients. Ailbhe has gained an academic Masters with Merit in Work Based Learning Studies - Professional Coaching from Middlesex University. Ailbhe draws on over 20 years experience, which has included working within the public, private and voluntary sectors.





ORAL PRESENTATION ABSTRACTS

(LISTED IN SESSION ORDER)

Oral Presentation - Water Quality – Session 1

Thursday April 7th (11.30 – 12.40) Boole 1

Bad Biology, Good Chemistry: Contrasting evidence for water quality recovery in Northern Irish streams

Author(s): Barry C. D., Foy R. H.

Corresponding Author Institution: AFBI

Keywords: Phosphorus, water quality, macroinvertebrates, Land use

Twenty years ago headwater streams of the Upper Bann and Colebrooke Rivers suffered from frequent agricultural point source pollution events (e.g. silage effluent and yard runoff – is this not diffuse runoff not point). This pollution was most frequent in lowland streams draining the more intensively farmed grassland. Such streams scored poorly under chemical classification and macro-invertebrate biotic scoring systems. Organic pollution from farms combined with elevated nutrient losses from fields resulted in high phosphorus concentrations, so contributing to the eutrophication of the receiving lakes: Lough Neagh and Lough Erne. Much has changed with respect to environmental/pollution/agricultural legislation and regulation in Northern Ireland. The introduction of a Farm Quality Assurance Scheme for beef farmers and the Single Farm Payment (SFP) for virtually all farms introduced an element of environmental cross-compliance that linked minimising farm-yard pollution risk to either beef sales and/or the receipt of the SFP. Farming practices have also changed with a switch to wilted silage, which produces less silage effluent, while the Nitrates Directive now forbids the application of slurries over much of the winter. This latter regulation has required an expenditure of €200m for the provision of slurry storage facilities. The headwater streams drain mini-catchments of 1-19km² offering relatively uniform land use that can be linked to water quality. By the late 1990s chemical water quality was improving but without a parallel improvement in biotic scores. In 2008 sampling was restarted (why had it stopped?) to determine the degree of recovery. Using the same classification systems as in the 1990s, the presentation compares historic data with chemical and biotic indices observed in 2008/9. The scale of reduction in phosphorus export rates is also compared over time and between catchments, particularly in light of the Erne Nutrient Management Scheme which targeted nutrient management advice to farms in the Colebrooke catchment.

Corresponding Author Email Address: chris.barry@afbini.gov.uk

Oral Presentation - Water Quality – Session 1

Thursday April 7th (11.30 – 12.40) Boole 1

Quantifying flows along pollutant pathways in Irish catchments

Author(s): O'Brien R, Deakin J, Misstear B.D., Gill L.W.

Corresponding Author Institution: Trinity College Dublin

Keywords: Catchment modelling, diffuse pollutants, Catchment Management Tool, river hydrograph separation

Diffuse contaminants originating on the land surface can make their way into rivers via a number of different pathways including overland flow, interflow, shallow groundwater flow, deep groundwater flow and, in some cases, via artificial land drains. If we can better understand the specific pathways that deliver a contaminant of interest, and the attenuation processes along the way, then appropriate mitigation measures can be more directly targeted. The Pathways Project, an initiative funded by the EPA STRIVE programme, is working towards a better understanding of hydrological pathway processes, water-borne contaminant fate and transport, and the subsequent impact of these contaminants on aquatic ecosystems in Irish catchments. The contaminants being investigated include phosphorus, nitrogen, sediments, pesticides and pathogens. The project is developing a Catchment Management Tool (CMT) to assist the EPA and River Basin District managers in achieving the objectives of the Water Framework Directive. One important aspect of this research is quantifying the proportion of the river hydrograph that is derived from each of the pathways. Data collected in the field are being used to verify the conceptual model and provide the constraints to these four pathways within various mathematical models. Various hydrograph separation techniques are being employed, including modified traditional physical methods, and more novel chemical separation methods, in conjunction with a semi-distributed, lumped and deterministic rainfall-runoff model, NAM. The contributions from each of the four pathways, combined with an understanding of the attenuation of the contaminants along those pathways, will inform the catchment management tool. The research is being carried out by a consortium involving QUB, UCD and TCD.

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Oral Presentation - Water Quality – Session 1

Thursday April 7th (11.30 – 12.40) Boole 1

Assessment of groundwater vulnerability to pollution in Ireland based on the COST-620 pan-European approach

Author(s): Pavlis M, Cummins E

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Keywords: Groundwater Vulnerability

The objective of this work was to assess the vulnerability of groundwater to pesticides in Ireland. A groundwater vulnerability assessment (GVA) method was developed to provide a qualitative classification of vulnerability. The model has the added advantage of considering surface water flow in a process-based way by taking into account the effect of topography and vegetation. Additionally, rainfall is considered as an external stress affecting groundwater pollution either by dilution processes or due to increased recharge. The model considers three parameters that affect groundwater vulnerability, the protectiveness of the overlying layers, the reduction of protection due to concentrated flow and finally precipitation. To develop the “overlying layers” parameter, four datasets were used: a) the Teagasc Topsoil map which provided the locations of peat soil and outcropping rock, b) the Soil Associations map of Ireland was used to assess topsoil permeability based on soil texture, c) the groundwater vulnerability map developed by the Geological Survey of Ireland (GSI) provided an indication of subsoil permeability and thickness for about 60% of the country, and d) the Teagasc Subsoil map was used to estimate subsoil permeability for the part of the country not covered by the GSI map. For the second parameter two scenarios were considered, occurrence of point karst features (e.g. swallow holes) and areas of karstified outcropping rock. In total 6 datasets were used, namely: a) the Teagasc Land Cover 95 map (TLC95) to assess the influence of vegetation on surface water flow, b) a digital elevation model with spatial resolution of 20m to take into account the effect of topography, c) locations of point karst features and losing or sinking streams provided by the GSI, d) the subsoil map was combined with the TLC95 map to produce a map of outcropping or sub-cropping (< 1 m) rock, and e) the aquifer database provided by the GSI was used to assess the degree of karstification of the outcropping rock. The influence of precipitation was assessed using precipitation data for the period 1980-2009. The precipitation data were interpolated using the ordinary kriging geostatistical method. The output of the method was reclassified into five classes of groundwater vulnerability. Based on the groundwater vulnerability method 2.7% of the country is classified as Very High vulnerability, 5% as High, 8.8% as Moderate, 49.6% as Low and 31.5 as Very Low, while the Water class occupies 2.3%. This work represents a state-of-the-art approach based on recent advances in the understanding of karstification processes in Ireland but also on the most detailed datasets currently available. It is expected that the output of the analysis will have several applications, especially in the agricultural sector, from defining suitable ways for controlling pollution, to determine appropriate changes in natural resources management, and prioritising areas for remediation activities.

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Oral Presentation - Biodiversity & Ecosystems - Session 2

Thursday April 7th (11.30 – 12.40) Boole 2

Modelling Eurasian Badger (*Meles meles*) populations in response to management practices in the Republic of Ireland

Author(s): Byrne A.W., Martin S.W., Sleeman D.P., O'Keeffe J., Green S., Davenport J.

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Keywords: Badger *Meles meles* bovine tuberculosis modelling GIS GEE GLM

Eurasian Badger (*Meles meles*) populations play a significant role in the functioning of Irish ecosystems (as ecosystem engineers, seed dispersers and predators), as well as being of considerable economic and veterinary health importance due to their role as a wildlife reservoir of bovine tuberculosis (bTB) (for example, overall monetary cost to the taxpayer of bTB control in Ireland is >€1 billion since 1954). Part of the current national strategy to eradicate bTB from the national herd involves the management of badger populations in areas where cattle herds breakdown (i.e. become restricted due to bTB within the herd) and a veterinary investigation suggests badgers are epidemiologically implicated. Here we use an extensive dataset, generated from these control activities, to assess factors that affect the capture regime, preliminarily investigate the population densities and estimate the relative reduction in badger population abundance in areas under capture. Initial modelling of the capture regime, using Generalized Estimating Equations (GEE), suggested that a number of factors significantly influence the probability of capture across attempts. The models suggest that year, season, the capture effort (the number of restraints laid), the previous capture history (total badgers caught prior to the current visit) and the number of openings (holes) used significantly contributed to the numbers of badgers caught. A number of methods have been employed (Leslie method, catch per unit effort and GIS/regression methods), to varying degrees of success, to quantify the relative population reduction in badger density across capture attempts (capture events are in units of 11 night blocks). Early results suggest that a significant proportion of the resident populations under capture are removed during the first 3-4 capture events. However, badgers can still be caught even after nine or more capture events at an individual sett, suggesting that immigration of badgers from non-managed land maybe taking place.

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Oral Presentation - Biodiversity & Ecosystems - Session 2

Thursday April 7th (11.30 – 12.40) Boole 2

Red Squirrels of Ravenpoint: A Priority for Protection

Author(s): Carr W, Naulty F, Hayden T.J.

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Keywords: Red Squirrels, Preferred Area

The Irish Squirrel Survey 2007 indicated that red squirrels (*Sciurus vulgaris*) have largely disappeared from Leinster. This research assessed the squirrel population of Raven Point, Wexford to determine its potential as a Red Squirrel Preferred Area (RSPA). Assessment of the population was carried out between 2008 and 2010. Over this period, the population increased from 331 to 492 individuals. The squirrel density in the northern end was 4.75 squirrels/ha and 1.81 squirrels/ha in the southern section. This variation in density coincided with variation in tree diversity and food availability. The diet varied between years in line with the seed crop availability. A sample of the population was trapped on eight occasions over the study to assess breeding rates and body condition etc. Some individuals were radio-tagged to assess home-range variation. There was no significant variation in body weight of adult squirrels either between sexes or seasons. Female breeding rates varied from 68% in spring to 40% in autumn. Home range size did not vary between the sexes. Seasonal changes were related to variations in food availability. Raven Point's stable red squirrel population may represent one of the most important populations in Leinster. It is recommended that it be designated an RSPA.

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Oral Presentation - Biodiversity & Ecosystems - Session 2

Thursday April 7th (11.30 – 12.40) Boole 2

Trophodynamics of the regional scale ecosystems of the N.E. Atlantic: Are they out of control?

Author(s): McGinty N, Power AM, Johnson MP

Corresponding Author Institution: Ryan Institute, Dept of Zoology, NUIG?

Keywords: Control Charts, Trophic position, Plankton, N.E. Atlantic

In the last decade the Continuous Plankton Recorder (CPR) has been used extensively to document dramatic changes in the abundance and biogeography of several important planktonic species and species groups on a basin wide scale. Processes at the regional scale < 200 nautical miles are perhaps not so clear. There has not previously been a partitioning of the ocean to allow regional scale comparisons to take place (at scales below the Large Marine Ecosystems or similar). By applying a scheme to define regions, we used a control-chart approach to investigate if processes such as regime shifts and trophic amplification are variable at regional scales. The approach is based on satellite-derived chlorophyll data to create “ecoregions” in the N.E. Atlantic, using an iterative clustering technique for data collected between Mar-Oct 1998-2008. CPR samples were extracted from within each region and species were divided into trophic levels based on previous literature. Multivariate control charts using a similarity distance class were used to assess if fluctuations within a trophic community reflect stochastic drift in species abundances or whether a significant underlying change has taken place. If a trophic level is deemed to have undergone a significant change, will this propagate through the other trophic levels creating an ecoregion which is “out of control”? These results from each “ecoregion” and the cross region variability will be discussed.

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Oral Presentation - Energy & Climate Change - Session 3

Thursday April 7th (11.30 – 12.40) Boole 5

A long relative humidity series for Armagh Observatory: Its consequences for atmospheric warming during the twentieth century and the underlying causes of the Great Potato Famine in Ireland

Author(s): Butler C J, Garcia-Suarez A M

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Keywords: Relative Humidity, Climate Change, Atmospheric Warming

We present a calibrated atmospheric humidity series for Armagh Observatory from 1838 to 2008, corrected for instrumental error and the time of reading. The mean seasonal and annual time series of RH show only marginal evidence for a trend since the 1880s, however there is significant decadal and multi-decadal variability, some of which appears to be cyclic. Two of the most conspicuous peaks in RH coincide with major infestations of potato blight in the 19th century. Wavelet analysis indicates the presence of two quasi-periodic components in RH, one ranging from 23.4 to 25.5 years and the other from 36 to 51 years. We discuss potential physical origins of these cycles such as changes in the atmospheric and thermohaline circulation and the solar magnetic cycle and the probability that they contributed to the Great Potato Famine in Ireland. Computations by Gerald Stanhill using this humidity series, together with our previously published temperature series for Armagh, have estimated the significant contribution of water vapour to twentieth century warming in Northern Ireland.

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Oral Presentation - Energy & Climate Change - Session 3

Thursday April 7th (11.30 – 12.40) Boole 5

Environmental policy: process or project based approach

Author(s): McGloughlin J S

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Keywords: climate change, policy design, governance

Governments are charged with addressing environmental problems and do so in two ways: by incorporating a specific agenda into the main policy documents (a process-based approach or mainstreaming) or by adopting targeted new policies for a specific issue (a project-based approach). There are benefits to both approaches and a review of existing Irish environmental policies reveals that neither approach has resulted in widespread uptake of environmental concerns. This paper considers which approach is better suited for environmental challenges and how this dilemma plays out at the local level. This research identifies the benefits and drawbacks of the two alternative approaches, considers Irish political realities, and proposes ways to advance environmental agendas. Mainstreaming environmental issues into strategic plans allows local authorities to address controversial issues within their prescribed remit. Mainstreaming also decreases the risk of negative interactions between fragmented policies. On the other hand, project-based approaches can use public support to fast-track action specific actions. Additionally, project-based approaches can increase transparency and accountability. This paper explicitly frames environmental policies by their approach as an alternative to the *ad hoc* policy design heretofore in Ireland.

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Oral Presentation - Energy & Climate Change - Session 3

Thursday April 7th (11.30 – 12.40) Boole 5

Carbon Footprint: can it ever be more than just a number? Making measurement & communication more meaningful

Author(s): Ryan B, Henry A, Dunphy N

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Keywords: Carbon Footprint, Climate Change, Methodology, Organisation, Product

Carbon footprinting (CF) has developed as an environmental indicator quantifying *“the total greenhouse gas emissions caused directly and indirectly by an individual, organisation, event or product”* (Carbon Trust, 2007). Increasingly, CF is being used by organisations globally, to measure the climate impact of their operations and/or products. However, as an indicator CF is not without its critics, for example, the *Wall Street Journal*: *“Now makers of everything from milk to jackets to cars are starting to tally up the carbon footprints of their products. So far, these efforts raise as many questions as they answer.”* (Ball, 2009). Much of this questioning arises because carbon footprints are rarely comparable, due to differences in methodologies, boundaries, assumptions, data quality, expertise *etc.* How then can most value be obtained from determining a CF? This paper examines current carbon footprinting methodologies and practice, drawing on a number of case studies to critique and explore the optimum use of this metric. It concludes that, in general, the most valuable use of the CF metric lies beyond the mere quantification of an amount of CO₂e. The value is more than just getting a result expressed as a single datum; it is about how the data can be used to plan, instigate, promote and communicate positive change in environmental impact over time. The use of CF as a stand-alone metric will be shown to be extremely limited, however the paper will illustrate how it can be an effective tool for organisations to increase the sustainability of their operations, products and services.

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Oral Presentation - Environmental Management - Session 4

Thursday April 7th (11.30 – 12.40) Boole 6

Assessing the impacts of the infilling of wetlands in County Galway with construction and demolition (C & D) waste using invertebrate bioindicators, biomonitors and hydrological parameters.

Author(s): Staunton J., Morrisson L., McDonnell R., Henry T., Gormally M..

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Keywords: Wetland, C & D waste, Infill, Sciomyzidae, Bioindicator, Metal, Snail, Bioaccumulation, Biomonitor

Wetlands are important watershed components providing many useful ecosystem services including water transfer and storage, plant and animal production, organic decomposition, habitat provision and flood control. Many wetlands in Ireland have been or are currently being infilled with C & D waste and while little is known about the impact of infilling on wetland ecosystem function in Ireland, previous studies have shown that C&D waste can produce harmful leachate. Seven wetlands partially infilled with C & D waste were selected in County Galway. These sites consist of five cutover bog sites, one reed and large sedge swamp and one marsh. Aerial invertebrates were collected using pan traps placed on infill and wetland vegetation during 2009 and 2010. Particular emphasis was placed on marsh flies (*Diptera: Sciomyzidae*) which are proven indicators of environmental change in other wetland types including turloughs and callows. Plant species composition around the pan traps was also assessed using quadrats. All sites were mapped using differential GPS and piezometers were used to establish the direction of surface and groundwater flow. Water samples from these piezometers are currently being analysed (elemental content) to establish if the groundwater chemistry is affected by the C & D waste. The bioaccumulation of metals from the infill material by aquatic snails (*Mollusca: Gastropoda*) is also being investigated. Snails have previously been successfully used as biomonitors of metal contamination from mining sites and this is the first time these organisms have been employed as biomonitors of C & D waste infill.

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Oral Presentation - Environmental Management - Session 4

Thursday April 7th (11.30 – 12.40) Boole 6

Design out waste in construction

Author(s): Dowd D, Kelly M

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Keywords: waste, construction, resource efficiency, waste management

Construction and Demolition (C&D) waste has traditionally been second only to agriculture in terms of tonnages of waste produced per annum in Ireland. In order to reduce the levels of waste produced in the construction sector, GMIT are carrying out case study based research on designing out waste in the construction. This research aims to identify areas where waste can be reduced through the implementation of design methodologies such as off-site and modular construction, as well as examining where design details can be made more waste efficient. The case study research is based on two major construction projects, with several smaller case studies. This paper details the waste efficiency measures that have been taken on both of these case studies, as well as the lessons learned from a waste minimisation perspective. The proposed Human Biology Building at NUIG is the first case study. Working with Scott Tallon Walker Architects as part of the design team on this project, it was possible to understand what influences the decisions which could affect the levels of waste produced. Specifications and contractual requirements were added to this project in order highlight the issue of waste to the contractors who will tender for the construction works. The second case study is the Mater Campus Hospital Development which is currently being built by John Sisk & Son as a design and build project. Working with the construction team, waste prevention measures can be implemented before they become an issue on site, thus increasing productivity and reducing costs for the main contractor and subcontractors alike. By implementing the findings of this research it may be possible to reduce substantially the levels of waste produced in this sector in years to come, thereby increasing resource efficiency and reducing the sectors dependence on environmentally unfavourable disposal options such as landfill.

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Oral Presentation - Environmental Management - Session 4

Thursday April 7th (11.30 – 12.40) Boole 6

Eco-Industrial Initiatives: Concept, Definitions, Typologies and Models of Development

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Keywords: Cleaner Production, Industrial Ecology, Eco-industrial Parks, Eco-Industrial Networks

In recent years a number of industrial ecology initiatives have emerged in Ireland, including embryonic eco-industrial parks (EIP) and eco-industrial networks (EIN). There are conflicting schemas within the literature for the classification of such initiatives. Clarity of nomenclature and a greater understanding of the underlying concepts are required to facilitate and encourage successful eco-industrial development. This paper presents a classification schema for eco-industrial initiatives, building on existing literature and the authors' engagement with groups of companies on industrial ecology, cleaner production and related projects. A number of Irish eco-industrial initiatives were reviewed to determine where such initiatives are placed in terms of the classification schema presented. This review produced a gap analysis, which identified the areas where focus could result in an improved classification. It will be shown that Ireland's eco-industrial development is at an embryonic stage, and that much work is needed to realise meaningful results and to validate the concept in the Irish context. In conclusion, the paper assesses the applicability of the industrial ecology concept within the Irish context, discussing the appropriateness of different types of eco-industrial initiatives and exploring the support framework required for such development.

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Oral Presentation - Environmental Technologies - Session 5

Thursday April 7th (14.00 – 15.10) Boole 1

Development of microelectrochemical sensors and portable instrumentation for the remote sensing of pollutants in port waters

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Keywords: microelectrochemical sensors, portable instrumentation, remote sensing,

The implementation of EU directives has triggered the need for new methods and systems which enable the monitoring of chemical and biological pollutants in European waters. The diversity of chemical substances which must be detected and monitored, together with the large number of rivers, lakes, underground and coastal waters within the European Union, poses a considerable challenge to analytical and environmental chemists. A new generation of sensors is needed to achieve remote monitoring of the chemical substances. Sensors need to be low-cost and provide reliable chemical measurements. Low-power instrumentation and efficient signal processing are also required to ensure that accurate measurements over time are recorded overtime. Microelectrochemical sensors fulfil these requirements as they can be produced in large quantities in a reproducible manner using standard fabrication technologies in the microelectronics industry. Instrumentation for microelectrochemical sensors can be miniaturised and automated, hence making electrochemistry a suitable method for remote sensing of pollutants. We present here the fabrication of microelectrode arrays based on silicon technologies. A portable instrument is also developed to operate remotely and allow signal processing. The device performances for the detection of copper in seawater will be presented. A limit of detection of 157 nM was achieved, demonstrating that silicon-based microelectrochemical devices have practical interest for the monitoring of polluted seawaters such as those in busy shipping ports.

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Oral Presentation - Environmental Technologies - Session 5

Thursday April 7th (14.00 – 15.10) Boole 1

Sensing of nitrate using polypyrrole nanowires modified with copper nanoparticles

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Keywords: nitrate, nanowires, nanoparticles

The determination of nitrate and nitrite levels and subsequent removal plays an important role in water analysis. In recent years, there has been considerable interest in nitrates with the Nitrates Directive (1991/676/EC) and the EU Water Framework Directive (2000/60/EC) (the nitrate safe limit is set at 30 mg/L i.e. 800 μ M). Nitrates are a common groundwater contaminant in irrigation waters and in heavily populated areas. Overexposure to nitrates can lead to a host of medical problems; for example nitrates can combine with amines to form toxic and carcinogenic nitrosamines. Also, nitrates in the form of fertilizers can cause eutrophication of water. The World Health Organisation recommends a maximum daily intake of 0.3 mg nitrate per kg of body weight. Increasing concern about the rising concentration of nitrate in groundwater has resulted in intensive research in the area of denitrification of drinking water. In this paper, the possible use of polypyrrole nanowires modified with copper nanoparticles for the electrochemical detection of nitrates was investigated. The application of a one-step potentiostatic method was used to synthesise the nanowires at the electrode surface. Once the nanowires were formed they were modified by electrodepositing copper nanoparticles on their surface. The nanowires were characterised using SEM, while various electrochemical methods were employed to monitor their ability to detect nitrate.

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Oral Presentation - Environmental Technologies - Session 5

Thursday April 7th (14.00 – 15.10) Boole 1

Mesoporous solids for low temperature carbon dioxide adsorption

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Keywords: CO₂ adsorption, amine, mesoporous

The reduction of greenhouse gas emissions into the atmosphere, in particular carbon dioxide, has received great attention in both the media and the scientific community. The major source of carbon dioxide is from power generation. Conventional technologies for carbon dioxide separation from flue gas involve the use of amines in aqueous solution. This process is associated with very high energy demands thus significantly reducing a power plant's efficiency. In addition, there are corrosion problems, amine emissions, and issues with amine degradation. In order to overcome the problems associated with the conventional aqueous amine technology, a solid amine based system involving the use of porous solids modified by amines could be used. In this project, mesoporous silica with a high surface area ($\sim 1000 \text{ m}^2 \text{ g}^{-1}$) and a pore size of 6 nm has been synthesised and modified with six different types of amines including aminopropyltriethoxysilane (APTES), tetraethylenepentamine (TEPA) and polyethylenimine (PEI) by means of grafting and wet impregnation. In order to optimise the adsorption capacity, the pore size of the solid was expanded to allow more effective diffusion of amines through the pores during modification. The adsorption capacity of each amine-modified solid was tested using a gas rig connected to an online mass spectrometer. This rig also enabled the testing of amine regeneration characteristics and amine stability during regeneration. Factors that were shown to be important for maximum CO₂ adsorption capacity included the pore size of the solid, the amine modification method and amine type. Desorption tests of the modified solids showed that carbon dioxide adsorbed from a gas stream of 15% carbon dioxide in helium was desorbed starting at 40°C and reached a maximum at 120°C. The amines appeared to be stable during all the tests carried out.

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Oral Presentation - Water Quality - Session 6

Thursday April 7th (14.00 – 15.10) Boole 2

Fenton's and photo-Fenton's oxidation for the removal of Active pharmaceutical ingredients from aqueous solutions

Author(s): Deegan A-M, Oelgemuller M, Nolan K, Tobin J, **Morrissey A**

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Keywords: Pharmaceuticals, water, Fenton's oxidation

Active pharmaceutical ingredients (APIs) are known contaminants of surface and ground waters. In some cases these are persistent organic chemicals which are only partially eliminated during conventional wastewater treatment. Advanced treatment methods such as photo-catalytic and photo-oxidative processes have been applied to the removal of micro-pollutants from wastewater to varying degrees of success. Since iron is abundant and non-toxic, Fenton's reaction is a viable option for wastewater treatment. In this project famotidine, tamsulosin hydrochloride and solifenacin succinate were successfully removed from aqueous solutions using Fenton's and photo-Fenton's oxidation. Fenton's chemistry involves reactions of hydrogen peroxide in the presence of iron to generate hydroxyl radicals. These hydroxyl radicals degrade wastewater constituents relatively unselectively. A halogen lamp was used to enhance this generation by the photo-reduction of Fe (III) to Fe (II). Initial concentrations of Fe (II) and H₂O₂ were optimised for the removal of each API. At 100 µM API starting concentration, 90-180 µM Fe (II) and 5 µM H₂O₂ was required for the complete removal of each API and intermediates monitored via LC-MS. A kinetic evaluation of the results was performed. Intermediates and final products of the degradation have been identified via LC-MS.

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Oral Presentation - Water Quality - Session 6

Thursday April 7th (14.00 – 15.10) Boole 2

Continuous flow solar oxidation and removal of arsenic (SORAS) from drinking water

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Keywords: Arsenic removal, photochemistry, reactor design

With up to 100 million people worldwide drinking water with As concentrations above the WHO recommended limit of 10 µg/l, the vast majority of whom are living in developing countries, there is a need for research into appropriate technological removal methods using natural resources such as solar power, and locally available materials. The solar oxidation and removal of arsenic process has been demonstrated in batch scale experiments in transparent bottles. However, such a batch process produces a limited volume of drinking water and is dependent on the dedication of each user. SORAS involves subjecting contaminated water to UV light to photochemically oxidize As(III) to As(V). This requires the presence of iron which generates free radicals that facilitate the oxidation. The presence of this iron promotes the subsequent co-precipitation of As(V), which can then be easily separated from the water. The aim of this research is to produce a centralized continuous flow system that operates by gravity flow. The continuous flow reactor consisted of a small scale compound parabolic reflector focusing light on six parallel Pyrex tubes, connected in series through which water spiked with As concentrations of up to 1000 µg/l, was circulated at a flow rate of 2.8 l/min. The reactor was placed in a blacked-out box illuminated over the equivalent of 4 hours irradiation time from above using a Philips HB 175 halogen lamp, giving 15 W/m² UV-A light. A series of continuous flow experiments showed that 99% arsenic removal could be achieved. These results are promising for the development of a full-scale treatment system for use at village level, and research is now being undertaken, into an appropriate technology to produce the iron in solution which is required for the process, as well as the design of a suitable clarification method for the precipitated arsenic.

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Oral Presentation - Water Quality - Session 6

Thursday April 7th (14.00 – 15.10) Boole 2

Comparison of Sequencing Batch Reactor and Intermittently Aerated Sequencing Batch Reactor Technologies in Nutrient Removal from Domestic Wastewater

Author(s): Henry LH, Xiao LX, Zhan XZ

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Keywords: Intermittently Aerated Sequencing Batch Reactor, Polyhydroxybutyrate, Phosphorus

The aim of this study was to compare the performance of intermittently aerated sequencing batch reactor (IASBR) and conventional sequencing batch reactor (SBR) technologies in nutrient removal from domestic wastewater. Two identical reactors were made from stainless steel with a working volume of 5 litres each. One reactor was run as an SBR and the other as an IASBR. The reactors ran four cycles per day; each cycle comprised a 5 hr react (including 10 min fill), 40 min settlement, and 20 min decant. The aeration rate during aeration periods was 1 l/min. The reactors had a SRT and HRT of 10 and 15 days, respectively. Both reactors were fed with synthetic municipal wastewater with average total chemical oxygen demand (COD_t), total nitrogen (TN) and total phosphorus (TP) concentrations of 346 mg/l, 33 mg/l and 10 mg/l, respectively. The reactors had similar COD and ammonium (NH₄-N) removal efficiencies, with 87% and 85% in SBR and 86% and 89% in IASBR, respectively. However the IASBR had higher TN, ortho-phosphate (PO₄³⁻-P) and TP removal than the SBR, with average effluent levels of 8.5 mgTN/l, 0.07 mgPO₄³⁻-P/l and 0.65 mgP/l as opposed to SBRs 13.2 mgTN/l, 0.65 mgPO₄³⁻-P/l and 0.97 mgP/l. Phase studies show that as P release peaked, so did PHB production. The P release and PHB production was higher within the IASBR, with P release up to 59.8 mgPO₄³⁻-P/l and PHB peak of 8% of total suspended solids (TSS), whereas the SBR released up to 57.7 mgPO₄³⁻-P/l with peak PHB of 6% of TSS. The next stage of this study will focus on the development of an intelligent IASBR technology that is capable of self-adapting its operation in response to varying influent characteristics. The authors acknowledge the financial support of the EPA (Ref.: 2009-PhD-ET-7).

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Oral Presentation - Water Quality - Session 6

Thursday April 7th (14.00 – 15.10) Boole 2

Treatment of Piggery Wastewaters Using Aerobic Woodchip Biofilters

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Keywords: Anaerobic digestion, nitrogen removal, piggery wastewater, woodchip biofilters

A laboratory test apparatus consisting of twelve identical woodchip biofilters was set up – when, size capacity. The biofilters were made from 225 mm diameter polyethylene pipes. A wire mesh base allowed a passage of air through the filters to maintain an aerobic environment. Lodgepole pine (*pinus contorta*) woodchips were added to the filters to a depth of 600 mm and used as the filter media. The separated liquid fractions of raw pig slurry (SR) and pig slurry after anaerobic digestion (SAD) were collected and stored in a cold room at 11 °C. The biofilters were fed twice daily with the respective pig slurries (SR and SAD). Two different hydraulic loading rates were applied: 5 l/m²/day (LLR) and 10 l/m²/day (HLR). Each treatment was replicated on three filters. The samples were tested for suspended solids (SS), unfiltered chemical oxygen demand (COD_{uf}), filtered chemical oxygen demand (COD_f), total nitrogen (TN), filtered total nitrogen (TN_f), nitrite-nitrogen (NO₂-N), nitrate-nitrogen (NO₃-N) and ammonium-nitrogen (NH₄-N). The SR and SAD units were operating for a period of 400 and 350 days, respectively. Following a start-up period of 60 days an average removal of 61% SS, 64% COD and 60% NH₄-N was observed for the LLR, and 43% SS, 47% COD and 43% NH₄-N were removed at the HLR for the SR units. Following a start-up period of 100 days, the SAD biofilters displayed very good SS, TN and NH₄-N removals. An average of 54% SS, 56% TN_{uf} and 89% NH₄-N were removed at the LLR. The HLR resulted in removals of 49% SS, 47% COD_{uf} and 69% NH₄-N. For both the SR and SAD a significant difference was noted between the LLR and HLR effluent NH₄-N means ($P < 0.05$), indicating that the LLR resulted in a higher removal of NH₄-N. The LLR also resulted in higher nitrate production than HLR ($P < 0.05$), indicating higher nitrification at the lower loading rate.

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Oral Presentation - Marine & Coastal Research - Session 7

Thursday April 7th (14.00 – 15.10) Boole 5

A critical examination of the European Commission's guiding principles for marine spatial planning through their application in the Clyde MSP Pilot Project

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Keywords: marine spatial planning; ecosystem approach; planning principles; stakeholder participation

The adoption of marine spatial planning (MSP) is promoted by the European Commission (EC) through a number of policy and legislative instruments. The EC has also developed a set of common principles for MSP in the EU. A critical examination of these principles in practice is undertaken through an evaluation of the Clyde MSP Pilot Project. The principles are found to be lacking in specificity and somewhat inconsistent with an ecosystem based approach. Lessons for new MSP initiatives, relating particularly to stakeholder participation, governance, data requirements, objective setting, and skills and knowledge needs are derived from the Clyde Pilot.

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Oral Presentation - Marine & Coastal Research - Session 7

Thursday April 7th (14.00 – 15.10) Boole 5

The Ecosystem Approach to Fisheries Management in Ireland; Challenges and solutions from the Beaufort Research programme

Author(s): Reid D.G., Burnell G., Rogan E., Cronin M., Fransworth K.D.,
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Keywords: Ecosystem, fisheries, modelling, top predators

The Ecosystem Approach to Fisheries Management (EAFM) is designed to allow management of fisheries in such a way to promote sustainable fisheries exploitation that minimises the impact on the marine ecosystem. Fisheries can, if carried out in an unsustainable way, lead to negative impacts on the ecosystem in terms of biodiversity, fish stocks and communities, charismatic top predators, and the seafloor habitat. Under the nationally funded SeaChange programme (2008-2015) we are carrying out research designed to address all of these issues. The presentation provides a basic outline of the research programme, as well as more detailed results from some project activities. Results from size spectrum based ecosystem modelling aimed at generating simulations of the marine ecosystem based on ecological theory are presented. These models can then be used to examine the impacts of particular fishing patterns, and the performance of a range of ecosystem indicators e.g. in biodiversity, and fish communities. Additionally, analysis of survey data on the impacts of fishing on the fish community size and make up, in particular on the proportions of large fish, is discussed. Finally, work on the interactions between top predators and the fisheries is presented, in particular we consider the use of space by seals and fishing vessels in the SW of Ireland, and how these do or do not overlap. In conclusion, the EAFM cannot be expected to work without the understanding and cooperation of the fishing industry, and this is a core component of the project. We outline some of the industry involvement in our work, and how that can be expected to develop as the project moves from research to operational fisheries management.

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Oral Presentation - Marine & Coastal Research - Session 7

Thursday April 7th (14.00 – 15.10) Boole 5

Future Proofing of Coastal Flood and Erosion Defence Structures

Author(s): Long E.J., Murphy J.

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Keywords: Coastal Flooding, Coastal Erosion

An increase in the amount of flooding and erosion in coastal zones can be attributed to sea level rise and an increase in storminess. Due to this, current defence structures are likely to be under designed which will result in the necessity for new innovative measures and design techniques for coastal flood and erosion defence methods. Ongoing research at the Hydraulics and Maritime Research Centre seeks to explore new ways of redesigning or modifying coastal structures such that to future protect them without incurring excessive cost or increasing crest levels beyond acceptable levels. To achieve this, physical model testing was undertaken at a scale of 1:30 in a 25m long wave flume. This testing consisted of two coastal defence measures; reservoir system and geotextile matting as will be described below. 1. Freeboard is the vertical distance between the design water level and the structure crest and for both aesthetic and economic reasons it cannot be continually increased. Currently a reservoir system is being researched to reduce crest level elevation but providing the same level of safety. In the model test there are a number of factors being examined e.g. design, slope and water level. This reservoir system also incorporates the possibility for energy extraction. Initial indications are that the reservoir system reduces the crest elevations as compared to a standard designed structure. 2. The reduction of coastal flooding can be achieved by retrofitting existing coastal structures with a wave absorbent geotextile matting seaward of a structure which reduces wave overtopping by absorbing the power of incoming waves. It is envisaged that a number of parameters will be examined to determine the optimum configuration. This is a conceptual idea and together with the reservoir system forms part of a research programme.

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Oral Presentation - Environmental & Health - Session 8

Thursday April 7th (14.00 – 15.10) Boole 6

Risk ranking of antimicrobial residues in the environment

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Keywords: Risk ranking, predicted environmental concentration, antimicrobial resistance

The primary objective of this study was to determine leading factors influencing the presence of antimicrobial residues in the environment and to rank their predicted environmental concentrations (PEC), using a number of ranking endpoints. A mechanistic model is presented for the determination of antimicrobial presence in the environment. The model evaluated PECs for six main groups of antimicrobials used in Europe. The model simulated the release of antimicrobials into the environment by integrating the effects of antimicrobial use, metabolism, degradation, and dilution. Each input variable was assigned a probability density to represent inherent uncertainty and variability. The PECs were ranked in relation to resistance potential (PEC less than the minimum inhibitory concentration), chronic and acute toxicity and hazard quotient (HQ). The model simulated the mean PEC of penicillins (PEN), β -lactams (BET), tetracyclines (TET), macrolides (MAC), quinolone/fluoroquinolones (Q/F) and sulphonamides/trimethoprim (S/T) (0.43, 0.14, 0.05, 0.05, 0.02 and 0.07 mg/m³/day, respectively). Degradation was the main input influencing PEN environmental concentrations, usage was foremost for BET and S/T, while metabolism was the most critical input for TET, MAC and Q/F. Q/F expressed the highest rate of resistance formation potential (57%). BET expressed a moderate HQ (within the range 1.1 - 10) with all remaining antimicrobials expressing a low HQ (between 0.01 - 1). No antimicrobial group was predicted to exhibit toxicity at the predicted concentrations but may lead to levels in the environment which can increase resistance formation. The sensitivity analysis indicates a possible role for considering metabolism during regulation of new antimicrobials as this can greatly influence the PEC value. The results and limitations presented here accentuate the need for further research into antimicrobials in the environment and the development of antimicrobial resistant strains.

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Oral Presentation - Environmental & Health - Session 8

Thursday April 7th (14.00 – 15.10) Boole 6

Secondary Wastewater Treatment Effectively Reduces Total *E. coli* including Antimicrobial Resistant *E. coli* Prior to Discharge

Author(s): Morris C., Morris D., Mulligan M., Cormican M.,

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Keywords: Antimicrobial resistance, *E. coli*, wastewater treatment

Antimicrobial resistant *E.coli* is a major public health problem worldwide and the role the environment plays in its dissemination is not widely studied. Data presented here were collected as part of a project funded by the EPA aimed at performing a risk assessment to assess the potential for hospital effluent to lead to human exposure to antimicrobial resistant *E.coli*. Between February 2009 and February 2011, 105 samples were collected from a series of points (hospital effluent(HE), municipal effluent upstream(UH) and downstream(DH) from a hospital, effluent from throughout a secondary wastewater treatment process(primary influent(PI), post return(PR), primary effluent(PE, treated effluent(TE)) through a municipal sewage system. All samples were screened for the presence of antimicrobial resistant *E.coli* by quantitative culture in the presence and absence of ampicillin (Am) 16µg/ml, streptomycin (S) 16µg/ml, cefoxitin (X) 16µg/ml, cefotaxime (F) 2µg/ml, tetracycline (T) 8µg/ml, sulphonamides (Su) 256µg/ml and ciprofloxacin (P) 2µg/ml. *E.coli* was detected in all effluent samples on all sample dates with an overall reduction in total numbers observed extending away from the hospital and throughout the wastewater treatment process (HE - 9.54×10^6 cfu/mL, DH - 4.08×10^6 cfu/mL; PI - 3.21×10^6 cfu/mL; PR - 5.42×10^6 cfu/mL, PE - 3.31×10^6 cfu/mL; TE - 2.22×10^5 cfu/mL). There was a broadly proportionate decrease in antimicrobial-resistant *E.coli* between PI and TE samples as follows: Am: PI 27% - TE 10%, S: PI 13% - TE 7%, X: PI 0% - TE 0%, F : PI 1% - TE 0%, T: PI 3% - TE 2%, Su: PI 33% - TE 2%, P: PI 6% - TE 2%. These data provides evidence that antimicrobial-resistant *E.coli* are removed at least as effectively as antimicrobial-susceptibly *E.coli* by secondary wastewater treatment although some antimicrobial-resistant *E.coli* are discharged into the environment.

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Oral Presentation - Environmental & Health - Session 8

Thursday April 7th (14.00 – 15.10) Boole 6

The Aqueous Environment as a Source of Vancomycin Resistant *Enterococci* (VRE)

Author(s): Morris D., Galvin S., Cormican M.,

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Keywords: Vancomycin resistant enterococci (VRE), effluent, water

Vancomycin resistant enterococci (VRE) are a significant public health problem. Environmental contamination with VRE is an area of increasing concern. The aim of this study, funded by the EPA, was to examine effluent and water for VRE. Total enterococci and high level VRE (growth at ≥ 1240 mg/L) were enumerated in effluent (hospital effluent, municipal effluent upstream and downstream from a hospital, effluent from throughout a secondary wastewater treatment process) ($n = 50$), water from three rural water supplies (source and piped) ($n = 102$), rivers and lakes ($n = 36$), and seawater ($n = 29$). Enumeration of VRE was performed using a modification of the Enterolert[®] Quantitray[®] 2000 method by the addition of vancomycin (256 μ g/ml). Selected isolates ($n = 20$) were screened for susceptibility to ampicillin (A), teicoplanin (T), gentamicin (G), linezolid (L) and quinupristin-dalfopristin (QD) in accordance with Clinical Laboratory Standards Institute (CLSI) methods, screened for the presence of *vanA* and *vanB* by PCR using specific primers as previously described. PFGE analysis was performed in accordance with PulseNet protocols. PFGE analysis was also carried out on 10 clinical isolates of VRE collected from blood cultures. VRE were detected most frequently, and in the highest numbers in hospital effluent, and in municipal effluent downstream from hospital. VRE was very infrequently or not detected at other sampling sites. All VRE isolated were *E. faecium* of *vanA* type, were resistant to ampicillin, and susceptible to linezolid and quinupristin-dalfopristin. Isolates were diverse by pulse field gel electrophoresis and were not apparently closely related to recent VRE blood culture isolates from an associated hospital. The extent to which VRE in the aqueous environment represents a risk to human health is difficult to gauge. However, its presence in low levels in the outflow of a wastewater treatment plant and in a single rural water supply suggest potential for transmission through environmental contamination.

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Conceptual design approaches for small scale onsite wastewater treatment units and their experimental model challenges for dissolved nutrient reduction

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Keywords: small scale onsite wastewater treatment, ammonia reduction, phosphorus removal, analytical hierarchy process, environmental system analysis.

The paper presents a theoretical conceptual design approach for small scale onsite wastewater treatment units, (OSWWTU), combining a multi-criteria decision tool and an environmental system analysis approach. The conceptual design approach was tested, and the main challenges investigated, with three combined bench-top experimental models. The following steps were employed in the conceptual design process: (1) a theoretical comparison of current available onsite wastewater treatment units was performed through analytical hierarchy methods and Gray's analysis approach, (2) the possible and optimal combinations of available onsite wastewater treatment technologies were identified, and (3) the effectiveness of those combined technologies were tested in the laboratory and the challenges and shortcomings investigated. Finally, a systematic redesign approach and possible technological modifications were determined in order to overcome the challenges observed during the experimental process.

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Oral Presentation - Environmental Technologies - Session 9

Thursday April 7th (16.00 – 17.15) Boole 1

The impact of on-site wastewater treatment for small community developments on groundwater quality

Author(s): Morrissey P J, Gill L W, Johnston P M

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Keywords: De-centralised systems, Groundwater quality, On-site treatment systems, Cluster developments

The impact of de-centralised wastewater treatment systems for small community developments on groundwater is being evaluated at separate developments (so called checker development) in different areas of groundwater vulnerability. Four study sites were identified and boreholes were drilled upstream and downstream of the cluster developments (with different sampling depths in each borehole). Groundwater quality is currently being monitored in these boreholes over an extended period of time. Interim results have shown increases in groundwater contaminants (particularly nitrates) downstream of some of the cluster developments. Continued monitoring of the study sites will take account of seasonal variances such as agricultural practices and fluctuations in the groundwater table. It will then be possible to identify whether these increases are directly associated with the density of the cluster development. Any increase in groundwater contaminants that can be directly associated with these developments would prove the density of cluster developments using de-centralised wastewater treatment systems does have an impact on groundwater quality. A generic model linking the vadose zone subsoil processes and aquifer properties that can predict the impacts of cluster developments on groundwater quality will then be developed. The density of on-site treatment systems discharging effluent to groundwater in cluster developments together with the subsoil conditions should affect future development planning. The generic model could be used to promote and influence more sustainable national and local strategies. Cluster developments that are too dense may lead to groundwater contamination and thus pose both a health risk to groundwater resources and an ecological risk to surface water receiving baseflow from such aquifers.

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Nutrient retention in an integrated constructed wetland used to treat domestic wastewater

Author(s): Dzakpasu M., Scholz M., Harrington R., Jordan S. N., McCarthy V., Hofmann O.

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Keywords: Integrated constructed wetland, domestic wastewater, nitrogen, molybdate reactive phosphate

The paper reports the performance of an on-going, full-scale, surface flow integrated constructed wetland system, (ICW), in treating primary domestic wastewater, which was established in October 2007 in Co. Monaghan, Ireland. The 3.25 ha ICW comprises of two sludge cells and a sequence of five shallow vegetated wetland cells with different hydraulic retention times. The ICW as a whole has a total nominal hydraulic retention time of 92 days. The performance of the ICW presented in this paper is based on the dynamic water budget and influent and effluent concentrations of water quality parameters including the five days at 20°C N-allylthiourea biochemical oxygen demand (BOD₅), ammonia-nitrogen (NH₃-N), nitrate-nitrogen (NO₃⁻-N) and molybdate reactive phosphate (MRP) collected weekly during a three year full-scale operation between February 2008 and February 2011. Treatment of wastewater in the ICW system resulted in retention rates of 386.1g BOD₅ m⁻².yr⁻¹, 34.6g NH₃-N m⁻².yr⁻¹, 4.8g NO₃⁻-N m⁻².yr⁻¹ and 3.9g MRP m⁻².yr⁻¹. The corresponding per cent mass retention rates were approximately 99%, 96%, 93% and 94% respectively. Fluctuations in nutrient loading were mainly due to high variations in rainfall (139-65.7 m³.d⁻¹) and evapotranspiration (39-27.9 m³.d⁻¹). The variability of hydraulic loading rate (7-10.5 mm d⁻¹), due to precipitation driven hydrological inputs had little influence on ICW treatment performance. Moreover, the reduction efficiencies for NH₃-N, NO₃⁻-N and MRP decreased slightly during the relatively cold winter of 2009/2010 and 2010/2011. The system should therefore be sufficiently large to increase retention time and maintain high removal efficiencies during this period.

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**Co-Treatment of Acid Mine Drainage with Municipal Wastewater
Using the Activated Sludge Process**

Author(s): Hughes T.A., Gray N.F.

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Keywords: acid mine drainage, activated sludge, co-treatment, municipal wastewater

Acid mine drainage (AMD), characterized by elevated metal and sulphate concentrations and low pH, is generated when mining activities expose mineral surfaces in sulphidic ore bodies or coal deposits to water and oxygen. The oxidation of sulphides (particularly pyrite, FeS_2) releases dissolved metals, sulphate, and hydrogen ions, causing contamination of surface and groundwaters. Co-treatment of acid mine drainage (AMD) and municipal wastewater (MWW) using the activated sludge (AS) process is an innovative approach to AMD remediation that utilizes the alkalinity of MWW and the adsorptive properties of AS biomass to remove acidity and metals from AMD-impacted waters. Preliminary treatability studies have been conducted to simulate the effects of introducing AMD to different stages of the AS process. Mixing high-strength synthetic AMD (pH 2.8, 540 mg L^{-1} Fe, 200 mg L^{-1} Al, 30 mg L^{-1} Cu, 60 mg L^{-1} Zn, 30 mg L^{-1} Mn) with settled MWW over a range of dilutions, simulating conditions in the primary sedimentation stage of the AS process, led to rapid and significant removal of metals from solution (average removal: 38 mg L^{-1} Al, 5 mg L^{-1} Cu, 56 mg L^{-1} Fe, 4 mg L^{-1} Mn, and 7 mg L^{-1} Zn). Mixing synthetic AMD with AS biomass at different solids concentrations, simulating AMD loading to the secondary (biological) treatment stage and/or to a subsidiary mixing tank, also removed significant fractions of metals from solution (average removal: 28 mg L^{-1} Al, 5 mg L^{-1} Cu, 25 mg L^{-1} Fe, 3 mg L^{-1} Mn, and 4 mg L^{-1} Zn at a mixed liquor suspended solids concentration of 6 g L^{-1}). Activated sludge respiration inhibition tests indicated high tolerance to spiked additions of synthetic AMD, demonstrating that acute toxicity is mediated by the neutralization and metal removal reactions that occur during mixing. Laboratory-scale process evaluation studies are underway to demonstrate the feasibility of co-treatment for full-scale application in the treatment of AMD.

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Oral Presentation - Environmental Technologies - Session 9

Thursday April 7th (16.00 – 17.15) Boole 1

Remediation of acid mine drainage through constructed wetlands; A green house trial

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Keywords: Spent mushroom compost, Constructed wetland, Heavy metals

Acid mine drainage (AMD) is created as a result of intense excavation of mining sites and occurs as a result of the oxidation of iron sulphide. It is also characterised by its low pH and high concentrations of sulphur compounds and heavy metals. The aim of this research was to establish the effectiveness of using spent mushroom compost (SMC) in the remediation of simulated acid mine drainage (SAMD) and to assess the biosorption capacity of SMC in an attempt to create an alternative management strategy of SMC, while ameliorating the challenges associated with AMD. Three in series surface flow experimental wetlands systems were established, each consisting of four cells of approximately 0.3m² and 0.5m in depth and seeded with various wetland macrophyte species. SAMD was passed through this system at a rate of 4.32 l/day and various electrochemical parameters were monitored over a 225 day period. In addition, bimonthly samples were analysed for heavy metal concentrations in each cell by atomic absorption spectrophotometry, along with dissolved organic carbon, dissolved inorganic carbon, alkalinity and sulphate concentrations. Results to date show that SMC has an exceptional buffering capacity against the acidic metalliferous 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 adsorption of zinc and copper, indicate that the SMC anaerobic 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.

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Oral Presentation - Biodiversity & Ecosystems - Session 10

Thursday April 7th (16.00 – 17.15) Boole 2

Saltmarshes on peat substrate on the southwest coast of Ireland: edaphic parameters and *Halimione portulacoides* distribution

Author(s): Cott G.M., Reidy D.T., Chapman D.V., Jansen M.A.K.

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Keywords: saltmarshes, peat substrate, edaphic parameters

Saltmarshes on peat substrate are common along the western Atlantic coast of Ireland. The peat which underlies these marshes was formed under freshwater conditions in post glacial times, after which these systems were subjected to a marine transgression. The peat bogs were subsequently colonised by saltmarsh vegetation and are now known as fringe saltmarshes. Within Europe, fringe marshes are confined to Ireland. The aim of this study was to determine the relationship between edaphic factors, substrate type and saltmarsh vegetation, specifically investigating the role of edaphic factors in determining the distribution of saltmarsh species *Halimione portulacoides* in Ireland. Edaphic parameters measured for each substrate included pH, moisture content, ammonium and nitrate. The peat was found to differ markedly from other substrates. Under both *in situ* and *ex situ* conditions *Halimione portulacoides* showed an affinity for drier substrate and its absence from fringe marshes in Ireland is likely due to a combination of both biotic and abiotic factors, including intolerance to high soil moisture levels.

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Oral Presentation - Biodiversity & Ecosystems - Session 10

Thursday April 7th (16.00 – 17.15) Boole 2

New survey techniques and a preliminary classification of Irish Sea cliff vegetation

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Keywords: Vegetation, survey, classification, sea cliffs

Sea cliffs are among the most natural habitats in Ireland and are included in Annex I of the EU Habitats Directive as Vegetated sea cliffs of the Atlantic and Baltic coasts (1230). However, until now, relatively little research has been carried out on them. In this study, novel methods were used to survey sea cliff vegetation structure, vegetation composition, physical structure and conservation status at 32 sites around Ireland. Sea cliff microhabitats or zones were defined on the basis of relative position on the cliff, maritime influence and vegetation. In total, 161 relevés were recorded. All relevés were recorded remotely using high grade optical equipment and 23 of these were also recorded by accessing cliffs directly by rope. In comparisons, the rope survey techniques were found to be more accurate with only 54% of species being recorded using remote techniques. Data collected using remote techniques from more open habitats were found to be more accurate than those collected from species-rich, densely vegetated communities. A preliminary classification of vegetation of Irish Sea cliffs identified seven vegetation groups, of which six are well defined and reflect distinct communities. Two of these communities have a strongly maritime character, and are located primarily on exposed, hard cliffs; two are maritime grassland communities and a single heath community was described. This is the first classification of Irish Sea cliff vegetation to be produced on the basis of a systematic vegetation survey of cliff faces including soft cliffs as well as cliffs on hard rocky substrates. This baseline survey will be used in reporting on the conservation status of Irish Sea cliffs to the European Commission under Section 17 of the Habitats Directive.

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Oral Presentation - Biodiversity & Ecosystems - Session 10

Thursday April 7th (16.00 – 17.15) Boole 2

Distribution, Conservation Status and Major Impacts on Annex I grassland habitats in Ireland: results of the Irish Semi-natural Grassland Survey (2007 to 2010)

Author(s): Devaney F.M., Martin J.R.

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Keywords: Annex I habitats, conservation, grasslands

The Irish Semi-natural Grasslands Survey (ISGS) has been on-going since 2007 and aims to cover all 26 counties of the Republic of Ireland by 2013. Twelve counties have been surveyed to date, with 783 sites visited and 3055 relevés recorded. One of the main aims of this national survey is to highlight grassland sites of conservation value, with the presence of Annex I grassland habitats an important component of this. Seven grassland habitats listed in Annex I of the EU Habitats Directive are recognised as occurring in Ireland: all seven have been recorded during the ISGS. Nearly one quarter of all the grassland sites surveyed since 2007 have had some Annex I grassland present, with *Molinia* meadows (6410) the most frequent and Species-rich *Nardus* grassland (6230) covering the largest area overall. EU member states are obliged to monitor the conservation status of Annex I habitats and to work towards achieving “Favourable Conservation Status” for those under their responsibility. Only 15 areas of Annex I grassland surveyed obtained an overall status of “Favourable”. The “Traffic Light” system used to assess the conservation status is presented, with emphasis on the criteria used to assess the structure and functions of each of the four main Annex I grassland habitats. The most significant impacts on these habitats are outlined and examples provided. The overall conservation status of most Annex I grassland habitats surveyed is “Unfavourable-Bad”, however many have good structure and functions that, with correct management, could become “Favourable”, and this is also the case for area and future prospects.

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Oral Presentation - Biodiversity & Ecosystems - Session 10

Thursday April 7th (16.00 – 17.15) Boole 2

Differential decomposition patterns of marine and terrestrial biomass in a coastal lagoon

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Keywords: lagoon, decomposition, detritus, organic matter, invertebrates

Lagoons are ecosystems where freshwater and marine organisms converge together with lagoonal specialists to form a mixed community that may vary spatially along a salinity gradient. Many organisms can only survive within relatively narrow bands of salinity. As a result of marine and freshwater inflows, together with exposure to variable salinity levels, dead marine and terrestrial biomass is accumulated in lagoons. Only a very small fraction of this biomass is consumed by herbivores and therefore the majority of the biomass is accumulated in the sediment and plays a crucial role in the ecology of coastal lagoons via the detritic pathway. The decomposition of organic matter is crucial in the functioning of aquatic ecosystems. It facilitates nutrient recycling thus supporting primary production and food webs. This study examined the *in situ* decomposition of marine (*Fucus vesiculosus*) and terrestrial (*Alder glutinosa*) biomass in Cuskinny Lagoon, Co. Cork, South West Ireland. *F. vesiculosus* decayed rapidly and uniformly across the lagoon. *A. glutinosa* biomass loss varied throughout the lagoon, with the greatest loss occurring near the freshwater inflow. Thus, the spatial pattern of *A. glutinosa* decomposition differs from that of *F. vesiculosus* decomposition. Invertebrate abundances were not related to the amount of biomass loss of the marine and terrestrial material. This study demonstrates the differential decomposition patterns of marine and terrestrial biomass in the dynamic environment of a coastal lagoon.

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Oral Presentation - Biodiversity & Ecosystems - Session 10

Thursday April 7th (16.00 – 17.15) Boole 2

Pollination service provision: Co. Armagh apples as a case study

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Keywords: pollination, native pollinators, ecosystem services, bumblebees

Honeybees and bumblebees are considered major pollinators of many crop and wild flower species in temperate Europe. Emergent and exotic diseases of honeybees mean that there is often a shortfall in this major commercial pollinator, *Apis mellifera* (colony collapse disorder: Cox-Foster et al. 2007), and there is an ongoing decline in bumblebees across Ireland and the UK probably due to habitat loss (Fitzpatrick et al. 2007, Goulson et al. 2008). Pollination services provided by bees facilitate out-crossing and sexual reproduction of many plants, including important agricultural crop species; 35% of global crop production relies upon insect mediated pollination. Apple is an economically important crop that requires insect vectors, principally bees, for pollination. Experimental studies (bagging experiments; netting placed over flowers before anthesis) were used to determine current levels of pollination service provision and any pollination shortfall (difference between flowers open to pollination versus those hand pollinated with cross pollen) in Co. Armagh orchards. Observations revealed a high abundance of native bumblebee pollinators, even in orchards where *Apis mellifera* colonies were present. Four pollination experiments were employed to assess the overall level of pollination service provision; 1. Supplementary pollination, 2. Open pollination, 3. Pollinator exclusion and 4. Supplementary pollination of enclosed flowers (control). The supplementary pollination treatment (treatment 1. above) was found to significantly enhance fruit set (Wald-chi squared=110.3, d.f.3, $p<0.001$), and final apple weight ($F=5.98$, d.f.2, $p<0.05$). Results indicate an overall shortfall in pollination service provision in Armagh apple orchards with a less than expected yield of open pollinated flowers (treatment 2. above). Data obtained from this study, together with future work on individual pollinator efficiency and landscape genetics, will be used to provide recommendations on land management and conservation efforts for the sustainable provision of pollination services.

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Oral Presentation - Water Quality - Session 11

Thursday April 7th (16.00 – 17.15) Boole 5

A SaaS Early Warning System for Drinking Water Treatment Plants in the Republic of Ireland

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Keywords: Drinking Water Management

Recent drinking water reword, such as the cryptosporidium outbreak in Galway during March 2007, indicate the need to address the problem of drinking water safety in a more complete and holistic manner using cutting-edge and latest technologies. A lesson learned from the recent drinking water reword is that distributing safe drinking water to consumers cannot be only achieved by installing early warning monitoring systems to monitor the presence of harmful agents in the water. In order to be truly proactive, there is a need to monitor the reword of the entire socio-technical system; that is responsible for the provision of potable drinking water to the consumers. In the Republic of Ireland, for example, key elements of the socio-technical system are state agencies such as the Environmental Protection Agency (EPA) and the Health Service Executive (HSE), the Local Authorities, Private Group water schemes and the personnel in charge of the technical components of drinking water treatment plants. The goal of this Ph.D. research is to use the latest Internet technologies to build a prototype early warning system, which will monitor the ?reword of drinking water treatment plants based on data feeds that will be sent by sensors and by the personnel of all elements of the socio-technical system like auditors, water sample analysts, and senior engineers. The system will analyse the data stream in real time and will assess the hazard level of drinking water treatment plants. If the hazard level exceeds a threshold value, the system will dispatch warnings to all relevant stakeholders to inform them that a drinking water treatment plant in their jurisdiction could enter into an unsafe state. The deployment model is based on the popular software as a service paradigm, which is a way to provide software features from an Internet browser instead of running it from our computers.

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Oral Presentation - Water Quality - Session 11

Thursday April 7th (16.00 – 17.15) Boole 5

The assessment of the impact of acid mine drainage (AMD) on surface waters from an abandoned Cu-S mine in SE Ireland using *Lemna minor*

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Keywords: Acid mine drainage, *Lemna minor*, Impact assessment, Surface waters

Acid mine drainage (AMD) is a global phenomenon that has severe implications for both surface and ground waters. Due to the complex nature of AMD, combining increased metal and sulphate concentrations with low pH, it is difficult to fully assess its impact. It can result in severe modification of freshwater ecosystems and often elimination of sensitive species. The chemical complexity of AMD makes prediction of impacts difficult using normal biotic and physico-chemical indicators. This study examines the use of duckweed *Lemna minor* as a universal indicator of AMD toxicity in freshwaters. Using real AMD from the abandoned Cu-S mines at Avoca Co Wicklow and water collected from the impacted Avoca River, duckweed toxicity assessment (EC_{50}) values were directly compared to an established multi-chemical assessment method (the AMD index - AMDI). While the AMDI gives an assessment of chemical contamination of AMD it provides no information of the overall toxicity to the biota. The Acid neutralizing capacity of surface water plays an important role in mitigating against AMD impact and this was further studied by relating the response of the duckweed to water hardness to provide a catchment specific indication of potential impact. Results show duckweed to be a reliable indicator of AMD impacted surface waters using the growth parameters frond number, biomass or frond area to calculate EC_{50} . A gradient of growth inhibition was observed downstream below the entry of AMD to the river which correlated well with the AMDI. Duckweed was found to be sensitive even to extremely low levels of AMD contamination which are often seen as a result of the large dilutions in the Avoca River. The buffering capacity of the river was shown to play a vital role in reducing AMD toxicity. Increasing water hardness resulted in a decrease in the observed toxic response in duckweed.

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Oral Presentation - Water Quality - Session 11

Thursday April 7th (16.00 – 17.15) Boole 5

The impact of herbage re-growth interval on phosphorus loss in overland flow post slurry application

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Keywords: phosphorus, overland flow, trailing shoe, herbage cover

Intensive phosphorus (P) use within the agricultural sector has made a significant contribution to P induced eutrophication within Northern Ireland waterways. Incidental P transfers following manure application to grasslands remain a key contributor to declining water quality. While most slurry is currently spread using traditional splashplate techniques, new spreading techniques such as the trailing shoe system offer increased nutrient efficiency, less sward contamination and a wider spreading window. However, little is known about the impact of these novel techniques on the risk of P loss, especially when slurry is applied to mature swards. An experiment was conducted to assess the impact of herbage re-growth interval on P losses in overland flows following application of slurry via a trailing shoe system. This plot study involved six treatments arranged in a 2 (slurry vs. no slurry) x 3 (three herbage re-growth intervals) factorial design, randomised block experiment (each treatment replicated 4 times). Herbage mass at the three re-growth intervals (0, 10 and 20 days) was 1550, 2050 and 2900 kg DM/ha, respectively. Slurry was applied at a rate of 25 m³/ha simulating slurry application via a trailing shoe system. Overland flow was generated at days 2, 9 and 16 post slurry applications, using a drip type rainfall simulator. Surface runoff was analysed for soluble and particulate P. Herbage re-growth interval had no significant effect on P losses in overland flow from the no slurry plots. In contrast, average soluble P losses from slurry treatment plots were 66% higher ($P = 0.004$) from the day-0 re-growth treatment than from either of the day-10 or day-20 re-growth treatments. Lower soluble P concentrations in overland flow from the day-10 and day-20 re-growth treatments were the result of sward interception. Consequently, slurry application to mature swards has the potential to reduce P loss in overland flow.

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Oral Presentation - Water Quality - Session 11

Thursday April 7th (16.00 – 17.15) Boole 5

Field investigation into the effects of OSWTS on surface water quality

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Keywords: OSWTS, Wastewater, Caffeine, Fluorescence

In Ireland, it is estimated that approximately 1.2 million people have homes which are not connected to public sewers. Wastewater from these dwellings is treated using private Onsite Wastewater Treatment System (OSWTS). Properly built and maintained OSWTS can treat effluent in a satisfactory manner prior to it reaching ground and surface water. However, poorly designed, installed or maintained systems are a potential source of contaminants to both surface and ground water. This can have detrimental effects on the ecological health of the system as well as causing a risk to human health. In order to meet the requirements of the Water Framework Directive (WFD; 2000/60/EC), it is necessary to identify the potential risks posed by OSWTS to these water bodies. This project aims to develop an increased understanding of the risk posed by OSWTS. One major difficulty in establishing the source of surface and subsurface water contamination is the inability to distinguish between human and animal sources of faecal pollution. This project aims to distinguish between the two types of pollution by analysing collected samples for tracers specific to domestic wastewater, mainly caffeine and fluorescent whitening agents FWAs, found in washing powders. The detection of these tracers in surrounding water bodies is a clear indication of human contamination from malfunctioning OSWTS. Four sites located north of Castleblaney in Co. Monaghan are currently being studied. Piezometers have been installed between the percolation system and the surface water body. Monitoring of surface and subsurface water is carried out on a regular basis for common nutrients and contaminants. Results to date, suggest that a number of OSWTS in the study are not treating water sufficiently, prior to reaching waterbodies. Two of the sites are discharging directly to surface water, bypassing the percolation system. These OSWTS pose an immediate risk to surface water. Monitoring is ongoing and the analysis of samples for caffeine and FWAs will act as a confirmation step for the presence of human effluent. These methods may be used in the future, as a monitoring tool for identifying hotspots of human faecal contamination in rivers and streams.

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Oral Presentation - Energy & Climate Change - Session 12

Thursday April 7th (16.00 – 17.15) Boole 6

Biomethane and biodiesel from energy crops in Ireland: a technical and economic appraisal

Author(s): Deasy E., Power N.

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Keywords: biomethane, biodiesel, grass silage, maize, oilseed rape, energy balance

The purpose of the work is to determine the optimum energy crop in Ireland for biofuel production by means of a life-cycle analysis. Over the past decade both national and international concern has increased over the issues of security of energy supply and global warming. A move away from traditional fossil fuelled economies to biofuel economies has long been accepted as an apparent solution, yet many attempts have proved for the most part unsuccessful. Therefore, within this work, particular emphasis is placed on net-energy production and economics of biomethane and biodiesel production. The approach involves an in-depth energy balance; taking into consideration both direct and in-direct energy consumption at the crop production stage (part A) and the biofuel processing stage (part B). This method allows for the overall life-cycle energy consumption to be calculated; from which the true net-energy is determined and the economics of the each biofuels is evaluated. The two biofuels investigated are biomethane and biodiesel; the crops investigated as feedstock for the biofuels are; maize and grass silage for biomethane and oilseed rape (OSR) for biodiesel production. The innovation of this research is that high yielding grass and maize silage (biomethane) and OSR (biodiesel) have not been systematically compared as potential transport fuel feedstock on an energy balance basis (from crop production to biofuel processing). The true relevance becomes apparent when one considers that Ireland must soon comply with the requirements of the Renewable Source Directive (2009/28/EC). Ireland must increase renewable energy, including a minimum of 10% of all transport fuel consumed in 2020 must be of renewable origin and the feedstocks used to achieve these targets must save a minimum 65% of greenhouse gas emissions in 2018. The results show that biomethane crops demonstrates considerably lower energy requirements during crop production and biofuel processing (per hectare of crop consumed) with a subsequent superior net energy balance from grass and maize silage of 214.4GJ/ha and 199.7GJ/ha respectively when compared with biodiesel 29.1GJ/ha. Economically, OSR illustrates favourable results at small scale production, while biomethane demonstrates improved results at larger processing scales.

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Oral Presentation - Energy & Climate Change - Session 12

Thursday April 7th (16.00 – 17.15) Boole 6

An investigation into nationwide biomethane development and its potential contribution to the Irish transport sector

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Keywords: biomethane, biodegradable municipal waste, anaerobic digestion, energy

There are currently over 2.1 million privately owned cars travelling on Irish roads consuming significant quantities of petrol and diesel annually. Fuel prices are at an all-time high in Ireland due to current tensions surrounding traditional fossil fuels and increased government taxes placed on their purchase. There are over 11.3 million Natural Gas Vehicles (NGV's) worldwide at present operating in a sustainable manner. However, natural gas cars are an unknown and untested technology in Ireland. Such vehicles can offer Irish motorists an eco-friendly alternative to conventional overpriced fuels which are currently on the market. NGV's can operate on biomethane, a gas produced from the breakdown of organic matter in a digester. Biomethane is an upgraded form of biogas in which the biogas is cleaned to 97% methane by removing carbon dioxide and other impurities. The fact that Biodegradable Municipal Waste (BMW) can be digested to produce biomethane is an added bonus. Ireland is currently struggling to comply with statutory landfill targets set by the European Union's Landfill Directive. Over the next five years, approximately 750,000 tonnes of BMW must be diverted from landfill to meet Directive requirements. Ireland is facing significant fines if these limiting targets cannot be met by 2016. The research investigates the optimality of biomethane development in Ireland on a technical, economic and environmental basis. A 30,000tpa biomethane facility has the capacity to provide gas to 2,863 cars per annum. From an environmental perspective, a car running on biomethane has the ability to save 9.5t CO₂ in comparison to a diesel car travelling the same average distance of 17,000km per annum. In terms of nationwide potential, ten of these facilities would provide 1.5% of the registered cars in 2008 with sustainable fuel each year. In terms of waste management, ten facilities can treat 300,000tpa of BMW which otherwise would be transferred to landfill. The potential of biomethane from BMW can serve a dual propose; sustainable transport energy availability for a nation consumed in fossil fuel usage and an effective waste management tool for reducing BMW quantities in already over occupied landfill sites.

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Oral Presentation - Energy & Climate Change - Session 12

Thursday April 7th (16.00 – 17.15) Boole 6

Farmers' perspectives for the development of a bioenergy industry in Ireland

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Keywords: Bioenergy, Farmer survey, Crop adoption, Energy crops

A survey of Irish farmers was conducted to identify potential adopters of bioenergy production in Ireland. The research characterised potential adopters demographically; defined their existing knowledge of bioenergy; identified their requirements and perceived obstacles to adoption; and examined the bioenergy crops which potential adopters would prefer to cultivate. One hundred and seventy-two surveys were completed from twenty-five counties in Ireland. Miscanthus, grass, willow, and oil seed rape were the preferred crops for adoption of bioenergy crop production. Potential adopters described themselves as having a significantly greater level of knowledge of bioenergy crop production compared to other respondents. Potential adopters were more likely to believe they could generate sustainable income from bioenergy than non-adopters, and more likely to have interest in bioenergy crop production due to its environmental benefits. The results indicate that lack of interest in adopting bioenergy crop production may be due to lack of knowledge regarding economic benefits of adoption and the variety of options for bioenergy crops. While multiple obstacles to adoption were identified in this study, they did not appear to negatively influence interest in bioenergy adoption. The establishment of long-term contracts, government schemes and cooperatives were identified as important requirements to assist farmers in adoption bioenergy crop production. These results are the first to provide valuable information on the perspectives of potential adopters of bioenergy crop production in Ireland for the promotion and implementation of a national bioenergy industry.

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Oral Presentation - Energy & Climate Change - Session 12

Thursday April 7th (16.00 – 17.15) Boole 6

Influence of the addition of different carbon rich bulking agents and composting on the characteristics of pig manure char

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Keywords: biochar, swine, compost, pyrolysis, manure

The aim of this study was to investigate biochar produced by pyrolysis of separated solids of pig manure (SPM) mixed with a variety of bulking agents, both before and after composting. Six different materials were analysed: SPM only (T1); SPM + sawdust (T2); SPM + shredded greenwaste (T3); SPM + chopped straw (T4); SPM + woodchip (T5) and SPM + sawdust + woodchip (T6). Biochar was produced from each feedstock using a laboratory-scale pyrolysis reactor at a peak temperature of 600°C and a residence time of 15 minutes in an oxygen-free atmosphere. Biochar and bio-oil yield (by weight) was calculated after pyrolysis. The feedstocks and biochars were analysed for water, ash and volatile matter contents; pH; and nitrogen, carbon (C), hydrogen and sulphur contents. Oxygen content, fixed carbon (FC) content and higher heating value (HHV) were calculated by equations. Biochar yield was up to 39% higher for the composted feedstocks, while the pH was lower in these materials. Carbon content was lower in biochar from composted feedstocks due to biological C degradation during composting. This resulted in a lower HHV for these biochar. For the lignin-rich feedstocks (T2, T5, T6), the biochar produced from composted feedstocks had lower ash and higher FC contents than those before composting. Generally, composting of pig manure before pyrolysis is not advisable if HHV or FC of the biochar is to be maximised. However, if lignin-rich bulking agents are used, composting the feedstock may increase FC in the biochar produced. The highest biochar HHV (20.02 MJ/kg) was found in T2 before composting, while the highest FC were found in T2 and T3 before composting (37%), and T2 and T6 after composting (39%). The addition of C-rich bulking agents to SPM increased the HHV and FC of the biochar produced.

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Optimisation of Seaweed Biomass Pre-treatments: an eco-friendly approach

Author(s): Vanegas C., Hernon A., Bartlett J.

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Keywords:

The use of terrestrial plants as energy crops has been the subject of much discussion since an increase in world food prices in 2008. As world population is growing exponentially it has become clear that we will struggle to meet the nutritional requirements of mankind and therefore, there is simply not going to be sufficient land to devote to biofuel production. Seaweed has emerged as an alternative feedstock for the production of a myriad of renewable fuels such as biogas. The commercialization of the seaweed to biogas process requires optimization to improve yields, before scale-up is feasible. One of the crucial steps is the pre-treatment of the algal biomass. The resistance of the algal cell wall to hydrolysis is a limiting factor in anaerobic digestion, thus an optimal pre-treatment process would enhance the bio-digestibility of the algal biomass, increase accessibility of the enzymes to the biomass and ultimately improving biogas yield. Dilute strong acid pre-treatment is a well documented technology for the pretreatment of biomass, however, it has a number disadvantages including, of being toxic, corrosive, hazardous and requiring reactors to be constructed with acid resistant materials, adding hugely to production costs as well as contributing negatively to the environment. Therefore, the use of a more environmental friendly pre-treatment was considered within this study. *Laminaria saccharina* and *Laminaria digitata* were subjected to a range of chemical, mechanical, thermal and biological pre-treatments with the aim of enhancing the bio-digestibility of the seaweeds and improving the biogas yield. The efficiency of each pre-treatment was assessed by monitoring the release of biomolecules from the algal biomass and the most suitable pre-treatment selected for anaerobic digestion trials. Findings from this study highlight the importance of seaweed pre-treatment and its potential use in the optimization of biogas production.

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Oral Presentation - Environmental Management - Session 13

Friday April 8th (9.00 – 10.30) Boole 1

A metric to evaluate policies to enhance Irish urban sustainability

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Keywords: sustainability; policy; metric; settlement

Approximately 75% of green house gases (GHG) are associated with lifestyle choices, with transport and household based consumption being responsible for the largest shares, concentrated in urban areas. This consumption is crucial in national and local scale policy development aimed at reducing GHG emissions. It is difficult to prioritise policy roll out as it has not been possible to estimate the future GHG savings associated with implementation of urban policies. Within the present project, a metric has been developed to enable a quantified estimate of the likely impact of implementation of policies to enhance urban sustainability. The metric is derived from a set of environmental, social and economic indicators developed in previous research. Prediction of policy impacts is facilitated by our database of circa 300 economic, social and environmental attributes of 79 Irish settlements. All policies which we are testing for impact have been both implemented in Ireland or elsewhere and evaluated in the literature. This evaluation, together with our data on Irish settlements, allows us to predict likely policy outcomes. Policies which appear likely to enhance Irish urban sustainability are then bundled together to facilitate possible synergies which create additional enhancements to sustainability. Backcasting is adopted for settlements so as to identify feasible future scenarios in which some, considerable or major enhancements to sustainability are achieved. We then identify the bundles of policies which are required to achieve scenario targets. Candidate policies are “reality checked” to establish that there are no serious impediments to their implementation in Ireland. This work is designed to provide decision makers with the evidence they require to make rational choices in relation to prioritisation of policies within a campaign to enhance the urban sustainability in Ireland and elsewhere, and may have application in strategic environmental assessment (SEA).

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Oral Presentation - Environmental Management - Session 13

Friday April 8th (9.00 – 10.30) Boole 1

Results from a Quantitative Evaluation of Policies to Enhance Sustainability in Irish Settlements

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Keywords: Sustainable development, Ex-ante Policy Evaluation, Urban Environment

Towns and villages will have a key role in securing balanced regional development, the ability of small urban areas to recover economically will depend upon the ability of every place in Ireland regardless of size or location to work in such a way as to maximise their potential. To achieve this, technological development is crucial, but much progress may be made through the wider roll-out of existing and proven technologies. However, it is unclear to policy makers which technologies should be prioritised, and this creates a major barrier to advancing sustainable development. There is a need for quantitative evidence to guide policy prioritisation and roll out implementation. This project aims to identify and evaluate feasible policy interventions which would be expected to enhance settlement sustainability. A previous project characterised 79 Irish settlements and evaluated their level of sustainability achieved. Some medium-sized settlements were found to be more sustainable than otherwise comparable settlements, conversely some smaller settlements were found to be less sustainable than otherwise comparable settlements. Using a customised metric, the impact of proposed policies is estimated using published analyses and direct experience in Ireland. The most cited and appropriate policies are chosen in the areas of transport, food, housing and urban form, energy, waste and water. A target of 40 policies has been set and all policies are checked for feasibility. To date 30 policies have been evaluated, and results show clear patterns. Preliminary results for both relatively more and relatively less sustainable settlements are presented, and some initial conclusions drawn in relation to policy prioritisation and implementation.

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Oral Presentation - Environmental Management - Session 13

Friday April 8th (9.00 – 10.30) Boole 1

Cycling Ireland to Work: Sustainable job creation through the construction of a National Cycling Network

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Keywords: Cycling network, sustainability, economy, tourism, cycling route design

In the midst of the current economic crisis, Ireland could be presented with the means to cycle its way back to work! A proposed National Cycle Network (NCN), connecting Ireland's major urban centres; and potentially opening up rural, recreational and commuter cycling routes, could lead to significant job creation in the construction, maintenance and tourism sectors. The first step towards the establishment of a NCN, is the carrying out of a feasibility study that will investigate (i) route selection (ii) design issues such as material selection and (iii) cost benefit analyses of a major route corridor. A potential cycle route along the Galway to Clifden corridor will specifically be investigated in this study. A key aim of the NCN is to maximise the off-road proportion of each corridor. This can be achieved by constructing off-road cycle tracks, but also by using existing paths including disused railway lines and canal tow-paths. The abandoned Galway-Clifden railway line is an example of one potential path. This cycle corridor will take full advantage of the natural scenery in this region of the West of Ireland and will connect two of Ireland's primary tourist destinations Galway City and Clifden. Cycle tourism is an established industry across Europe and it has been found that cycle tourists spend at least as much as other types of tourists and in some cases more. On one network in Switzerland, the average spend per day by holiday tourists was 121 SF (94) and the initial investment of €6.3 million in the network was returned in 2-3 years (Failte Ireland, 2007). The development of a cycle tourism industry, prevalent across much of Europe, would bring jobs and revenue to local regions. A NCN can also have clear societal and economic benefits. Sustainable jobs can be created in the construction and maintenance works and a new, lucrative tourist industry developed. This study is an important step to developing guidelines to ensure sustainable and cost-effective design, development and implementation of the National Cycle Network.

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Oral Presentation - Environmental Management - Session 13

Friday April 8th (9.00 – 10.30) Boole 1

Impact of phosphate fertilizer input on the microbial community of pasture soil

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Keywords: phosphate, fertilization, microbial community, sustainable agriculture

Under modern agricultural management practice, artificial phosphate fertilizer is intensively applied to maintain a high level of soil phosphorus for the benefit of crop growth. However, this reliance on phosphate fertilization comes at a high price, both environmentally and economically. Indeed, additional studies are needed that are focused on the effects of phosphate fertilization on soil health in Ireland. Using innovative molecular approaches, we investigated the impacts of different phosphate regimes on the soil microbial communities present within a grassland soil system. Within this study we demonstrated that these artificial phosphate fertilization regimes altered the total microbial diversity presented in the soil. It also affected keystone microbial groups, which have been previously linked to important soil ecological functions. This knowledge will provide a great understanding of how the soil microbial communities are affected at both their diversity and functional levels by artificial phosphate regimes, and provide vital information and strategies for managing sustainable agricultural practices in the future.

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Oral Presentation - Environmental Management - Session 13

Friday April 8th (9.00 – 10.30) Boole 1

Assessment of Impacts of Forest Operations on the Environment

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Keywords: Forestry, peat, greenhouse gases, Phosphorus

Forestry practice in Ireland in the 1980's led to trees being planted in areas adjacent to water courses with no allowance for a riparian area. Clearfelling of these forests may result in elevated levels of nutrients and suspended sediment (SS) released into water courses. These effects may be mitigated through the use of riparian buffers. This project aims to assess the impact of clearfelling on sediment and nutrient release, acidification and greenhouse gas (GHG) emissions, and to determine the effectiveness of two types of riparian buffer: (1) a naturally revegetated peatland buffer and (2) a standing mature coniferous forest. The naturally revegetated peatland buffer consists of a strip of land adjacent to the river, which was clearfelled four years ago and allowed to regenerate. Pre- and post-clearfelling data will be collected at the study site for surface and subsurface water, watertable depth and GHG emissions. Surface and subsurface waters are sampled regularly across the site and during storm events, and are analysed for SS, dissolved reactive phosphorus (DRP), total phosphorus (TP), ammonium-N ($\text{NH}_4\text{-N}$) and nitrate-N ($\text{NO}_3\text{-N}$). GHG emissions are being studied in four areas: (1) the naturally revegetated peatland buffer, (2) the standing mature coniferous forest, (3) a recently clearfelled coniferous forest and (4) a virgin peatland site. Results obtained on site to date show there is an increase in DRP concentration moving from the forest edge to under the brash mat. This reduces again closer to the river. These initial indications show that a revegetated buffer is successful in reducing phosphorus concentrations from the forest to the river bank. GHG emissions are highest in the revegetated peatland buffer and the virgin peat site, while the lowest emissions are found in the standing and mature coniferous forest. Further data will be collected pre- and post-clearfelling to assess the effectiveness of two types of buffers and GHG emissions.

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**Active Degraded Raised Bog- How Effective are
Restoration Strategies?**

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Keywords: Raised bog, degraded, sustainable, restoration, hydrological function, peat oxidation

Restoration of degraded active raised bog has focused on rebuilding the fragile remnants of original ecosystems by manipulating and restoring ecosystem structure and management of hydrology and biodiversity with a view to developing and sustaining the characteristic functions required for the transition back to pristine fully functional raised bog¹. To achieve the principles outlined requires development of a management plan embracing the hydrological regime, biogeochemical cycling, macro and micro topography combined with monitoring and data analyses over a prescribed timeframe. The fundamental problem with most restoration strategies is lack of, or rapid depletion of water supply to the area that is actively regenerating², thereby accelerating peat oxidation rates, adverse chemical transformations and subsequent subsidence of the peat mass. Quantitative on site hydrological fluctuations were monitored monthly using Water Level Range Gauges combined with water sample analysis of major nutrients by Atomic Absorption Spectrophotometer, Atomic Absorption Spectrophotometer with Graphite furnace, Aquakem 250, Hydrolab DS5X Water Quality Multiprobes. Monitoring of water levels and chemical parameters was carried out to determine hydrological gradients within the site. Mechanical bunding methods were analysed to determine sustainability of hydrological function within the bog. A solar powered pumping system maintaining water level to critical areas is currently under evaluation. Monitoring and analysis of mechanical interventions has indicated a positive response, renewed inundation has favoured establishment of peat forming vegetation. Internal drains have been successfully dammed using sheet piles combined with peat reinforcing; however, the use of sheet piles on the high bog has contributed towards further contraction, oxidative losses and carbon dioxide production. Long term monitoring is required to ensure sustainable restoration is successful; the reinstatement of raised bog remains a fertile area for future research.

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Oral Presentation - Biodiversity & Ecosystems - Session 14

Friday April 8th (9.00 – 10.30) Boole 2

Climate change impacts on the distribution and ecology of montane plant communities in western Ireland

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Keywords: montane vegetation, bryophytes, climate change, species distribution modeling

Although the mountains of western Ireland do not reach a high altitude, conditions on their summits are comparable to those at higher altitudes elsewhere in Europe, due to the effects of the prevalent hyper-oceanic climate. These oceanic conditions strongly affect the composition of the montane heath vegetation on western Irish mountains, where bryophytes play a particularly important role. Among these bryophyte communities are the internationally important mixed northern hepatic mats, or liverwort heath. These communities are limited in distribution to humid, shady mountain slopes in western Ireland and western Scotland, principally due to the precise ecological and climatic requirements of their characteristic species. The future conservation status of these montane heath and bryophyte-dominated plant communities is currently facing a multitude of threats, few more important than climate change and its consequences. In this study we used species distribution modelling to project future changes to the distribution of these montane species based on a range of climate and ecological variables. Projections suggest that there may be a reduction in suitable climate space for the species that make up these communities in the future. Montane bryophyte and higher plant species will respond in different ways, with bryophytes of hepatic mat vegetation projected to lose suitable climate space in the south of their range and gain climate space in the north. In contrast, many species of montane heath are projected to gain no space and suitable conditions are projected to become limited to only the highest altitudes in Ireland. These species and communities are already facing a range of serious threats, and increased pressure from changes in the climate may result in the loss of a number of rare and important species from these communities in many sites in the western Irish mountains.

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Oral Presentation - Biodiversity & Ecosystems - Session 14

Friday April 8th (9.00 – 10.30) Boole 2

Investigations of turlough soil property variation

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Keywords: turloughs, soil properties, spatial variation, conservation

An improved understanding of soil property variation in turloughs is necessary for adequate conservation of these internationally protected Irish karstic wetlands. We examined spatial variation of surface soil nutrient characteristics within and among turloughs. One aspect of the study examined differences in soil nutrient properties between two turlough types. Turloughs in the shallow karstic flow system had more alkaline substrates, with significantly higher organic matter and calcium carbonate contents, and lower total phosphorus and total potassium concentrations, than turloughs in the deep karst system. Total nitrogen or plant-available phosphorus did not differ significantly between the karstic flow systems. No significant interaction effects were detected between turlough types and sample location (upper, middle, lower), suggesting that differences between the two types are not dependent on sampling location. The more extensive aspect of the work investigated the effects of flooding, land use and vegetation on turlough soil nutrient properties, in addition to examining nutrient variation across 18 turloughs. Samples ($n=104$) were analysed for pH, organic matter content (OM), calcium carbonate content (CaCO_3), sand/silt/clay content (INORG), total nitrogen (TN) and total phosphorus (TP). Data on flooding duration, frequency, grazing regime, vegetation type and soil type were collated for each sampling point. Turlough soil properties presented a wide range of values and complex associations. TN ranged from 3600 to 34300 mg kg^{-1} . OM was found to be an efficient predictor of TN and the higher TN of ungrazed areas, sedge dominated plant communities and Fen Peats was attributed to OM accumulation. TP ranged from 244 to 3270 mg kg^{-1} , often presenting values within the agricultural range. Higher TP occurred in grazed areas and management may be driving turlough soils to more eutrophic conditions. Low TP ($< 500 \text{ mg kg}^{-1}$) was associated with a relatively low number of inundation events (< 7) yet elevated TP was associated with a wide range of flooding frequencies. High degrees of within-site variation occurred within turloughs and consequently only two turloughs had significantly different TN and TP. In conclusion, turlough soil nutrient properties are highly variable, are sensitive to changes in land use and flooding regimes and present a challenging environment for soil nutrient assessments. **Author Email Address:** kimberls@tcd.ie

Oral Presentation - Biodiversity & Ecosystems - Session 14

Friday April 8th (9.00 – 10.30) Boole 2

Genetic diversity and phylogeography of the endemic groundwater amphipod *Niphargus kochianus irlandicus*

Author(s): McInerney C.E., Arnscheidt J., Eriksson K., Hack C.J., Dooley J.S.G

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Keywords: Groundwater, genetic diversity, phylogeography

Groundwater ecosystems contain important freshwater resources, however due to their vulnerability to pollution, pristine habitats no longer exist. In addition to anthropogenic pressures, environmental perturbations such as climate change also pose an environmental risk to groundwater ecosystems and hence to global water security. Comparatively little is known about groundwater ecosystems. Accordingly, the European Union Groundwater Directive (2006/118/EC) identified a knowledge gap regarding groundwater ecology and encourages member states to undertake groundwater research. An understanding of genetic diversity is a prerequisite for risk assessments with regard to potential threats to groundwater fauna (stygofauna). Hence, we investigated the phylogeography of the endemic amphipod *Niphargus kochianus irlandicus*. This tiny, eyeless crustacean is an important genus of the stygofauna of Ireland and Europe. We test the alternative hypotheses of either glacial survival in Ireland or postglacial recolonisation. A lack of fossil records means this question can only be addressed by genetic analysis. If postglacial colonisation occurred, then the levels of genetic divergence between *Niphargus kochianus* subspecies should be relatively low. A total of 118 specimens from thirteen sites (boreholes, wells) around Ireland were sequenced at two mitochondrial genes (COI, 16S) and a nuclear gene (28S). Genetic data analysis incorporating published and unpublished DNA sequences revealed that *Niphargus kochianus irlandicus* are highly divergent from other *Niphargus kochianus* subspecies and are characterised by comparatively higher levels of genetic diversity, typical of refugial populations. The findings were independently corroborated by three genes. We provide preliminary evidence that suggests that *Niphargus kochianus irlandicus* survived the last ice age in sub-glacial refugia in Ireland. Thus, *Niphargus kochianus irlandicus* populations in Ireland potentially are descendents of an older genetic lineage that predates the last ice age. In combination with geological and hydrogeological data, phylogeographic analysis of groundwater fauna can provide important new information for groundwater management and conservation.

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Oral Presentation - Biodiversity & Ecosystems - Session 14

Friday April 8th (9.00 – 10.30) Boole 2

Groundwater as an ecological supporting condition in raised bogs and the implications for restoration

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Keywords: Raised bog, subsidence, groundwater

Peat bogs are traditionally considered to be relatively isolated hydrological systems with no direct linkage to a source aquifer. The isolation of a raised bog ecosystem from regional groundwater flow is primarily a consequence of its mode of development, where natural drainage is impeded by topography and geomorphology. Recent research on Clara Bog, Ireland, indicates a more complicated relationship between the peat body and the regional groundwater system. This interconnection has significant implications for restoration design. Typical of most Irish raised bogs, peat overlies low permeability lacustrine clay, impeding downward movement of water. However, there are areas under the bog where this clay barrier is naturally absent, allowing the peat to rest directly on an underlying aquifer, a regional body of relatively permeable till subsoil. In the recent past the western tract of the bog has subsided significantly, up to 1.0 m locally, and as far as 600 m from the bog margin towards its centre. Consolidation of the peat substrate has altered hydrological conditions on the bog surface, thereby affecting its ecology. Coincident with bog subsidence has been a localised drop in regional groundwater table. External drainage has created an enhanced hydraulic connection between the high bog and regional groundwater flow, resulting in vertical drainage from basal peat in the high bog. Both peat consolidation and groundwater level decrease have occurred in areas where lacustrine clay is absent. The inference is that maintenance of regional groundwater levels can be a critical support condition in the conservation of raised bog wetlands, and that restoration measures must be designed based on the bogs controlling hydrogeological processes.

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Oral Presentation - Biodiversity & Ecosystems - Session 14

Friday April 8th (9.00 – 10.30) Boole 2

The Assessment of Evolved Volatile Organic Compounds, as an indication of Sphagnum Growth and Biomolecular Content

Author(s): Flanagan A, McKeon-Bennett M. M. P., Stutte G. W

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Keywords: VOC, Volatile Organic Compound, sphagnum moss, polyphenols, growth chamber, enclosed ecosystems, wetland conservation, Irish peatlands, SCFE, LCMS

Peat bogs are important to Ireland and are an excellent source of biomass and biomolecules for study and industry. Peat forming wetlands are important global sinks for CO₂ and greenhouse gases (i.e. methane), and cover approximately 1.3 million hectares or 16.2% of the land surface in Ireland. Sphagnum mosses are the dominant species of moss in peat bogs. Sphagnum based bogs produce volatile organic compounds (VOCs), including isoprene, monoterpenes, and many aromatic alkane compounds. The ability of sphagnum to absorb water, extract nutrients, and sequester carbon, has led to the development of sphagnum based water purification systems with space and terrestrial applications. Volatile emissions of Sphagnum moss can be used as a biological indicator of its quality and metabolic reactions. Each species vary in the degree of VOC emissions as a result of their unique metabolic process, which in turn is a result of its physical polyphenol makeup. By understanding these processes, a large number of questions in relation to wetland conservation can be answered and applications of the living plant to ecosystem design, waste water remediation and enclosed environment air quality purification. Three Sphagnum species are currently under investigation and are grown under controlled environmental conditions, such as nutrient availability to simulate various waste water streams, temperature and carbon dioxide concentration. The production of VOCs and growth rate of each sphagnum species is monitored throughout the growth cycle. VOC determination is carried out using Head Space Gas Chromatography, while polyphenol structure of the sphagnum species is determined via Liquid Chromatography Mass Spectrometry (LCMS) after extraction of the polyphenols via Super Critical Fluid Extraction (SCFE).

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Oral Presentation - Biodiversity & Ecosystems - Session 14

Friday April 8th (9.00 – 10.30) Boole 2

Upland commonages in Connemara: can biodiversity be used to inform sustainable agri-environmental policy?

Author(s): Canning B, Bell A, Mongan B, Gormally M, Sheehy Skeffington M, van Rensburg T

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Keywords: Biodiversity indicators, Uplands, Commonage, Carabidae, Flora

While the Connemara landscape has been heavily influenced by agriculture for some time, the effects of modern farming practices in recent decades have been much more rapid and intense. Despite the introduction of several policy initiatives including REPS, CFP and decoupling to address environmental problems, the effects of these measures on biodiversity in the uplands have not been studied in any great detail. This research investigates the biodiversity value of upland commonages in Connemara. In 2009, six commonages throughout northern Connemara were mapped and scored on their habitat condition (good, moderate and poor condition) and thirteen sites of different habitat quality within these commonages were selected. More than 100 vegetation relevés were recorded in 2010 and 350 pitfall trap samples were collected for ground beetle determination. Preliminary results suggest that areas of differing habitat condition are reflected in the plant and ground beetle communities. The question is how much do these differences matter in the context of developing economic models for maintaining biodiversity in Connemara within existing and future agri-environmental policies. This study which forms an intrinsic part of an extensive socio-economic investigation of Connemara, will contribute to the development of agri-environmental policy in supporting the provision of agrobiodiversity on farms in the uplands.

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Oral Presentation - Marine & Coastal Research - Session 15

Friday April 8th (9.00 – 10.30) Boole 5

Into the wild: documenting and predicting the spread of Pacific oysters (*Crassostrea gigas*) in Ireland

Author(s): Kochmann J., O'Beirn F., Yearsley J., Crowe T.

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Keywords: biological invasion, Pacific oyster, aquaculture, management

The Pacific oyster was introduced to Ireland for aquaculture more than 30 years ago and today, it is one of the main cultured shellfish species. It was thought that it would not be capable of successfully spawning due to unfavorable temperatures. However, there is now evidence of recruitment into the wild. A collaborative, structured sampling programme was established between UCD, the Marine Institute, the Loughs Agency, Bord Iascaigh Mhara and Queen's University Belfast to assess the current range and status of wild Pacific oyster populations in Ireland. It was designed to be cost-effective and repeatable and to identify factors that potentially limit or increase its likelihood of establishment. Moderate populations were revealed in Loughs Foyle and Swilly and small populations at some locations in the Shannon Estuary. A logistic model showed that oysters were more likely to be found in proximity to aquaculture, on hard substrata and in large intertidal areas and were less likely to be found in the presence of macrophytes. Subsequently, the findings were used as the basis for experimental tests of mechanisms affecting establishment. In addition, genetic tools are being used to ascertain whether oysters outside aquaculture are forming self-sustaining populations or are the result of repeated spawnings from aquaculture. Investigations describing populations at an early stage of marine invasion are rarely available in literature. In Ireland, we have the opportunity to gain insights into early stages of establishment of Pacific oysters, to improve prediction of its further spread and directly inform management action.

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Oral Presentation - Marine & Coastal Research - Session 15

Friday April 8th (9.00 – 10.30) Boole 5

Sustainability and Welfare in Crustacean Fisheries; the case of the Edible Crab, *Cancer Pagurus*

Author(s): McCambridge C, Dick J, Elwood R

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Keywords: Marine, Fishery, Sustainability, Edible crab, Animal welfare, Declawing

The edible crab, *Cancer pagurus*, is an integral part of the shellfish industry, and is the main crab species regularly fished for human consumption in the UK and Ireland. Within Northern Ireland (NI), landings of *C. pagurus* have increased annually, and the issue of exploitation, the problems of stock assessment in the crustacean fishery and the enforcement of appropriate regulations has raised concerns about the pressures facing the fishery. *C. pagurus* will autotomise chelae and pereopods when they become trapped or injured beyond use, then regenerate lost limbs incrementally during the moult cycle. De-clawing of *C. pagurus* before it is returned live to the sea and during storage aboard fishing vessels has been legal in NI since the revocation in 2000 of the Crab Claws (Prohibition of Landing) Order (1986) and is extensively practiced in NI crustacean fisheries. Feeding ability and motivation were assessed to investigate how this fishery practice may affect crabs returned to the sea. Crabs were either induced to autotomise a walking leg, one or both claws, or had a walking leg, one or both claws forcibly removed, before they were offered food. Initially all crabs were offered mussels, *Mytilus edulis*, after 24 hours all surviving crabs were then offered fish, a more readily handled food source. Autotomy induced crabs consumed more mussels and fish than crabs that had been de-clawed. The feeding ability of de-clawed *C. pagurus* indicates a reduction in the ability of these crabs to feed on mussels and fish compared to crabs that autotomise limbs naturally. The discontinuation of claw removal needs to be considered, both for the sustainability of the fishery and animal welfare concerns.

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Oral Presentation - Marine & Coastal Research - Session 15

Friday April 8th (9.00 – 10.30) Boole 5

An investigation of the genotoxic impact of the marine biotoxin okadaic acid, on three different bivalve species: *Mytilus edulis*, *Tapes semidecussatus*, *Crassostrea gigas*

Author(s): McCarthy M, Carey B, O'Brien N. M, James K. J, van Pelt F. N. A. M, O'Halloran J.

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Keywords: okadaic acid, genotoxicity, toxic algae, bivalve, diarrhetic shellfish poisoning

Toxic algae of the species *Prorocentrum* and *Dinophysis* produce the okadaic acid group of toxins which can accumulate in filter feeding bivalves, causing Diarrhetic Shellfish Poisoning in humans. Bloom events of these algal species regularly cause closures of aquaculture farms around Ireland during the summer months. Little is known about the impact of these toxins on the shellfish that accumulate them. In this study the genotoxic impact of okadaic acid was examined on three bivalve species of economic importance in Ireland; *Mytilus edulis*, *Tapes semidecussatus* and *Crassostrea gigas*. Okadaic acid was vortexed with 100 µl of algal feed to ensure uptake of toxin. The shellfish were exposed to 10 µg/ml of okadaic acid daily over 7 days or a single feed of 20 µg/ml okadaic acid at T₀. Haemolymph was extracted at 24h, 72h and 7days and the single-gel electrophoresis (Comet) assay was performed; DNA damage was expressed as percentage tail DNA. Results showed similar trends for the three species. There was increase in genotoxicity over the study period in the animals fed daily amounts of toxin; the increase was statistically significant in *Mytilus edulis*. The animals fed one higher dose of okadaic acid at T₀ showed an initial increase of percentage tail DNA with a gradual decline over the study period, indicating DNA repair was occurring. This is the first study examining the genotoxic impact of okadaic acid on these three species.

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Oral Presentation - Marine & Coastal Research - Session 15

Friday April 8th (9.00 – 10.30) Boole 5

Effects of increasing densities of invasive oysters (*Crassostrea gigas*) on the structure and functioning of estuarine ecosystems

Author(s): Green, D.S., Crowe, T.P. and Rocha, C.

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Keywords: biodiversity, ecosystem functioning, invasive species, biogeochemical cycling.

Invasive species are one of the most important threats to ecosystems due to their impacts on biodiversity and ecosystem functioning and services. Invasive bivalves, such as the Pacific oyster, *Crassostrea gigas*, are of particular concern in coastal marine ecosystems due to their ability to transform large areas of habitat. Wild populations of *C. gigas* have recently been found inhabiting a range of habitats in Ireland. A field experiment was used to explore the effects of increasing densities of *C. gigas* on biodiversity and ecosystem functioning in a number of estuarine habitats. Faunal samples, pore-water nutrient profiles, community respiration and organic matter were measured after 3 and 15 months. Assemblage structure differed between habitats and densities of oysters, and multivariate dispersion indices decreased with increasing densities of oysters. The abundance of some key taxa including *Littorina littorea*, *Tubificoides benedii* and an invasive barnacle, *Elminius modestus* increased with increasing density of oysters. Similarly, community respiration (CO₂ flux) and diffusive flux of NH₄⁺ across the sediment-water interface increased with increasing density of oysters. The impacts of *C. gigas* on diagenetic processes, can potentially affect the quality of services, such as nutrient cycling, provided by estuarine ecosystems.

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Oral Presentation - Marine & Coastal Research - Session 15

Friday April 8th (9.00 – 10.30) Boole 5

Partnerships Involving Stakeholders in the Celtic Sea EcoSystem (PISCES): Translating EU maritime policy into practical outputs for multiple sectors spanning Ireland, the UK, France and Spain

Author(s): Twomey S, Sutton G, O'Mahony C

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Keywords: Marine management, Ecosystem approach, Stakeholder engagement, Bottom-up approach

The Celtic Sea marine ecosystem is an area of diverse wildlife and important ecological activity. It is also one of the most heavily used bodies of water in the world, with multiple sectors competing for space and resources. Like oceans and seas globally, this region is experiencing pressures due to increasing human activity. In response to this growing problem, the European Commission LIFE+ programme funded a project called Partnerships Involving Stakeholders in the Celtic Sea Eco-System (PISCES). The primary aims of PISCES are to: find new and innovative ways to engage stakeholders in working together on environmentally sound solutions for the region; develop stakeholder understanding of the ecosystem-based approach to marine management; and, produce a set of stakeholder-led guidelines for an ecosystem-based approach to management of activities in the area. Current EU-wide marine management policies rely on effective application of an ecosystem-based approach (e.g., the EU Marine Strategy Framework Directive; the Common Fisheries Policy). PISCES is a pioneering project in that it is translating EU maritime policy into practical outputs for multiple sectors and across a multinational area encompassing four countries: the UK, Ireland, France and Spain. This three-year project, which began at the end of 2009, identifies the key players in the Celtic Sea representing all major human uses and impacts, and builds successful stakeholder partnerships through a series of workshops whilst also facilitating additional interactions in order to maximise the out-reach and impact of the practical guidelines. Stakeholders include the fishing and aquaculture industries, marine renewable energy companies, shipping, oil, gas and aggregate extraction industries, ports, environmental agencies, coastal tourism and recreation industries, as well as key policy makers from the four countries.

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Oral Presentation - Marine & Coastal Research - Session 15

Friday April 8th (9.00 – 10.30) Boole 5

Developing Local Coastal Adaptation Strategies to Climate Change across North West Europe: How IMCORE is addressing the Challenges

Author(s): Gault J., Gray S, Cummins V.

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Keywords: Climate Changes

There are a number of challenges in developing effective local adaptation strategies to climate change ranging from lack of public awareness of potential impacts through to lack of capacity and resources in local authorities. IMCORE (Innovative Management for Europe's Changing Coastal Resource), (INTERREG IVB), is applying various techniques to overcome these challenges at nine sites across North West Europe. This entails identifying the potential impacts of a range of climate change scenarios on coastal sectors (e.g. fisheries and aquaculture, ports and shipping, marine recreation and coastal protection) and subsequently developing an effective response in the form of adaptive management strategies at each site. Site specific issues associated with these sectors are also being considered and these include: coastal conservation, marine spatial planning, integration of decision making across sectors, coastal regeneration, renewable energy, public participation and marine biodiversity. The Project actively promotes partnership between research centres and local authorities who are working in tandem to address local issues thus avoiding the very real risk of perpetuating the disconnect that exists between the scientific output and the needs of local government. IMCORE advocates an ecosystem approach to management and therefore considers not just the environmental impacts but also the economic and social consequences that may result from the impacts of climate change. This paper will provide an overview of the project, present reasons why adaptation is necessary and highlight the key challenges to developing strategies. Using the ongoing development of the Cork Harbour adaptive management strategy as an example it will demonstrate how the innovative approach employed by IMCORE is being utilized to address these challenges.

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Oral Presentation - Energy & Climate Change - Session 16

Friday April 8th (9.00 – 10.30) Boole 6

A Techno-Environmental Assessment of Combined Offshore Wind and Wave Energy Platforms

Author(s): O' Sullivan K, Murphy J

Corresponding Author Institution: Hydraulic and Maritime Research Centre, UCC

Keywords: Wave Energy, Floating Wind Turbines, Multi-purpose renewable energy platforms

The offshore environment off the west coast of Ireland has one of the most energy dense wind (>8m/s) and ocean wave (~21TWh) climates in Europe. This will play a significant role in achieving Ireland's national commitment to renewable energy by 2020 and 2050, and also in terms of energy exports, significant for Europe's 3.6GW renewable energy target by 2020. It has been found that these sources of energy are in fact complimentary, wave energy provides the reliability of supply, thereby reducing the negative impact of the intermittent nature of wind energy. In the current research project, a techno-environmental assessment of a generic floating wind/wave platform is carried out. The assessment has suggested that these combined platforms are desirable from an environmental impact and power generation perspective. These platforms present considerable technical issues to be overcome including survivability of the platform in high seas, platform stability during synchronous loading by wind and waves, the appropriate wave energy converter technology, motion of the wind turbine and the issues of weather-vaning make anchor design a prominent concern. From an environmental point of view, the platforms will share power export cables, will be large floating structures and therefore interact with the seabed less than present generation nearshore devices, and promote biodiversity activity around the structure. Significantly, these structures will be unseen from the shore, and therefore will have no impact on the Irish coastal and mountainous landscape. These combined platforms will, in the next 5-10 years, be the focus for renewable energy developers, as they will provide wave energy with the commercial step it currently requires, and also take wind energy generation offshore to a higher and more sustained wind climate, allowing more reliable power generation for the national grid.

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Oral Presentation - Energy & Climate Change - Session 16

Friday April 8th (9.00 – 10.30) Boole 6

The impacts of incorporating large-scale offshore wind generation into the future Irish Electricity System

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Keywords: Wind energy, offshore wind, power system, simulation modelling, and energy storage

The recent release of the Offshore Renewable Energy Development Plan (OREDP) and the announcement in 2009 by the Department of Communications, Energy, and Natural Resources of the Renewable Energy Feed in Tariff (REFIT II) specific to offshore wind at 140 €/MWh, have led to a new and very large incentive for offshore wind to be developed in Ireland. This is evident from the nearly 1800MW of offshore wind developments in different stages of submission in the planning process. The OREDP uses three scenarios of low, medium and high for total offshore development where installed wind capacity ranges from 800MW to 4,500MW, predicting ahead to 2030. The installed capacities are also divided into regions around the Republic of Ireland's coast. The latest offshore wind targets for the Northern Irish coast will also be used. The predominantly onshore wind capacity envisaged in Portfolio 5 of the All Ireland Grid Study 2008 will be used as a comparison as it is the closest to the government's 2020 targets. The question that will be examined is: what are the effects of large amounts of offshore wind on the power system in terms of costs and capacity credit compared to those of a predominantly onshore wind scenario. This will be used to determine optimum storage to be constructed in order to provide sufficient reserve for the system. The project will use the energy systems modelling tool PLEXOS to simulate the operation of the future power system in Ireland. The results will be used to determine the effects on the power system of wind portfolios that are mainly onshore compared to the different large-scale offshore wind scenarios proposed under the OREDP.

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Oral Presentation - Energy & Climate Change - Session 16

Friday April 8th (9.00 – 10.30) Boole 6

The Design and Optimisation of a Water Vortex Hydropower Plant

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Keywords: Hydropower, Renewable Energy, Innovative, Hydraulics, Vortex, Free Surface Flow, Gross Head, Circulation, Vorticity, Impeller, Physical Modelling, Mathematical Modelling, Efficiency

Motivation/Problem Statement: The Water Vortex Hydropower Plant is a new, innovative technology which produces sustainable energy over a relatively small head difference on a river. The plant generates strong free surface Vortex flow which imparts rotational energy on a vertical axis impeller. This mechanical energy is then converted to electricity in the generator. This low head hydropower option has perceived advantages but currently remains undeveloped because no solution to an optimum design has yet been established. **Approach:** The aim of this research will be to suggest a design for an optimum plant with the ability to predict a reliable power output. The approach was to compare numerical vortex models to the nature of scaled physical models to manipulate its operation and maximise performance. This paper will present many of the current findings. **Discussion of Findings:** The physical models constructed and tested produced significant vortex strength which increased as the outlet diameter increased. Each geometry was characterised by a head discharge linear relationship with excellent correlation. The geometrical analysis also indicated that a spiral casing would be optimal. The hyperbolic water surface profiles were modelled numerically and compared to the actual profiles which proved to be very accurate. The Froudean Model for hydraulic scaling was employed for a 1/20 scale site evaluation. This indicated that the head-discharge relationships would be a desired design approach. Theoretical vector analysis on a simple impeller turbine indicates that the ideal power output depends on the flow rate and the height of vortex created. **Conclusion/Future Work:** This research has indicated that there is an excellent opportunity to optimise and design the system based on numerical/physical modelling. A vortex optimisation tank will be used in future work to accurately consider various horizontal and vertical geometries. This hydraulic optimisation will then complete Phase-1 of the research to permit progression to Phase-2, optimising the turbo-mechanical performance.

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Oral Presentation - Energy & Climate Change - Session 16

Friday April 8th (9.00 – 10.30) Boole 6

Benefit Analysis of Pumped Storage in the Single Electricity Market

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Keywords: Pumped Hydro, Wind Energy

In 2009 (predominantly imported) fossil fuels generated approximately 86% of the total electricity on the island of Ireland. In order to reduce Ireland's reliance on imported fuels and to meet its Kyoto emissions targets, the Irish government has set the ambitious target that by 2020; renewables will generate 40% of electricity in Ireland. Wind is regarded as the frontrunner in achieving this target, for a combination of reasons namely, Ireland has one of the best wind resources in Europe and wind turbines are a well-established technology. Wind is intermittent so cannot be relied upon to generate electricity when required. Increasing wind penetration does not necessarily result in the closure of fossil fuel power plants, as they must be retained as a "backup" to wind. A 2009 study into the Single Electricity Market (SEM) found that additional pumped hydro needs to be examined in the context of increasing wind penetration. This study uses a validated model of the SEM, created using *Plexos for Power Systems*, a modeling tool, which is used to model electricity markets worldwide. Plexos uses a number of different inputs including electricity demand, wind generation, generator unit availability and the technical characteristics of generator units, to produce a dispatch schedule which ensures sufficient generation is available to satisfy demand at least cost. The effect of incorporating additional pumped hydro storage units into the current generator portfolio is evaluated in terms of generator unit dispatch, generation costs and greenhouse gas emissions. Different volumes of additional pumped storage are examined for three different fuel price scenarios and for both current and future levels of wind penetration. Initial results show that the benefits to the market include a reduction in both the market price of electricity and CO₂ emissions.

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Oral Presentation - Energy & Climate Change - Session 16

Friday April 8th (9.00 – 10.30) Boole 6

An analysis of hydrological model uncertainty at the local stage of a climate change impact assessment in the Suir catchment

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Keywords: Hydrological models; climate change; uncertainty; flood magnitude/ frequency; Suir catchment

Fluvial flood magnitude and frequency relationships may change under climate change in Ireland, with implications for adaptation decisions. The Suir catchment is employed as a case study area to analyse the changes in catchment hydrology and in future flood magnitude and frequency relationships due to climate change. Two lumped conceptual rainfall-runoff models of different degrees of complexity are forced with the output of three GCMs and two emissions scenarios (A2 and B2) downscaled to synoptic station level by empirical statistical downscaling (Fealy and Sweeney, 2007). In the analysis of changes to catchment hydrology for the 2050s and the 2080s, GCM uncertainty is the greatest source of uncertainty. However, by the 2080s, uncertainty due to equifinality of parameter sets and model structure is also a significant source of uncertainty, with increases in streamflow being most extreme in February. Furthermore, results suggest that flood magnitude and frequency relationships will intensify under climate change. A robust finding is the notable agreement in new return period values in the 2080s with both models suggesting that the 10, 25 and 50 year flood events simulated in the control period will become 3.2, 5.4 and 9 year flood events. However, the magnitudes of the flood events differ for each model. These results suggest that model structural uncertainty is a significant source of uncertainty and should be taken into account by employing a suite of hydrological models at the local stage of climate change impact analyses that inform anticipatory flood adaptation decisions or policy frameworks.

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Oral Presentation - Energy & Climate Change - Session 16

Friday April 8th (9.00 – 10.30) Boole 6

Long-term organic matter dynamics and greenhouse gas balance of an Irish grazed grassland

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Keywords: grassland management, nitrogen cycle, net ecosystem exchange, ecosystem modelling, climate change mitigation

The long-term effect of grassland management on soil organic matter levels and on greenhouse gas balance is rarely investigated. Many conceptual considerations indicate that soil organic matter levels are likely to saturate, but it is difficult to estimate the time until saturation is reached. Similarly, net greenhouse gas emissions may also depend on the soil organic matter levels, and thus stabilize over time if management stays constant. For grazed grassland in Northern Ireland a linear increase of soil carbon and nitrogen was observed over a 10-year period (Watson et al 2007, SUM23:121-128). It was hypothesized that strong immobilization of nitrogen in soil organic matter contributed to this effect, although only total carbon and nitrogen in the soil was measured, without fractionation into organic matter pools of different stability. In order to understand mechanistically how accumulation of nitrogen in these soils is happening, we adapted an ecosystem simulation model (DAYCENT) to the site and investigated the long-term dynamics of soil organic matter, as well as mechanisms of organic matter accumulation. Results from model validation will be presented as well as hypotheses concerning the mechanisms of organic matter accumulation in grassland soil under cool, oceanic climates. Implications for long-term soil organic matter dynamics and for the greenhouse gas balance of these grasslands will be discussed. This work can contribute to devising optimal grassland management strategies for climate change mitigation in Irish agricultural grasslands.

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Oral Presentation - Environmental Technologies - Session 17

Friday April 8th (11.30 – 12.45) Boole 1

Green roofs: An environmental opportunity for the next decade

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Keywords: green roofs

Replacing the vegetated footprint destroyed when building are constructed with a green roof is an environmental opportunity and challenge for the next decade. Roofs are generally unused areas and offer a unique opportunity to sequester carbon. Green roofs can be part of a strategy to address climate change. Ireland compliance with the Kyoto Protocol will not be known until after the 5 year (2008-2012) period is over. Ireland's total national emissions for 2009 of 62.32 Mt CO₂eq were just below the Kyoto Protocol limit of 62.84 Mt CO₂eq., (EPA 2010). In the residential sector increased housing stock drove a gradual upward trend in emissions after 1998. The 2009 emissions in this sector showed 0.9% decrease on 2008 and were 0.6% higher than their 1990 level (EPA 2010, Figure 2). Green roofs can remit cementisation of our cities and offer carbon storage potential. Green roofs involve growing plants on rooftops. Establishing green roofs, or vegetated roofs provide a more aesthetically pleasing environment but can improve stormwater management , conserve energy, mitigate urban heat island effects, increase longevity of roofing membranes, improve return on investment compared to traditional roofs, reduce noise and air pollution, increase urban biodiversity, and. Several barriers to widespread acceptance exist such as a lack of awareness regarding green roofs, potentially higher installation costs, limited quantifiable data pertaining to the benefits they provide, no technical information or regulations on how to build them, and a lack of government incentives or tax breaks.

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Oral Presentation - Environmental Technologies - Session 17

Friday April 8th (11.30 – 12.45) Boole 1

Applying biomimetic design to the development of sustainable antifouling for ocean monitoring technology

Author(s): Sullivan T, Regan F

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Keywords: Antifouling, biofouling, biomimetics, biomimicry, surface topography

There is currently a significant and continued research effort directed towards designing and developing novel, non-toxic antifouling materials for ocean monitoring technology. Of particular interest are the mechanisms utilised by aquatic organisms in order to prevent settlement and growth on their outer surfaces, and the chemical and physical parameters responsible for this natural antifouling ability. Biomimicry of such mechanisms to confer protection to artificial surfaces is a highly attractive prospect to those charged with developing surface coatings and antifouling technology. In order to achieve this, the mechanisms responsible for antifouling must be elucidated by careful study of the natural organism and identification of the critical surface parameters responsible for the antifouling property. In this paper the authors report on the characterisation of natural, non-fouling surfaces and the elucidation of the surface mechanisms responsible. The authors also show how artificial surfaces exhibiting the surface properties responsible for antifouling capability can be created and the results of testing of such surfaces. Finally, applications of antifouling surfaces/materials to environmental monitoring technologies are discussed.

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Oral Presentation - Environmental Technologies - Session 17

Friday April 8th (11.30 – 12.45) Boole 1

Succession of fungal community structure and physicochemical properties of spent mushroom compost (SMC) associated with varying composting methods

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Keywords: spent mushroom compost, composting systems

In 2006, Ireland was producing upwards of 242,000 tonnes of SMC per annum, most of this nutrient rich, lignocellulosic material was spread on land and while this can be successful there are serious implications for eutrophication of Irish waters. This study compares and contrasts the composting process as progressed through four laboratory scale composting systems. The progression of the composting process is assessed in relation to the micro-fungal community, physico-chemical and compost maturity observed in each composting system over time. The compost residue in all cases was spent mushroom compost, as it is an abundant agricultural residue in Ireland. The four compost models were chosen to represent the following composting systems; thermostable, adiabatic, windrow and in vessel composting. Thermostable composting refers to an externally heated system where a chosen temperature is maintained throughout the process. Adiabatic composting occurs when the effects of external heat fluctuations are limited by insulating the composter from atmospheric interferences. Windrow composting is piled compost in rows that may be manually turned to aid in aeration and heat distribution throughout the process. In-vessel composting occurs, industrially, in enclosed reactors and this allows for advanced control over composting parameters. Samples from each system were taken routinely throughout the duration of the trial. These samples were analysed for fungal growth and were identified by their plate morphology and characteristics observed under light microscope. Physico-chemical analysis was performed on these samples and changes in nutrient concentrations, temperature, pH and conductivity were monitored. Compost maturity was assessed over time in relation to percentage C/N, germination index and using a *Solvita* compost maturity test kit. Results indicate that thermostable and windrow systems in combination are the most viable option.

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Effect of organic loading rates on anaerobic co-digestion of solid fraction of pig manure and grass silage

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Keywords: Co-digestion; energy yield; grass silage; organic loading rate; pig manure

Anaerobic co-digestion of solid fraction of pig manure (SPM) with grass silage (GS) was evaluated in three identical lab-scale continuously stirred tank reactors (CSTRs) at 35±1°C. The CSTRs had a working volume of 3 litres each. The mixtures of feedstock treated in the CSTRs were 20%GS/80%SPM in CSTR1, 30%GS/70%SPM in CSTR2 and 40%GS/60%SPM in CSTR3 in terms of volatile solids (VS). The organic loading rates (OLR) increased gradually from 1 kg VS/m³/d to 3 kg VS/m³/d in the three CSTRs. The results show that co-digestion of SPM and GS was feasible with the GS fraction up to 40% in the feedstock at OLR of 3 kg VS/m³/d. The concentrations of volatile fatty acids (VFAs) were less than 1050 mg/l in CSTRs after each increase in OLR. The highest NH₄⁺-N and free ammonia concentrations in CSTRs were 1830-2288 mg/l and 52-74 mg/l, respectively, which did not cause the inhibition. VS removal rates were 67.0%-68.3% at the OLR of 1 kg VS/m³/d and decreased to 43.7%-44.3% at the OLR of 3 kg VS/m³/d. The specific methane yields (SMYs) were 253, 262 and 271 ml CH₄/g VS added at the OLR of 1 kg VS/m³/d in CSTR1, CSTR2 and CSTR3, respectively. At the OLR of 3 kg VS/m³/d, the volumetric methane production was 482, 490 and 501 ml/l in CSTR1, CSTR2 and CSTR3, respectively, which increased by 85-91% than that (253-271 ml/l) at the OLR of 1 kg VS/m³/d. At the OLR of 3 kg VS/m³/d, the post-methane production potential of the digestate was 183-197 ml CH₄/g VS added and equal to 38-41% of total methane production potential of the feedstock. The biogas produced via anaerobic digesters with a capacity of 300 m³ can potentially generate an electrical energy output of 186-194 kWh/d with a thermal energy output of 266-277 kWh/d in a combined heat and power system. Therefore, co-digestion of SPM and GS on a farm-scale level will generate renewable energy and provide a means to treat pig manure.

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Biological treatment of methane using a novel biofilm technology

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Keywords: Methane, biofilm reactor, low temperature, biological treatment

Recent studies have identified numerous health and environmental problems that arise from emissions of greenhouse, toxic and odorous gases generated in wastewater treatment plants (WWTPs). New cost-effective, sustainable solutions are required to remediate these emissions. In this study, a novel horizontal flow biofilm reactor (HFBR) has been designed and is being investigated for its efficacy in biologically treating methane gas. The HFBR consists of a stack of horizontal dimpled sheets supporting biofilm growth. To date 3 laboratory scale HFBR units have been commissioned to examine CH₄ removal. These reactors have a working volume of 20 litres (L) and a top plan surface area (TPSA) of 0.04 m². An air and CH₄ (1%v/v) mixture is introduced at the top of each reactor and flows downwards with concurrent flow of synthetic domestic wastewater (8 L/HFBR/day). The total gas flow rate is 1.2 m³/m³/hr (0.6 m³/m² TPSA/hr) and the CH₄ loading rate is 8.5-9.0 g CH₄/m³/hr (4.25 - 4.5 g CH₄/m² TPSA/hr). The HFBRs were seeded with a methanotrophic rich biomass following a 3 month enrichment procedure. This seed material contained a microbial community capable of methane oxidation. Activity tests provided methanotrophic activity potential profiles for each reactor. The operating temperature of the reactors is 9.0-11.0°C, typical of ambient wastewater in Ireland. Currently, research into methane oxidation at these temperatures is limited. Significant removal of CH₄, averaging 40 - 50%, has been achieved to date with the low operating temperatures. Recent work has focused on optimising the nutrients available in the liquid substrate, resulting in up to 80% CH₄ removal efficiencies being achieved. The results obtained to date suggest that the HFBR has excellent potential to biologically treat greenhouse and noxious gases in a simple, effective manner, reducing the carbon footprint of waste treatment facilities and making their presence more acceptable to the public.

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**Characterising landcover using vegetation seasonality profiles
determined from satellite imagery**

Author(s): Scarrott R., O' Connor B, Dwyer N., Cawkwell F.

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Keywords: landcover, vegetation seasonality, time-series, remote sensing,

The pan-European CORINE landcover classification system has limitations for national-scale applications in Ireland. CORINE is derived from satellite images acquired a maximum of twice within any one year, thereby failing to fully indicate seasonal changes in vegetation. This has been shown to provide useful information to improve landcover characterisation. A lack of information on seasonal variability within a single class, for example different pasture management practices, can limit the use of the data as well as contribute to potential misclassification. This research explored an alternative approach to deriving information about Irish landcovers using the seasonal cycle of vegetation growth retrieved from medium resolution satellite imagery. The study used the Enhanced Vegetation Index (EVI) product for 2006 from the MODIS-TERRA satellite sensor. A time-series of 250m spatial resolution, 16-day composite EVI images was processed, using time series analysis methods. The seasonal profile per pixel was first modelled to reduce the effect of cloud interference. Modelled pixels were then clustered using a divergence-guided ISODATA clustering algorithm, grouping pixels of similar seasonality together. A final Jeffries-Mathusita threshold analysis determined cluster distinctiveness. Clear seasonal patterns in vegetation seasonality were detected across the island, with 5 clusters each having a distinct seasonality pattern, and 5 cluster groupings containing up to 20 similar patterns. Certain areas, predominantly within the CORINE “pastures” class, exhibited two seasonal peaks in growth, with a marked decrease in vegetation activity in June/July. Visual analysis of these areas on higher spatial resolution satellite imagery also acquired during 2006, confirmed their location within pasture areas. Land use such as silage cutting, practiced in intensively-managed grasslands, is suggested as the most likely cause of the detected double-season cycle. This finding has important implications for carbon accounting under Ireland’s commitments to the Kyoto protocol and can help improve our knowledge of grassland management in Ireland.

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Oral Presentation - Environmental Management - Session 18

Friday April 8th (11.30 – 12.45) Boole 2

An assessment of the potential of satellite borne radar to detect peatland subsidence over a raised bog in Ireland

Author(s): Wheeler J, Dwyer N, Cawkwell F, Barrett B

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Keywords: remote sensing; peatlands; SAR; interferometry; raised bogs

Raised bogs once covered an area of around 310,000ha of Ireland. Roughly 1% remains as 3,000ha of active, peat-forming raised bog. Changes in surface elevation, principally from anthropogenic drainage, are a clear indicator of bog degradation. Monitoring of such displacement is a necessary part of bog management. Clara bog, the test site for this study, is a protected site (NHA and SAC) and the largest raised bog in the midlands of Ireland, with a relatively high proportion of it intact. Fluctuations in bog height have been measured previously during site-surveys. The objective of this study is to determine whether radar image pairs from the Advanced Synthetic Aperture Radar (ASAR) sensor onboard the ENVISAT satellite can be used to determine surface movement in raised bogs. Interferograms are generated by manipulating data from pairs of images that have been acquired from close to the same point in space. Fourteen image pairs met this criterion and interferograms were generated. A measure of the signal stability between images, known as the coherence, was then generated. Good image stability was found for seven interferograms. Seven surface displacement maps were generated from them. It was found that while the displacement values do not relate to absolute surface height changes, the scale of displacement measured is consistent with values from ground based studies. Similar trends in displacement occur between interferograms from different image pairs. As a result, radar image pairs are a potentially useful tool for measuring relative surface displacement in bogs. Signal stability was found to be greatest when images were acquired during periods of low vegetation growth, and when image pairs were acquired from closer together in space and time. It is recommended that future studies acquire images with these criteria in mind, and examine the potential of longer wavelength SAR (such as L-band).

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Oral Presentation - Environmental Management - Session 18

Friday April 8th (11.30 – 12.45) Boole 2

GIS hazard assessment of landslides in Ireland

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Keywords: Landslide, GIS, Kernel density

Ireland is generally regarded as a benign environment with regard to landslides. However events in recent years have shown an increase in landslide activity especially in bogland landscapes. It is therefore important to better understand and map these hazards. An up to date landslide inventory in Ireland with 136 records has been compiled into a GIS database by the Geological Survey of Ireland. With this database and Digital Elevation Models (DEM) of Ireland with different resolutions including 90 m SRTM data and 20 m data, the relationships between landslide occurrences and topographical parameters (e.g. elevation and slope) were investigated using GIS techniques. The results showed that most landslides were located in areas with relatively high elevations and steep slopes. Landslides involving peat, in both raised and blanket bog, make up a significant number (63) of events. We produced a landslide hazard map using the Kernel Density method. Areas featuring high densities of landslides were located in the mountainous areas of counties Wicklow, North Mayo, and Leitrim. It is hoped that this work will lead to further research in an effort to predict where landslides might next occur.

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Oral Presentation - Environmental Management - Session 18

Friday April 8th (11.30 – 12.45) Boole 2

Some aspects of spatial data analyses in environmental monitoring

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Keywords: GIS, spatial statistics, environmental monitoring

Environmental databases are being constructed at regional, national and international scales. As a result, analysis of the large volume of environmental monitoring data has become a challenging task. The current paper discusses some of the issues associated with environmental mapping exercises. The topics to be discussed are spatial outlier identification, spatial variation and spatial modelling. Outliers in a dataset can cause biased statistical results and thus should be identified. Spatial outliers are identified based on a comparison with their neighbouring data, and they may imply a different process from the background, such as pollution. Spatial variation has been conventionally evaluated using visual interpretation based on maps, but the development of local statistics enable the quantification of spatial variation. Meanwhile, a geographically weighted regression can be applied to model the spatially varying relationships between environmental parameters, making it possible for spatial modelling in environmental monitoring data analyses. These issues are demonstrated using environmental geochemical data from Ireland.

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Oral Presentation - Environment & Health - Session 19

Friday April 8th (11.30 – 12.45) Boole 5

Indoor / outdoor air quality relationship in an urban environment: Dublin case studies

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Keywords: Air Pollution, Indoor/Outdoor, PM2.5, NO_x

Legislative reductions in air pollutant limits values seek to improve outdoor air quality, in turn reducing associated illnesses such as cardiopulmonary mortality, strokes and lung cancer. This study focuses on two major anthropologic pollutants NO_x (NO₂ + NO) and PM2.5. New attainments dates for limit values look as far as 2020, when Ireland will be obliged to achieve annual mean PM2.5 concentrations of 20 g/m³, while the limit of 40 g/m³ for NO₂ is legally binding since January 2010. Previous research suggests that people now spend up to 90% of their day indoors yet in Ireland no legislative indoor air pollutant limits exist. A study carried out a study on 57 office environments and found 75% of our daily NO₂ exposure occurred while at work. This research aims to determine the relationship between exposure of staff to specific air pollutants in Irish working environments (e.g. shops, offices) and factors such as ventilation systems, door design and volumes of human traffic entering the building. Urban planners in cities globally can utilise data for commercial building design in order to minimise the influence of outdoor air pollutants on indoor air. To date in this project monitored working environments include; a sports centre, a college canteen, a computer repairs shop and two office buildings all of which are located busy street canyons of the city centre in Dublin, Ireland. Clear relationships between indoor and outdoor concentrations could be seen for all sites. Results indicate that indoor concentrations can be significantly greater than outdoor concentrations for some buildings causing greater exposure to those working within them than ambient concentrations indicate. Strong indoor sources were noted in some sites. A building using natural ventilation had statically insignificant differences in PM2.5 and NO for indoor and outdoor concentrations during working hours.

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Risk ranking of pesticides used in Irish agriculture

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Keywords: Pesticide, Risk

Pesticides used in agriculture can have an inadvertent negative impact on an ecosystem. In order to reduce the risk associated with their use, chemical risk ranking tools can be used to prioritize harmful pesticides, identifying ones requiring increased management and surveillance. The aim of this study is to quantitatively assess the risk of pesticides (used in Irish agriculture), and their degradation products, to groundwater and human health. A human health risk based approach is presented which combines the predicted leached quantity with an exposure estimate and the No Observed Adverse Effect Level (NOAEL) as a toxicity ranking endpoint, resulting in an overall risk ratio value. The study looks at 34 active substances, commonly used in the agricultural field, and their metabolites. The 3 pesticides ranked in order of decreasing human health risk were: MCPA, Desethyl-terbuthylazine and Deethylatrazine (with risk ratio values of 1.2×10^{-5} , 9.7×10^{-6} and 6.3×10^{-6} , respectively). A sensitivity analysis revealed that the soil organic carbon content and soil sorption coefficient were the most important parameters which affected model predictions (with correlation coefficient values of -0.61 and -0.58, respectively), highlighting the importance of soil and pesticide properties in influencing risk estimates. Other parameters such as water consumption, interception fraction and groundwater level also influenced human exposure levels. The analysis also highlights the change in ranking of pesticides when just the leach quantity is considered and emphasises the advantages of taking a risk based approach (i.e. including level and severity of exposure) for the ranking of pesticides.

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**Adsorption isotherms of fungicide chlorothalonil in
selected Irish soils**

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Keywords: adsorption isotherms, pesticides, batch equilibrium method, chlorothalonil

Assessment of the potential impact of pesticides use in agriculture on environmental quality requires quantification of sorption as it is one of the most important processes controlling the fate of chemicals in soil. Generally, sorption of non-polar pesticides is mainly due to hydrophobic interactions with organic soil substances whereas sorption of polar chemicals is influenced by pH, which determines the degree of dissociation. Chlorothalonil (2, 4, 5, 6- tetrachloro -1, 3-benzenedicarbonitrile) is an organochlorine, non-polar, non-systematic foliar fungicide, applied for the control of fungal diseases in different commodities. In Ireland, chlorothalonil can be applied to arable crops at 2 kg ha⁻¹ active substance and between 3 to 12 kg ha⁻¹ to vegetables and fruits. The transport and toxicity of chlorothalonil is of concern, especially in aquatic systems since it is considered “very highly toxic” to fish and invertebrates with acute toxicity levels of 10 to 80 g/L. Different stochastic or deterministic models are used to predict the fate of a given pesticide in the environment and this requires estimation of equilibrium sorption data such as distribution coefficient (K_d) or organic carbon normalised coefficient (K_{oc}). The extent of adsorption is usually determined indirectly by measuring the change in solution concentration after an adequate equilibration period using batch technique. In this study, the batch adsorption experiments were performed using four tillage and one grassland soil. The distribution coefficients (K_d) ranged from 12 L/kg in Clonroche tillage soil to 42 L/kg in Elton grassland soil indicating different behaviour of chlorothalonil in the soils. The Freundlich adsorption isotherms ranged from 9 to 39 (mg^{1-1/n} kg⁻¹) (L)^{1/n} and the regression constant ranged from 0.71 to 0.96 indicating that the adsorption of chlorothalonil was approximately linear. The results showed that the adsorption of chlorothalonil was related to cation exchange capacity and organic carbon content for the soils studied. The results indicate that tillage soils will offer less protection of water resources from pesticide contamination than grassland soils.

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**Development of a toxin screening multi-parameter
on-line biochip system**

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Keywords: Toxicity testing, cell based biosensors, integrated microsystem platforms,

The development of a cell based biochip-sensing platform that examines the effects of toxic chemicals both electrically and optically is presented. The name of this sensing platform is called Toxichip and it aims to develop and promote alternative novel *in-vitro* testing methods for the monitoring of a vast array of toxicants. Cell-based biosensors (CBBs), which treat living cells as sensing elements, are able to detect the functional information of biologically active analytes and also provide quantitative analysis. In general, they maintain living cells and observe the cellular physiological response after subjecting cells to toxin stimuli and verify the presence and the concentration of these stimuli. CBBs characterise with high sensitivity, excellent selectivity and a fast response time. There has been increased interest in the use of microelectronic biosensors that allow cellular activity to be analysed *in vitro*. Toxichip is concerned with developing a multi-parameter integrated detection platform for real-time and simultaneous measurement of cell adhesion, cell morphology, pH and temperature of the media. Impedance measurements on cellular systems with inter-digitated electrode structures (IDES) have been shown to be an effective way of monitoring cellular behaviour on-line and in real-time. The IDES sensors that we have fabricated are indium tin oxide (ITO). ITO was chosen as the biosensor material due to its optical transparency, electrical characteristics, and biocompatibility. The transparent nature of the electrode material allows microscopic imaging of the cells, which provides important information on the distribution, morphology, size and shape of the cells. ITO IDES have been successfully used to measure the bioimpedance of cells *in vitro* within a fluidic set-up. This integrated biochip platform system will address markets including, environmental monitoring, health care, pharmaceutical industry and security/defence sectors.

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Oral Presentation - Environment & Health - Session 19

Friday April 8th (11.30 – 12.45) Boole 5

Early Warning Signal Analysis in Drinking Water Treatment Plants Operations

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Keywords: Early Warning Signal Analysis, Water treatment

Early warning signals contain useful information that can be used to foresee accidents in complex socio-technical systems, allowing pre-emptive actions to be taken. The identification and collection of early warning signals presupposes the creation of models that express possible accident scenarios. These models need to relate possible observable values with a complete set of causal factors that contribute to a loss. To address this problem, a hazard analysis approach known as STAMP Based Process Analysis (STPA) has been extended to incorporate the identification of warning signals to identified hazards. The result is the Early Warning Signal Analysis approach based on STPA (EWaSP). Applying EWaSP to real world problems requires a considerable amount of work. To address this problem a dedicated EWaSP software editor was created to help analysts identify, collect and relate early warning signals, with causal factors, to losses. For the development of the EWaSP editor a Domain Specific Modeling Language, which is a collection of graphical models that represent key concepts and relations of this problem domain, was defined. EWaSP and its dedicated editor were recently tested in a drinking water treatment plant water chlorination unit. The result was a two-fold increase in the number of identifiable early warning signals, compared to those given by the domain experts.

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Oral Presentation - Water Quality - Session 20

Friday April 8th (11.30 – 12.45) Boole 6

Investigation of bacterial pathogen sources and transfer hydrodynamics in rural catchments

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Keywords: Bacterial pathogens, microbial source tracking, water quality, Real-time PCR

In Ireland, bacterial pathogens from continual point source pollution and intermittent pollution from diffuse sources can impact both drinking water supplies and recreational waters. This can pose a serious public health threat. Monitoring and determining the source of faecal pollution to water is imperative for the protection of water quality and human health. Conventional culture methods to detect such pollution via faecal indicator bacteria have been extensively utilised but do not determine the source of pollution. To combat this, microbial source tracking, an important emerging molecular tool, is utilised to detect host-specific markers in faecally contaminated waters. The aim of this study is to target ruminant and human-specific faecal *Bacteroidales* and *Bacteroides* 16S rRNA genes within rural river catchments in Ireland and investigate hydrological transfer dependencies. Large (5-20L) untreated water samples were collected from two catchment sites, Cregduff, Co. Mayo and Dunleer, Co. Louth, during storm and non-storm periods. Samples were filtered through 0.2 µm nitrocellulose filters to concentrate bacterial cells which then underwent chemical extraction of total nucleic acids. Animal and human stool samples were also collected from the catchments to determine assay sensitivity and specificity following nucleic acid extraction. Aquifer response to seasonal events was assessed by monitoring coliforms and *E. coli* occurrence using the IDEXX Colisure Quanti Tray/2000 system in conjunction with chemical and hydrological parameters. Host specific primers BacCow-UCD, BacHum-UCD BacUni-UCD and BoBac were then assayed against both faecal and water extracts and quantified using real-time PCR. As expected, the universal primer (BacUni) detected *Bacteroidales* in all faecal samples while ruminant primers (BacCow and BoBac) detected *Bacteroidales* and *Bacteroides* in bovine and ovine faecal samples and faecally spiked water samples. The microbial source tracking techniques and hydrodynamic model that will be designed by this project will be of vital importance for water quality control in Ireland.

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Oral Presentation - Water Quality - Session 20

Friday April 8th (11.30 – 12.45) Boole 6

The effect of anoxia and anaerobia on ciliate communities in biological nutrient removal (BNR) systems using laboratory-scale sequencing batch reactors (SBRs)

Author(s): Dubber D., Gray N.F.

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Keywords: wastewater treatment, activated sludge, Phosphorus removal, protozoa, process performance

Little is known about the effect of anaerobic and anoxic stages on protozoan communities in the activated sludge process and how this subsequently affects performance. Using a laboratory-scale BNR system the effect of different periods of anoxia on both the protozoan community and performance efficiency have been examined. Four SBRs were operated at two cycles per day using a range of combined anoxic/anaerobic periods. Effluent quality (TOC, BOD, TP, TN, $\text{NH}_4\text{-N}$, $\text{NO}_3\text{-N}$ and $\text{NO}_2\text{-N}$), sludge settleability and ciliate community (species diversity and abundance) were analysed over a periods of up to 24 days of operation. In further experiments the impact of the frequency of anoxia/anaerobia exposure and the importance of recovery times for ciliate communities were examined. The species richness and total abundance of ciliates were found to decrease with longer anoxic/anaerobic periods. Both, positive and negative significant correlations between the abundance of certain species and the period of anoxia was observed, although other species were unaffected by exposure to anoxia. In the laboratory-scale units, a 60 min anoxic/anaerobic period resulted in good process performance (TOC and BOD removal of 97-98%), nitrification (80-90%) and denitrification (52%) but poor levels of biological P-removal (12%) were reached. The protozoan community was moderately affected but still diverse with high abundances. Increasing the length of anoxia to up to 200 min did not enhance denitrification although P-removal rates increased to 22 - 33%; however, ciliate species richness and total abundance both decreased and sludge settleability became poorer. The study shows that activated sludge protozoa display a range of tolerances to anoxia and anaerobia that result in altered ciliate communities depending on the length and frequency of combined anoxic/anaerobic periods within the treatment process. It is recommended that anoxic/anaerobic periods should be optimised to sustain the protozoan community while achieving maximum performance and nutrient removal.

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Oral Presentation - Water Quality - Session 20

Friday April 8th (11.30 – 12.45) Boole 6

Foaming Scum Index (FSI) - A new tool for the assessment and characterisation of biological mediated activated sludge foams

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Keywords: Activated sludge, biological foam, stability

Biologically mediated foaming continues to be a significant problem for activated sludge operation and management. It is the stability and persistence of these foams within this wastewater treatment process which differentiates them from other bubble entities seen on the surface of aeration tanks. Whilst several different approaches have been utilised to assess the propensity of activated sludge samples to foam, there is still lacking a standard procedure that can be used in order to rank and categorise foams so it is then possible to accurately gauge what is occurring at plant level. In this study a detailed classification system of biological activated sludge foams has been developed. The Foaming Scum Index (FSI) is based on a number of different foam characteristics such as foam thickness, foam stability, foam coverage and biological composition which have been measured on foam samples taken from several different sites. Path analysis has then been used to evaluate co-dependencies among sets of variables which have been weighted accordingly using principal component analysis. The index has been bench-marked using results obtained from different foamability measurements. From this work it is proposed that the index can be readily applied as a standard tool in the coordination of research into the phenomenon of activated sludge foaming.

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Oral Presentation - Water Quality - Session 20

Friday April 8th (11.30 – 12.45) Boole 6

Detection of parasitic protozoans and common indicator bacteria in two wastewater treatment plants in Northwest Ireland

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Keywords: Cryptosporidium, Giardia, wastewater treatment, Escherichia coli, Clostridium perfringens, Enterococci

This study aims to detect transmissible stages of the *Cryptosporidium* and *Giardia* genera of parasitic protozoans in wastewater treatment plants (WWTPS), and to determine if their presence or absence bears any relationship with numbers of typical indicator organisms. The viability and overall condition of these transmissible stages are also investigated, to determine their ability to survive the treatment process and pose an environmental threat to public health. To these ends, samples from two large-scale WWTPs in Co. Sligo and its environs were taken every two months over an 18 month period. Both solid and liquid phase samples were analysed for the target organisms, before and after treatment. Both WWTPs are of a standard-type activated-sludge process design, however one further treats sludge via pasteurisation and anaerobic digestion, and final effluent via UV-irradiation. The increase in treatment efficacy from these additional processes is also investigated with regards to bacterial and protozoan targets. Results indicate that the biological quality of the effluent and sludge from the plant which had these extra treatment processes, was far higher (in bacterial indicator terms) than the plant without. UV-irradiation reduced microbial numbers across all bacterial targets in effluents as did pasteurisation and anaerobic digestion. Protozoan targets were isolated in low numbers in sludges and effluents. No viable examples were detected and those detected were degraded or ruptured with little or no contents. *Cryptosporidium* oocysts and *Giardia* cysts were detected and enumerated via fluorescence microscopy, after incubation of the sample with FITC-conjugated monoclonal antibodies (mAbs) specific to each genera. The use of 4'-6-Diamidino-2-phenylindole (DAPI) and Propidium iodide (PI) in the assay allowed 1) The visualisation of infective stage nuclei within the oocysts/cysts if they were present, 2) The determination of infectivity/viability of the oocysts/cysts. Total coliforms, *E. coli*, Group D streptococci and *C. perfringens* were determined by standard pour-plate methods.

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Oral Presentation - Water Quality - Session 20

Friday April 8th (11.30 – 12.45) Boole 6

A Stormwater Sampling Protocol for Monitoring of Sediment Transport in an Urban Catchment

Author(s): Morgan D.T., Johnston PM, Gill LW, Collins P, Osei K

Corresponding Author Institution: Trinity College Dublin

Keywords: Stormwater, urban runoff, monitoring protocols, heavy metals, particle size distribution

Urban stormwater runoff may contain pollutant loadings of suspended solids, heavy metals, nutrients, hydrocarbons and other toxic constituents. Stormwater discharges to receiving water bodies can have damaging physical, chemical and biological impacts, ultimately resulting in degradation of beneficial uses. Particulate matter (suspended solids) in the runoff is recognised as a key parameter as many pollutants are associated with the solid fraction. Under the EU Water Framework Directive, the recently published River Basin Management Plans in Ireland acknowledge that stormwater discharges will need to be regulated, and that treatment of runoff is necessary. However, the high temporal and spatial variability of stormwater pollutants presents difficulties in characterising loads and assessing stormwater treatment measures. A pragmatic and rigorous stormwater sampling and analysis protocol is therefore needed. Initial field testing has been conducted on an advanced hydrodynamic vortex stormwater separator for removal of suspended solids, the Downstream Defender. The testing focused on heavy metals, suspended solids and particle size distributions in stormwater and captured sediments across a number of representative drainage systems in the greater Dublin area. This testing has led to the development of a stormwater sampling and analysis protocol, which will be applied to a recent installation in Kimmage, Dublin. The Kimmage study will yield information on the sediment and pollutant yield of an urban catchment, methods of estimation and the efficiency parameters of the separator.

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POSTER PRESENTATION ABSTRACTS

(LISTED BY THEME)

POSTER ID: ET1

POSTER ORAL SESSION: Session 5, Thursday, April 7th, 14.00-15.10 (Boole 1)

Screening of Polycyclic Aromatic Hydrocarbons (PAHs) in Water Using Electrochemical Immunosensors.

Author(s): Ahmad A, Paschero A, Moore E

Corresponding Author Institution: Tyndall National Institute

Keywords: Polycyclic Aromatic Hydrocarbons, Enzyme Labelled, Electrochemical Detection

Detection, identification and quantification of potential pollutants in the environment are usually performed by analytical methods, which are generally time-consuming and expensive. In contrast to conventional monitoring methods, this research focuses on the development of highly sensitive low cost immunosensor biochips for the determination of polycyclic aromatic hydrocarbons (PAHs) in water. This portable immunosensor utilizes immunological reaction to capture, detect and quantify target compounds by measuring the chemical response to specific antibodies. A biochip consisting of three electrodes system was fabricated for rapid determination of PAHs. The biochip sensors comprise a gold working electrode, a platinum counter electrode and an Ag/AgCl reference electrode. For indirect enzyme-linked immunosorbent assay (ELISA), a receptor molecule was synthesized where pyrene butyric acid was coupled with bovine serum albumin (BSA) to form a hapten conjugation of BSA-Pyrene. Displacement ELISA format was used where primary monoclonal 4D5 antibody was displaced with a known concentration of PAHs. Detection is carried out using an alkaline phosphatase enzyme labelled and bovine serum albumin was used as blocking agent. The enzyme used specifically converts the substrate into a detectable signal. The proposed system showed acceptable reproducibility and good stability. The immunosensor exhibited a wide linear response to PAHs. A limit of detection (LOD) for this sensor was in the range of 1 ng/mL - 100 ng/mL in aqueous samples. For real sample analysis, samples were collected from seven collection points along the River Lee in Cork, Ireland. As a comparison, and to help further validate the results, data collected will be compared with traditional analytical chromatographic techniques for monitoring PAHs, such as high performance liquid chromatography and gas liquid chromatography.

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POSTER ID: ET2

POSTER ORAL SESSION: Session 5, Thursday, April 7th, 14.00-15.10 (Boole 1)

Application of Wireless Sensor Technology to Wastewater Treatment Plant Environmental Monitoring Systems

Author(s): Casey AM, Heneghan M, Treacy J, Oakley K, Zhelev T

Corresponding Author Institution: Limerick Institute of Technology

Keywords: wireless sensors, odorant monitoring, pH, wastewater treatment

Wastewater treatment plants (WWTPs) are cited as a source of odorous compounds, both inorganic and organic. This research investigated the occurrence of inorganic odorous compounds, namely hydrogen sulphide and ammonia, in WWTPs. The parameters of pH and temperature were also studied in wastewater. Novel wireless technology was used for monitoring of each of these analytes. The wireless technology implemented in odorant monitoring was compared with conventional chemical methods of analysis. These conventional chemical methods encompassed passive sampling with “radiello” diffusive samplers and active sampling with colorimetric tubes. The wireless technology included electrochemical gas sensors which followed the IEEE 802.15.4 protocol, also termed “ZigBee”. The highest concentration of hydrogen sulphide was 5 ppmv using the wireless hydrogen sulphide sensors. These had a sampling period of 20 seconds. Ammonia was not detected. The correlation between the wireless hydrogen sulphide sensors and the conventional chemical methods were investigated and showed promising results. The best correlation coefficient was 0.9242. This related to the data obtained from active samplers which had the fastest sampling period (2 minutes) of the conventional chemical methods employed. The parameters of temperature and pH in wastewater were also monitored using wireless technology. Temperature and pH sensors were converted to wireless devices and ZigBee technology was also used for this purpose. Wastewater temperatures were seen to rise and fall in accordance with the seasons and the pH was constantly found to be within the range 6-7 pH units at the outfall. The research concluded that wireless technology is advantageous for complex processes such as wastewater treatment that requires stringent monitoring. The real-time monitoring provided by wireless technology can deliver detailed data on an analyte under investigation at stages of the process that are known to be problematic.

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Environmental Technologies – Poster

POSTER ID: ET3

POSTER ORAL SESSION: Session 5, Thursday, April 7th, 14.00-15.10 (Boole 1)

Analyse Early Warning Signals

Author(s): Imran S

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Keywords: Early Warning Signal Analysis

Safety has become a major challenge for our society. Accidents often generate headlines around the world and impact on many of our lives. There is a need to understand what has caused these accidents and how we can ultimately prevent them from occurring. A series of indicators or warning signals are usually present before an incident or accident occurs. A method to identify indicators or warning a signal is needed to allow a proactive response and prevent them taking place. Warning signals are information or data that can be used to foresee and react to incidents or accidents in a timely manner. The structured analysis of early warning signals is not readily supported by conventional hazard and risk analysis approaches. To address this problem, a well established approach known as STAMP Based Process Analysis (STPA) has been extended to incorporate the identification of warning signals to identified hazards. The novelty of this research is that a new methodology to identify warning signals has been developed.

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POSTER ID: ET4

POSTER ORAL SESSION: Session 5, Thursday, April 7th, 14.00-15.10 (Boole 1)

Development of novel integrated photocatalytic adsorbents (IPCA) for organics removal from water & wastewater

Author(s): Keane D., Nolan K., Morrissey A., Basha S., Tobin J.

Corresponding Author Institution: DCU

Keywords: Activated carbon, titanium dioxide, famotidine, IPCA, active pharmaceutical ingredients

Active pharmaceutical ingredients (APIs) are an important group of organic environmental contaminants that have the potential to cause health risks for humans as well as biota. Currently research interest is focusing on development of novel water treatment systems for their removal. Hybrid processes, which couple the adsorptive properties of activated carbons with the photocatalytic properties of titanium dioxide (TiO_2), offer the potential to significantly enhance the photo-degradation of a range of hazardous organics in water. A medium molecular weight active pharmaceutical ingredient, famotidine, has been chosen as a model pollutant in this study. It is partially degraded by conventional water treatment and is a suitable proxy for more hazardous organic pollutants. Photodegradation under illumination from a 125W medium pressure mercury lamp has demonstrated the ability of the integrated photocatalytic adsorbents (IPCA) to photo-degrade famotidine from aqueous solution. The surface morphology of the IPCAs has also been characterised using SEM/EDX, which indicates uniform deposition of TiO_2 nanoparticles across the AC surface. The use of calcination (heat treatment) in IPCA preparation and its effect on photocatalytic performance were also investigated.

The amount of TiO_2 deposited on the IPCA played a significant role on its photodegradation ability. The percentage of the famotidine degraded by the 10% wt TiO_2 IPCA under UV irradiation was nearly 77% after 180 min. Heat treatment was found to decrease photodegradation ability probably due to the conversion of the anatase phase in the TiO_2 to the less photoactive rutile phase. The 0.5 and 1% wt IPCAs demonstrated the highest adsorption equilibrium constants most likely due to the availability of more adsorption sites as a consequence of their lower TiO_2 content.

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POSTER ID: ET5

POSTER ORAL SESSION: Session 5, Thursday, April 7th, 14.00-15.10 (Boole 1)

Microporous solids for low temperature carbon dioxide adsorption

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Keywords: CO₂ Capture, Environmental Catalysis, Adsorption

With the advent of climate change, CO₂ emissions from manmade sources have come under scrutiny as a driver of manmade climate change. Combustion of fossil fuels and related practices is seen as the primary source of such emissions. 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. As an alternative, the amines can be supported on porous solids. The flue gas can then be passed through the amine-rich solid which should adsorb CO₂ from the gas stream. Once the solid is fully saturated, pressure swing or temperature swing methods can be applied to the solid to initiate a CO₂ desorption cycle which should alleviate some of the problems associated with the conventional CO₂ capture technology. In this project, a CO₂ capture technology based on adsorption was investigated using economically viable materials such as amine modified microporous zeolites. Factors investigated included zeolite pre-treatment, silica/alumina ratio, method of amine attachment, amine amount, and amine type. This study looks primarily at CO₂ adsorption from low temperature exhaust streams with two primary focuses; CO₂ adsorption capacity and regeneration energy requirements. These were measured using a gas system with on-line mass spectroscopy detection. The most successful adsorbent was found to be Y-80 Zeolite which was modified with 3-Aminopropyltriethoxysilane (APTES) using simple dry impregnation. This showed relatively high levels of CO₂ capacity while also having a relatively low CO₂ affinity with desorption occurring at 70^oC. This solid was also tested over several adsorption/desorption cycles to test its stability. The solid sample was found to remain stable even after 9 consecutive adsorption/desorption cycles.

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POSTER ID: ET6

POSTER ORAL SESSION: Session 5, Thursday, April 7th, 14.00-15.10 (Boole 1)

**Effects of growth parameters & gravity on Isoflavonoid production
in etiolated soybean seedling and callus tissues**

Author(s): Downey P, Levine L. H., Musgrave M, Stutte G. W., Moane S, McKeon-Bennett M. M. P.

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Keywords: Isoflavonoid, genistein, daidzein, genistein, soybean, seedling callus, growth chamber, gravity, centrifugal, enclosed ecosystem

Isoflavonoid levels in soybean (*Glycine max.*) tissues generated under stationary and centrifugal conditions were examined in order to explore the potential impact of hypergravity on isoflavonoid biosynthesis. Soybean seedlings (*Glycine max* (L.) Merr. cv. McCall) were grown in the dark for 6 days at 22 °C in a rotor or an adjacent stationary treatment. Isoflavonoid aglycone and glycoside concentrations (daidzin, 6-O-malonyl-7-O-glucosyl daidzein, genistin, 6-O-malonyl-7-O-glucosyl genistein, daidzein, genistein) were analysed at “gravity” treatments of 1 g (ground control), 4 g and 8 g. Soybean hypocotyl and root tissues showed an increase in total isoflavonoid production with increasing gravity, relative to the stationary ground control. However, total isoflavonoid concentrations in cotyledon tissue remained unchanged potentially due to naturally high concentrations. Concentrations of individual isoflavonoids showed similar trends within each tissue type, with hypocotyl tissue exhibiting the largest percent change for certain isoflavonoids relative to ground controls; as much as 400% in one case. The potential interaction between gravity and hormonal activity for isoflavonoid potential is discussed, specifically whether the increase in isoflavonoid production was due, in part, to differential levels of development under the “gravity” conditions employed. Results suggest that gravity does have an effect on isoflavonoid production in soybean, but it’s mode of action, particularly in relation to hormone interaction is still unclear. Given the nutraceutical benefits of particular isoflavonoids within the human diet, the idea of forced evolution through environmental manipulation is becoming increasingly noteworthy, particularly for space life sciences and commercial viability of nutraceutical products.

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POSTER ID: ET7

Towards a more sensitive atmospheric monitor for elemental mercury

Author(s): Darby S B, Smith P D, Venables D S

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Keywords: atmosphere, monitoring, mercury

Mercury (Hg) is a toxic heavy-metal with large biogenic and anthropogenic sources. Through complex biogeochemical processes, atmospheric Hg can be converted to organic forms such as methyl-mercury which can bioaccumulate and enter the human food chain. The understanding of these biogeochemical cycles is limited by current instrumentation. The state of the art atmospheric monitors today do not give detailed information on speciation or fluxes in the atmosphere and there is a need to improve on these technologies to make instruments for atmospheric Hg detection faster, cheaper and more sensitive. Here we present a novel approach based on cavity enhanced absorption spectroscopy (CEAS). Even in a relatively small instrument, the highly reflective mirrors of optical cavities can increase the pathlength of light through the sample to hundreds of metres, thereby greatly improving the absorption sensitivity. Although lasers are conventionally used in CEAS systems, an innovation of our CEAS instrument is to use an Hg lamp as the light source and avoid the expense and complexity of deep-UV laser systems. We analyse the sensitivity of the device and discuss potential applications of the approach.

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POSTER ID: ET8

An optical fibre system for the detection of gaseous pollutants in an urban environment

Author(s): Devine B.D., Walsh JW

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Keywords: Differential Optical Absorption Spectroscopy, Miniaturised Spectrometer

Detection of pollutants in urban environments is performed using a variety of techniques that are expensive and are fixed in permanent locations. The novel system presented here is designed for the *in-situ* detection of pollutants in an urban environment using absorption spectroscopy. Expanding on earlier research to develop a miniaturised *in-situ* fibre-optic system to take readings of nitrogen dioxide (NO₂) in an urban area, the novel system consists of a miniaturised spectrometer, an optical fibre and a collimating tube coupled with an Ocean Optics collimating lens. Work has also been carried out to recommission the OPSIS-DOAS system installed on the roof of Kevin St. DIT and other locations. The Differential Optical Absorption Spectroscopy (DOAS) method is very accurate but it presently requires the apparatus to be fixed in position and it can be expensive. The principle of operation is based on Beer's Law: $A = \log(I_0/I) = \alpha cL$. The DOAS method requires an algorithm to determine the differential of intensity, I , at three separate wavelengths. In the laboratory tests were performed using polypropylene bags filled with air and a known concentration of NO₂. Using an algorithm, based on the DOAS method, the laboratory tests on NO₂ have verified Beer's Law for varying concentrations of analyte gas and different path lengths of the same concentration. Data has also been recorded on the roof of the FOCAS building to detect the differential absorption of NO₂. To perform these tests rigorous optical set-ups have been designed, constructed and tested. Tests have also been performed with LEDs for use as alternative light sources. Comparison of the measurements taken with the test system and the various DOAS methods will be used to calibrate and improve its accuracy. A more precise apparatus for taking measurements outside is being developed for accuracy and the reduction of signal/noise.

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POSTER ID: ET9

Development of novel graphene-titanium oxide photocatalytic adsorbent for organics removal from water and wastewater

Author(s): Gholamvand Z., Nolan K., Tobin J., Morrissey A.

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Keywords: Graphene-TiO₂, photocatalytic adsorbents, TiO₂ photocatalysis, organic compounds

Over the past decades degradation of organic pollutants using titanium dioxide has attracted increasing attention for the purification of water. One of the newest methods is combining titanium dioxide and an adsorbent material to create integrated photocatalytic adsorbents (IPCA) which overcome some of the limitations of TiO₂ nano-particles such as low photocatalytic efficiency at low pollutant concentrations and complicated separation after purification. Carbonaceous porous materials such as activated carbon are promising for this purpose. However, several problems hinder the efficiency of current TiO₂-C composites, such as the marked decrease of the adsorption during photodegradation, lower light intensity at the catalyst surface, and the lack of reproducibility due to preparation and treatment variation. In this project it is proposed to develop a facile and reproducible route to obtain a chemically bonded TiO₂ nanoparticle-graphene composite and evaluate its ability to purify water and wastewater. The combination of TiO₂ and graphene nano-sheets promises to simultaneously possess excellent adsorption, transparency, conductivity and controllability due to its very large planar structure, which would enhance pollutant adsorption and charge transportation to facilitate photodegradation of the pollutants. These results will be compared to the photocatalytic performance of other adsorbent-TiO₂ (e.g zeolite-TiO₂ and activated carbon-TiO₂ composites) composite's ability to absorb and degrade pollutants under the same experimental conditions.

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POSTER ID: ET10

**Air Quality Monitoring System for a more Comprehensive Look at
Transportation Emissions**

Author(s): Lord E, Geraghty D

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Keywords: air quality, continuous monitoring, pedestrian exposure

Recent studies indicate that pedestrians are regularly exposed to high levels of sulfur dioxide (SO₂), nitrogen dioxide (NO₂), nitric oxide (NO), and ozone (O₃) as well as carbon monoxide (CO) at street level, with peak concentrations during the rush hour commute. Current roadside monitoring of transportation emissions is irregular and subject to the availability of personnel to remain on site, indicating the need for a more continuous system for data acquisition. The unit being developed is compact, unobtrusive, cost effective and easily installed at street level for continuous monitoring of air pollution to provide a more comprehensive data set on daily pedestrian exposure to air pollution. This system utilizes compact sensors and a unique Linux based operating system, facilitating a simple expansion protocol to a network of sensor nodes, allowing for regional comparison as well as the facilitation of modeling urban levels of carcinogenic gas.

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POSTER ID: ET11

The role of the ClpXP protease chaperone complex in the regulation of styrene degradation in *Pseudomonas putida* CA-3

Author(s): Ryan W. J., O'Leary N. D., Dobson A. D.

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Keywords: global regulation, catabolite repression, aromatic degradation

Research into the microbial degradation of aromatic compounds often focuses on the identification of pathway specific/substrate related catabolic and regulatory processes and their molecular basis. Less insight has been provided however on the role played by global regulatory elements on the activation and repression of these pathways. The current study seeks to address this knowledge gap through efforts to identify global regulatory factors affecting degradation of the aromatic pollutant styrene in *P. putida* CA-3. In natural environments it is widely held that activation and repression of aromatic degradation pathways are tightly integrated with general cell metabolism/physiology. The identification of mechanisms facilitating such integration may offer targets in the future for improved biotechnological outputs from such pathways/organisms, e.g. biocatalytic applications and value added product synthesis. Recent efforts to identify functional regulators of styrene catabolism in *P. putida* CA-3 via mini- Tn5 random mutagenesis has identified a potential regulatory role for the protease chaperone protein ClpX. Here we report on our characterisation of the potential role played by this protein in regulating the degradation of the styrene by *P. putida* CA-3.

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Energy & Climate Change - Poster

POSTER ID: ECC1

POSTER ORAL SESSION: Session 3, Thursday, April 7th, 11.30-12.40 (Boole 5)

The Production of Fuel From Algae: An Introduction To The Biomara Project

Author(s): Hernon A., Vanegas C., Bartlett J.

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Keywords:

The use of arable land for the production of fuel has become a hotly debated topic in recent years and has been cited as a contributing factor in the spike of global food prices in 2007/2008. In an effort to address this issue, the INTERREG funded BioMara project will demonstrate the feasibility of producing *mari-fuels* from marine biomass derived from both macroalgal (seaweeds) and microalgal (single celled plants) sources as an alternative to agri-fuels production from terrestrial land plants. Within the BioMara group, researchers at Institute of technology, Sligo focus on the production of biogas from algal biomass. Feasibility studies into the production of biodiesel from algae have highlighted the importance of a “biorefinery” approach to biofuel production (Sialve et al., 2009, Khan et al., 2009, Lardon et al., 2009). Mindful of this, the chief focus of this study is the co-digestion of algal sludge with other byproducts of the biorefinery.

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POSTER ID: ECC2

POSTER ORAL SESSION: Session 3, Thursday, April 7th, 11.30-12.40 (Boole 5)

Anaerobic digestion of marine macroalgae *Ascophyllum nodosum* and *Palmaria palmata*

Author(s): McKennedy J, MacArtain P, Gilleran C

Corresponding Author Institution: Dundalk Institute of Technology

Keywords: Anaerobic digestion, macroalgae, headspace, biogas

The use of marine biomass as a resource for energy production has garnered increasing interest in recent years. The benefits of non-competition with terrestrial resources are somewhat offset by the relative difficulty in obtaining the biomaterial. Justification of the exploitation of marine biomass as an energy source will depend on the conversion efficiency and environmental impact of the transformation to useable energy. In the investigation of the anaerobic digestion of macroalgae the process has been analysed by monitoring the composition and quantity of gas produced, the pH profile and the volatile fatty acid (VFA) profile of the substrate on a regular basis. Samples of macroalgae species *Palmaria palmata* and *Ascophyllum nodosum* were anaerobically digested. The BM100 test devised by the Energy Agency in the UK was used as the protocol. Both samples were anaerobically digested at 35degC with waste water treatment plant sludge used as an inoculum. Proximate analysis of the macroalgae was also conducted. The VFA profile of the samples was evaluated using an optimised method on a Varian GC 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. Biogas production cumulatively reached 0.17 l/ g VS with a maximum methane concentration of 62% for *Ascophyllum nodosum*. VFA concentrations are shown to change over the period of the experiment, with differing VFA profiles for the two macroalgae. Proximate analysis by NREL standards showed a higher calcium content in *Ascophyllum nodosum* than *Palmaria palmata*.

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Energy & Climate Change - Poster

POSTER ID: ECC3

POSTER ORAL SESSION: Session 3, Thursday, April 7th, 11.30-12.40 (Boole 5)

Simultaneous Energy Efficiency Improvement and NO_x emissions reductions in Industrial Boiler Systems

Author(s): Mooney E, Zhelev T, Semkov K

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Keywords: NO_x emissions reduction, energy efficiency, low grade waste heat recovery, GHG emission reduction

Reducing environmental emissions generated through industrial processes is important to both industry and the Irish Nation. Government commitment to minimising emissions is demonstrated through participation in the EU NEC Directive and the National Climate Change Strategy. This support is confirmed through projects such as the I2E2 (Innovation for Ireland's Energy Efficiency) Research Programme, which is co-funded by Enterprise Ireland and the IDA. One of the priority research themes of this programme is low grade waste heat recovery. The main investigation of this research focuses on emission reduction, primarily NO_x, with simultaneous energy efficiency improvement in natural gas fired boilers. This is to be achieved through the prehumidification and heating of combustion air, and consequent condensing of the water vapour from the flue gas, using a second generation contact economiser system. Two potential impacts are expected: i. Environmental: a reduction in NO_x emissions and a decrease in fuel related carbon and water vapour emissions. ii. Economic: supplementary waste heat recovery of 10 to 13% equivalent saving of fuel. Currently second generation contact economiser systems are successfully installed in large boiler systems. The focus of this research is the extension of application of the technology to widely used medium and small boilers, as well as to contribute to the design of a pilot plant and to conduct and assess pilot experiments. Prehumidification of combustion air up to 11% v can be applied to all types of burners achieving up to 3.6 times reduction in NO_x emissions. In currently installed systems a 12% reduction in fuel consumption has been achieved with a reduction in NO_x emissions from 133 to 37 ppm. Another part of the research is to optimise the required prehumidification level according to impact/cost term depending on the boiler design and recovered heat sink parameters. The expected result is the development of a cost and energy efficient device for small to medium boilers. The I2E2 project brings together researchers in several energy efficiency related areas creating the ground for fruitful cross-projects collaboration and synergistic impact in the area of efficiency improvement and environmental protection.

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Energy & Climate Change - Poster

POSTER ID: ECC4

POSTER ORAL SESSION: Session 3, Thursday, April 7th, 11.30-12.40 (Boole 5)

Single cell oil production using potato processing wastewater as a feedstock by *Aspergillus oryzae*

Author(s): Muniraj I, Xiao Liwen, Zhan Xinmin

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Keywords: Single cell Oil: Potato processing waste water: Biodiesel; Waste water treatment

Due to recent energy crises, environmental concerns and debatable issues on land use for energy crop production, much attention has been paid to usage of microbial lipids, also called single cell oils (SCOs), as a feedstock for bio diesel production. However, the cost of raw materials is a bottleneck for commercialization of this technology. In this study, potato processing waste water, a zero cost raw material, was used for microbial lipids production by oleaginous fungus *Aspergillus oryzae*. Potato is an important food in Irish cuisine; an enormous amount of waste water (which contains organic matter) is generated in the potato processing industry. Potato processing waste water was collected from a local vegetable processing plant and was stored at 4°C in the lab until use. Unsterilized waste water had initial concentrations of total suspended solids of 0.72 g/l, total carbohydrates of 3.58g/l, reducing sugars of 0.6 g/l. Concentrations of total chemical oxygen demand (COD), total nitrogen and total phosphorus were 7645 mg/l, 500 mg/l and 210 mg/l, respectively. The pH value of the waste water was 4-4.5. Five ml of 48h old mycelium suspensions of *Aspergillus oryzae* was inoculated aseptically in 250 ml conical flasks containing 50 ml of sterilized potato processing waste water medium. The pH value was adjusted to 6.5 and incubated at 30°C in an incubator shaker. An average of, 20.7 g/l of biomass was produced at 156 hours of cultivation, with the lipid content of 32.6% in biomass. Total nitrogen and phosphorus were completely removed by the fungus after 126 hours and 156 hours, respectively. 85% of total starch and 92% of COD were removed after 240 hours of cultivation. These results suggest that potato waste water can be utilized as an economic raw material for SCO production. In addition, this study also provides an effective approach to treat potato processing waste water. Acknowledgment: Iniya Kumar is supported by the College Postgraduate Scholarship provided by the College of Engineering and Informatics, NUI Galway.

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Energy & Climate Change - Poster

POSTER ID: ECC5

POSTER ORAL SESSION: Session 3, Thursday, April 7th, 11.30-12.40 (Boole 5)

Graduate student developed renewable energy research project proposals

Author(s): O'Dwyer A.

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Keywords: renewable energy priorities, Masters Students, research projects

This poster will report on renewable energy research priorities, as revealed through the development of research project proposals, by Level 9 (masters) students in separate Engineering and Energy Management programmes at Dublin Institute of Technology over the past three academic years. The author has had, over that time, the responsibility for delivery and co-ordination of a module in Research Methods, whose outcome is the development of an individual research project proposal by students. This proposal is subsequently researched and results reported in a dissertation. The pedagogical approach relies extensively on peer-learning, activated through the use of face-to-face workshops and the use of a collaborative website (wiki). The student driven approach is designed to facilitate learner-centered education, motivate independent learning, and to unlock previous work and learning experiences to the benefit of all learners. A major theme that emerges from the process is proposals in renewable energy research, accounting for 68 of the 187 such proposals developed over the past three years. Proposals in bio-energy e.g. wind, wave, tidal, solar, geothermal and hydro were developed.

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Energy & Climate Change - Poster

POSTER ID: ECC6

POSTER ORAL SESSION: Session 3, Thursday, April 7th, 11.30-12.40 (Boole 5)

Isolation and characterization of novel laminarin degrading enzymes for use in the macroalgae to bioethanol industry

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Keywords: Macroalgae, Laminarin, Biodegradation, Enzyme, Bioethanol

Climate change, caused by the release of CO₂ from burning fossil fuels, has led to an increased desire for alternative environmentally friendly energy sources. Macro and micro algae are currently being investigated for their potential as carbon neutral biofuels. This work reports on a strategy to develop a cost effective, environmentally benign strategy to degrade macroalgae, releasing easily fermentable sugars. In this study, the bacterial biodegradation of beachcast seaweed (*Laminaria spp.*) was investigated. Experimental scale composting trials investigating the biodegradation of collected beachcast seaweed (*Laminaria spp.*) were conducted above the high water mark on Rush Head, North County Dublin, from mid May to mid October 2011. The *Laminaria spp.* exhibited good decomposition over a short period of time with thalli being unrecognisable after a period of less than a month. Samples of the decomposing seaweed were returned to the laboratory where the inhabiting microbial flora was cultivated. Bacteria with a high degradative ability were isolated and evaluated in submerged fermentation for the production of novel carbohydrases. The extracellular carbohydrate degrading enzyme activities of the isolated marine bacteria were assessed on various polysaccharides and the hydrolytic potential of these enzymes for the efficient release of fermentable sugars and the degradation of macroalgae is illustrated.

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POSTER ID: ECC7

Iodine emission and particle formation from *Laminaria Digitata*

Author(s): Ashu-Ayem E, Monahan C, Nitschke U, Darby S, Stengel D, O'Dowd C, Venables D

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Keywords: Iodine, seaweed, IBBCEAS

The study of iodine emission and particle formation from *Laminaria Digitata* has been carried out in an atmosphere simulation chamber. Samples were stored in an aquarium and used within 7 days of collection. Individual *Laminaria* plants were placed in a container in the chamber and initially covered with sea water. During experiments, the seawater was removed from the container, gradually exposing the sample to chamber air containing ozone. Incoherent Broadband Cavity Enhanced Absorption Spectroscopy (IBBCEAS) was used to measure I₂, IO and OIO during each experiment. Particle formation was measured using a nano-SMPS. Large particle bursts were seen immediately after exposure of *Laminaria Digitata* and this was true even for some experiments where ozone was absent.

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POSTER ID: ECC8

Development of a novel solid biofuel - using solid pig manure

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Keywords: Pig manure, Biofuel, Renewable energy

The expansion of biofuel production has increased over the past couple of decades, due to the near depletion of fossil fuels. Substances which were once considered wastes are now being converted into biofuels (e.g. combustion of MSW producing electricity). One such waste in abundant supply is pig manure. The preferred method of disposing manure is land-spreading. The Nitrates directive (SI 610 2010) and the gradual end to the transitional arrangements for the application of phosphorus from pig manure means that increased areas of land are required for land-spreading therefore generating excess manure. Manure has been used to create heat and energy by anaerobic digestion. However, the use of manure as a solid fuel is in its infancy. The solid fraction from separated raw pig manure (SRM) was composted neat and with various biomass addendums. Composting should result in reduction of moisture and promote mixing of the two components. Effects of this composting process on the chemical composition of the samples will determine the suitability as a biofuel. Moisture, ash, gross calorific value (GCV), net calorific value and elemental analysis were determined. During composting the ratio of inorganic/organic species altered, leading to an increase in ash and a subsequent decrease in GCV. Chemical analysis showed that a SRM and sawdust sample with 6-8 hours composting time had the most suitable results. However, an allied study found that 3-7 days composting was required for removal of microbiological pathogens. GCV was determined to have a similar range to other existing biofuels. Initial elemental studies have shown that the samples contained high amounts of metals (K, Na, P, Fe, Cu, Cr, Cd). Analysis of Al, Ca, Mg, Mn and Zn is being conducted. The main problem encountered was a high ash content. Analysis of samples varying in C/N ratios is underway, potentially reducing ash content.

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Biodiversity & Ecosystems - Poster

POSTER ID: BE1

POSTER ORAL SESSION: Session 2, Thursday, April 7th, 11.30-12.40 (Boole 2)

Halting biodiversity loss: the potential of High Nature Value (HNV) farmland in North West Ireland.

Author(s): Boyle P., Moran J.

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Keywords: High Nature Value farmland, remote sensing, birds, butterflies

High Nature Value (HNV) farmland areas in Europe are defined as areas where agriculture is a major, typically dominant, land use and where agricultural practices support high species diversity, habitat diversity or species of European conservation concern¹. The concept of HNV Farming arose from the recognition of the need to protect biodiversity associated with low-intensity farming². European Union member states have committed to identifying, maintaining and monitoring changes in HNV farmland. The North-West of Ireland has potentially high proportions of HNV farmland but as yet very little useful information has been gathered on its extent or quality. With limited information comes limited incentives for farmers to maintain the management methods which have shaped areas of high biodiversity. Abandonment and intensification of land use leads to loss of biodiversity. Therefore identification and monitoring of HNV areas and the development of better understanding of associated farming practices is essential to preservation of biodiversity and the services it provides to society. This project aims to test existing methods for identification and quantification of HNV farmland areas e.g. use of remote sensing, bird indicators and butterfly indicators, to develop indicators for monitoring HNV areas using indicators such as birds, butterflies, invertebrates and flora species and to determine links between biodiversity and land use management practices within the North West of Ireland. The target area for the project includes counties Donegal, Sligo, Roscommon, Leitrim and Mayo. Currently in its start up phase, the project will involve both quantitative and qualitative methods. A combination of remote sensing and field based studies will be used to develop new indicators for the identification of extent and quality of HNV farmland. It is hoped that this project will pave the way for a number of initiatives in the region.

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Biodiversity & Ecosystems - Poster

POSTER ID: BE2

POSTER ORAL SESSION: Session 2, Thursday, April 7th, 11.30-12.40 (Boole 2)

People, Environmental Policies and Tropical Forests in Southern Yunnan, southwest China: A Forest History of Xishuangbanna, 1900 -2010.

Author(s): Sun J.

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Keywords: Tropical rainforests, forest history, land-use change, biodiversity, climate change, ethnic minorities; agroforestry, environmental policies, southern Yunnan, China.

Xishuangbanna of southern Yunnan is biogeographically situated at a transitional region from tropical Southeast Asia to subtropical East Asia. Although far from the equator, it has a rich tropical flora and typical tropical rainforests. Xishuangbanna is a globally significant biodiversity hotspot and home to over 30 ethnic minorities. This research firstly examines the primary tropical forest vegetation of Xishuangbanna and its significance for biodiversity, hydrological cycles, regional climate regulation, soil erosion control, local livelihood as well as ethnic culture. Due to agricultural exploitation in the 20th century, especially the last 40 years, primary tropical forests have been greatly transformed and now they only exist in the Nature Reserve. The physical change of tropical forests, including area and species composition, since 1900 is described based on ecological, digital spatial techniques as well as archival documents. Traditional agroforestry practices conducted by ethnic minorities in both lowland and highland communities of Xishuangbanna have been reviewed to demonstrate that historically indigenous knowledge places a high value on protecting forests, landscape, water catchment and biodiversity conservation. New agroforestry patterns, dominated by rubber trees, tea and other economic plants, have been widely introduced by the Chinese government since the 1950s and thus are in extension in villages and state farms in Xishuangbanna. The driving forces of forest degradation and land-use transition are systemically analyzed, including political, economic and socio-cultural factors. Land-use change in Xishuangbanna has brought massive economic benefits to the people living here, however, at the expense of its large area of tropical rainforests. Therefore, an evaluation of forest deterioration and current agroforestry systems in Xishuangbanna was carried out. The issues of biodiversity loss, climate change in the Great Mekong Sub-region are specifically highlighted. Finally the potential for establishing a sustainable forest management regime in Xishuangbanna and its neighboring regions is discussed.

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Biodiversity & Ecosystems - Poster

POSTER ID: BE3

POSTER ORAL SESSION: Session 2, Thursday, April 7th, 11.30-12.40 (Boole 2)

National Survey of Upland Habitats: niche communities in the uplands

Author(s): Perrin P.M., Roche JR

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Keywords: uplands, vegetation mapping, conservation assessment, Annex I, heath, blanket bog

The uplands form our largest expanses of semi-natural habitats. Upland habitats include blanket bog, heath, flushes, grassland and communities associated with exposed rock and scree. Almost 19% of Ireland can be considered to support upland habitats. The importance of these areas to plant and animal conservation is unquestionable, with numerous habitat types listed under Annex I of the EU Habitats Directive and many rare and threatened bird and animal species being recorded in these areas. Furthermore, over 40% of the total terrestrial area designated as candidate Special Area of Conservation (cSAC) in Ireland is over 150 m in altitude. However, drainage and reclamation, agricultural improvement, extensive afforestation, wind farm development and high sheep stocking densities have resulted in widespread degradation of upland habitats, and the fragile nature of their soils makes upland habitats more likely to suffer irreversible damage. The National Survey of Upland Habitats was commissioned in 2010 by the National Parks and Wildlife Service after a pilot survey in 2009, with the aim of surveying a range of upland sites across Ireland. Surveys consist of detailed mapping of the mosaics of vegetation communities, the recording of relevés, and baseline assessments of the conservation status of key Annex I upland habitats. These assessments will help fulfil Ireland's national level obligations under the Habitats Directive. Relevé data collected by the survey has been collated with existing data for relevant habitats to produce a preliminary classification of upland habitats. To date, six sites comprising 374.3 km² have been surveyed. Whilst the vast majority of the upland landscape is a matrix of blanket bog, heath and grassland, it also contains niches which support smaller habitat features such as springs, flushes, soakways, rocky clefts, tall herb ledge vegetation, alpine grasslands and North Atlantic hepatic mats that have previously received little study in Ireland.

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Biodiversity & Ecosystems - Poster

POSTER ID: BE4

POSTER ORAL SESSION: Session 2, Thursday, April 7th, 11.30-12.40 (Boole 2)

Wind Turbines and Water Birds: Displacement or Tolerance?

Author(s): Richard Nairn, Ciara Hamilton and Ian Herbert

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Keywords:

A study is being undertaken in Ireland to determine the nearest distances from operating wind turbines that non-breeding water birds can feed and roost in various coastal habitats. Three study areas have been chosen to represent a range of habitats including rocky shore, shingle beach, sand flats, muddy shore, coastal marshland and agricultural land. In each case a single turbine has been selected for visual monitoring through the winter period. Concentric circles of radius 100m to 500m, around the turbine bases, have been measured and marked out on the ground with wooden stakes. This allows the observers, concealed near each turbine, to monitor and plot the position of all water birds within 500m to an accuracy of + or - 20m. Observation periods cover 4 hours in daylight and, on tidal sites, include low, mid- and high tide levels. Preliminary results from the period January to March 2011 have recorded up to XX species of water birds within the 500m zone (including ZZ species listed in Annex I of the EU Birds Directive). Tolerance distances are within 200m for all species and as close as 50m for some species. The primary factor limiting the distribution of water birds is habitat availability. A further phase of the study will involve the monitoring of control areas, without turbines, in each study site.

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POSTER ID: BE5

POSTER ORAL SESSION: Session 2, Thursday, April 7th, 11.30-12.40 (Boole 2)

The Effects of Wavelength on Bioactive Enhancement in Plants

Author(s): Skerritt T, Stutte G. W., Walsh D. J., McKeon-Bennett M. M. P.

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Keywords: antioxidant, phytochemical, *Lactuca sativa* cv., growth chamber, enclosed ecosystems, HPLC, ORAC

The current research was carried out to investigate the effects of blue 440 nm light on the phytochemical composition of *Lactuca sativa* cv. Outredgeous. To test the hypothesis that the introduction of blue 440 nm light may be utilized to optimize the production of specific antioxidant phytochemicals in this lettuce cultivar lettuce plants were grown in environmental growth chambers and subject to four different light treatments supplied via light emitting diode (LED) arrays. All light treatments subjected plants to a total of $300 \text{ mol m}^{-2} \text{ s}^{-1}$ of photosynthetically active radiation with an 18 h-light/ 6 h-dark photoperiod. Environmental conditions were maintained at $1200 \mu\text{mol-1 CO}_2$, 23°C temperature and 65% relative humidity for the duration of the experiment. Light treatments were as follows: (i) red 640 nm ($270 \mu\text{mol m}^{-2} \text{ s}^{-1}$) + blue 440 nm ($30 \mu\text{mol m}^{-2} \text{ s}^{-1}$) for 0-21 days after planting (DAP); (ii) red 640 nm ($270 \mu\text{mol m}^{-2} \text{ s}^{-1}$) + blue 440 nm ($30 \mu\text{mol m}^{-2} \text{ s}^{-1}$) from 0-14 DAP, with blue light removed for the final week; (iii) red 640 nm light ($300 \mu\text{mol m}^{-2} \text{ s}^{-1}$) from 0-14 DAP, with blue light added for the final week; and (iv) red 640 nm light ($300 \mu\text{mol m}^{-2} \text{ s}^{-1}$) from 0-21 DAP. Treatments (i) and (iv) served as control treatments for comparison of the effects of removal/ addition of blue 440 nm light from treatments (ii) and (iii), respectively. Lettuce plant extracts were assayed spectrophotometrically for anthocyanin content and the oxygen radical absorbance capacity (ORAC) assay was carried out to assess antioxidant capacity of samples. A high performance liquid chromatography (HPLC) method was also developed with the aim to characterise phytochemical constituents of the lettuce samples.

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Biodiversity & Ecosystems - Poster

POSTER ID: BE6

POSTER ORAL SESSION: Session 2, Thursday, April 7th, 11.30-12.40 (Boole 2)

Developing Integrated Biodiversity Impact Assessment for the Republic of Ireland

Author(s): Hochstrasser T, Gonzalez A, Fry J, Scott P, Carvill P, Grist B, Shahumyan H

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Keywords: EIA, SEA, AA, legal requirements, planning, public participation

Currently, the multitude of administrative processes and legal requirements (e.g. EU Habitats, Water Framework, EIA and SEA Directives) for biodiversity impact assessment is placing a large monetary and administrative burden on the Irish government. An integration of legislative requirements, streamlining of administrative processes and a more efficient management of information regarding biodiversity impact assessment is therefore required. An Integrated Biodiversity Impact Assessment methodology should address these needs within an effective decision-making methodology. Development of this methodology needs to take into consideration current practice and specific Irish circumstances regarding biodiversity information. For this purpose an in-depth review of current practices is being linked with a national consultation process in a one year EPA-STRIVE research project (<http://www.ucd.ie/ibia>). This poster presents the methodological approach (including reviews of Appropriate Assessments (AA), legal requirements, and data limitations) and outlines the integral consultation process.

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POSTER ID: BE7

Will ecosystems cope with climatic change and pollution? Unravelling the effects of multiple contaminants.

Author(s): Brooks P.R., Browne M.A., Benedetti-Cecchi L., Crowe T.P.

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Keywords: Ecosystems, Climatic change, Pollution, Impacts, Biodiversity, Functioning

Humans exert many pressures on coastal ecosystems that alter their biodiversity and ability to function. Natural habitats are replaced with infrastructure and degraded through addition of chemicals used to manage pests in cities, farmlands and in aquaculture. Climatic change is expected to increase rainfall and storminess, which is likely to increase the number and concentration of pollutants washed into coastal ecosystems and to modify temporal patterns of influx. Metals and organophosphates are routinely used as biocides and are important classes of pollutants found in marine habitats. A novel system has been developed for delivering specified concentrations of these pollutants at controlled intervals to mimic scenarios of run-off anticipated through climatic change. Field experiments with epifaunal assemblages are examining whether climatic change will alter the impacts of pollutants on marine ecosystems. We aim to test whether multiple stressors (copper and chlorpyrifos) act independently or interactively and whether their effects on biodiversity and its functions vary depending on their respective concentrations and the timing of their arrival. Through this, our work offers an example of how ecology can assist the sustainable management of coastal ecosystems in a changing world.

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POSTER ID: BE8

Diptera diversity associated with debris resulting from thinning and clearfell activity in commercial Sitka spruce plantations in Ireland paying particular attention to the Fungus Gnats: Mycetophilidae, Keroplatidae, Bolitophilidae and Diadocidiidae (Diptera: Sciaroidea)

Author(s): Deady R.J., Chandler P.J., Kelly T.C., Fuller L., Irwin S., O'Halloran J.

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Keywords: Mycetophilidae, Saproxylic, deadwood, Sciaroidea

Abstract Destruction of global ecosystem functioning, biodiversity and ecosystem services is occurring at an alarming rate. This damage is most evident in highly speciose ecosystems that are typically the focus of conservation concern. Forests, in particular, house a suite of species due to the heterogeneity of their composition in terms of, habitat, microclimates and resource availability. In managed forests, habitat heterogeneity is often reduced due to successional felling. A current trend of deadwood extraction for use as biofuel is further pressuring these ecosystems, and specifically at risk are saproxylic arthropods due to their reliance on it. This study aimed to examine the dipterous fauna utilizing felling and thinning debris in commercial Sitka spruce plantations in Ireland. This habitat is particularly important in preserving species that may be lost due to forestry management operations. Using Standard Emergence Traps (S.E.Ts), we compared woody debris resulting from clearfell processes to debris from systematic thinning of stands. We examined the abundance and species richness of Mycetophilidae, Keroplatidae, Bolitophilidae and Diadocidiidae (Diptera: Sciaroidea) to test the null hypothesis that there is no difference between clearfell and thinning debris. We also investigated whether the fungus gnat assemblages in the debris consisted mainly of saproxylic (decaying-wood) species. Preliminary results suggest that there is a sustained fungus gnat population in thinning debris, probably feeding on the fungal mycelia breaking down the woody debris. Approximately 80 species have been catalogued with potentially 5 new species to Ireland.

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POSTER ID: BE9

Can roads be used to enhance biodiversity of forests?

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Keywords: Biodiversity, invertebrate, forestry

Over the last century forest cover in Ireland has increased from 1% to 10%, primarily through the establishment of non-native plantation forests. The effect of these forests on biodiversity is important, particularly in the context of the global interest in biodiversity and Ireland's participation in the Convention on Biological Diversity. In particular, the invertebrate biodiversity of these ecosystems is of interest, as invertebrates play important functional roles in forest ecosystems as herbivores, decomposers, predators and prey. Invertebrates are a much understudied group in Irish forests, and gaps in knowledge are still being filled. Spiders and ground beetles are two invertebrate taxa that are widely regarded as useful bioindicators in forests, due to their responses to a variety of environmental factors. Open space within forests is important for biodiversity, and the aim of this study was to investigate the effect of forest road width on forest invertebrate biodiversity, at sites that had originally been investigated in 2005. We aimed to assess the effect of forest road-width on invertebrate biodiversity as the trees mature and canopy cover increases over the forest road over time. We tested the hypothesis that a wider road-width increases species richness and abundance using a "standard" 15 metre road-width and a "wide" 30 metre road-width. Eight manipulation sites were established in second rotation plantation forests in the winter of 2003/2004. Spiders and beetles, two well-known and ubiquitous invertebrate bioindicator taxa, were sampled by pitfall trapping and identified to species level in 2004/2005 and again in 2010.

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POSTER ID: BE10

**Modelling habitat suitability in *Nephrops Norvegicus*
using INFOMAR Products**

Author(s): Johnson MP, Guinan J, Marsh I, Power AM

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Keywords: ENFA, neural net, classification, backscatter

The inaccessibility of marine habitats means that there will always be a requirement for surrogate information on the distribution of marine organisms. Multibeam sonar signals potentially contain large amounts of information on the topography and composition of benthic habitats. This in turn may be valuable in mapping areas of preferred habitat for benthic species, such as the Dublin Bay prawn, *Nephrops norvegicus*. This project used topographic information to generate habitat suitability maps based on the distribution of *Nephrops* as estimated from underwater tows. Modelled habitat suitability was moderately successful in predicting *Nephrops* density ($r^2 = 32\%$). A neural net classification of multibeam backscatter and habitat suitability was used to classify the habitat. The optimum solution was six habitat classes, with the best habitat occurring close to the foot of an area of steeper slope.

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POSTER ID: BE11

The Controlled Environment Laboratory for Life Sciences Research Group

Author(s): McKeon-Bennett M. M. P.

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Keywords: CELLS Research Group

This research group aims to combine expertise from the existing Shannon Applied Biotechnology Centre with Life Science research currently being undertaken at the NASA Space Life Science Laboratory, Kennedy Space Centre, Florida. This link stems from training received by the principal investigator Michelle McKeon-Bennett, in Kennedy Space Centre of 12 months duration, initiated in Sept 2003. The training included all aspects of hydroponics (plant growth without soil), waste management and bioremediation systems for the space industry. This included the use of growth chamber technologies for the manipulation of plant growth to improve such plant characteristics as crop yield, plant height (dwarfism and gigantism, to produce a plant suitable to particular environments), plant nutrition, aesthetic appearance and biomass value. Since 2003, the PI has continued to expand her research group in hydroponics by sending 2 to 3 graduates on a graduate training program every year to Kennedy Space Centre. Their training is for a 6 to 12 month period and forms the basis of the graduate's preparation for postgraduate studies in this field. All the students are trained in hydroponics and the use of growth chambers for phyto-biological enhancement. There are currently six postgraduate students carrying out their research in the CELLS Research Group, LIT where four growth chambers, identical to those in KSC, are used. Photo-biological enhancement of plants provides a cost effective and "non-genetic manipulation" method of changing the composition of plants to optimise the nutraceutical content of the plants. Through manipulation of the growth environment of a plant species it is possible to increase the abundance of a biologically available compound such as an antioxidant for later extraction using methods such as super critical fluid extraction (SCFE). Environmental growth chambers are used to vary CO₂, temperature, humidity, photoperiodism, and nutrient supply to change a plants growth for targeted outcomes. Initially, this work was carried out for the space industry to provide astronauts with an enriched food product with high biological availability. Dwarfing of the plants was also studied to reduce the physical space required and weight of the plant for takeoff purposes. Everyday applications of this technology include its use as a means of producing high yield crops for the food industry and functional food inclusion.

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Marine Coastal Research - Poster

POSTER ID: MCR1

POSTER ORAL SESSION: Session 7, Thursday, April 7th, 14.00 – 15.10 (Boole 5)

Sustain - Assessing and Supporting Sustainability in Europe's Coastal Areas

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Keywords: Indicators, coastal planning, sustainable development

The increasing intensity of human activities along our coastline (e.g. the development of ports and harbours, coastal protection, land reclamation, tourism and sand/gravel extraction) have the potential to impact on coastal communities and natural habitats. The EC has adopted a renewed EU Sustainable Development Strategy which aims to bring about a high level of environmental protection, social equity and cohesion, economic prosperity and active promotion of sustainable development. There are multiple inter-linkages between the key challenges: for example, between the use of offshore environments for renewable energy, and the consequences of adapting to a changing climate. The key objective of the SUSTAIN project is to develop a fully implementable indicator-based policy tool, applicable for all 22 coastal states of the EU, which will ensure that integrated management will support sustainable development. This entails the identification of a set of criteria which are readily measurable and which cover both the threats of an unsustainable development and the opportunities provided by a sustainable future, which is a challenge facing all coastal authorities and communities throughout Europe. The SUSTAIN project partnership comprises 12 partners (including authorities [regional and local], universities and NGOs); and the project is pan-European in scope with partners representing the North Atlantic and South Atlantic seabords, the Mediterranean, Baltic and Celtic Seas.

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POSTER ID: MCR2

POSTER ORAL SESSION: Session 7, Thursday, April 7th, 14.00 – 15.10 (Boole 5)

Preliminary evaluation of the ecological and ecosystem-level impacts of intertidal SGD by SIA

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Keywords: Submarine groundwater discharge, stable isotope analysis, intertidal, biodiversity, ecosystem functioning, pollution

Submarine groundwater discharge (SGD) provides a pathway for land derived nutrients/pollution into the marine environment, usually at the intertidal zone. Difficulties in quantifying the mass flux associated with SGD have resulted in a lack of knowledge regarding the potential environmental impacts of this loading source, particularly as a driver of ecological and functional ecosystem changes. Hence, studies on the effects of SGD at ecosystem level are crucial to elucidate its role in altering the functioning of coastal ecosystems. The ecological alterations associated with SGD are dependent on the source and type of its constituent contaminants, and stable isotope analysis (SIA) provides a valuable tool for identifying these sources, tracing them into impacted food webs, and differentiating between impacted and un-impacted food webs. To determine if the presence/absence of SGD results in significant differences in community ecology and nutrient transfer pathways through the local food web, a preliminary analysis of the intertidal section of a lagoon containing both nutrient-contaminated-seepage (+SGD) and non-seepage (-SGD) sites, was carried out at the Ria Formosa, South Portugal. Apart from an intensive field survey and sampling campaign to characterise the local intertidal community at +SGD and -SGD sites, SIA of $\delta^{15}\text{N}$ and $\delta^{13}\text{C}$ in organisms representing the local food web was conducted in order to 1) identify the source of SGD-contained N, and 2) evaluate its transfer through the selected foodweb. Results indicate that +SGD sites generally supported a greater species diversity, and larger biomass of primary producers and subsequent trophic levels than -SGD sites. The preliminary results of SIA suggest that fertiliser may provide the main source of SGD-contained nutrients. This altered species richness and biomass has implications in terms of biodiversity, as well as the potential to impact the types and numbers of ecosystem goods and services provided by this system.

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POSTER ID: MCR3

Resource mapping for marine functional foods

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Keywords: Environmental Management

There is currently much interest in adding value to the seafood and seaweed sectors by refinements to processing that return products of commercial value. Examples include the production of omega-3 fatty acids for food supplements or antioxidants for stabilizing product quality. The raw materials for processing are not, however, evenly distributed around Ireland's coastline. The volume and composition of catch varies, with Killibegs representing the largest potential source of fisheries material. Aquaculture licences are concentrated in the south and west, with nearly 60% of licences in the counties of Donegal, Cork and Galway. Further restrictions on potential activity are the locations of designated sites for nature conservation (particularly Special Areas of Conservation, SACs). Expansions of activity in such area is likely to be limited due to the requirement for appropriate assessment of potential impacts. The importance of the spatial distribution of potential resources has been captured using a GIS database as part of the Nutramara project. Summary plots show the relative composition of landings at different ports and can be used to pick suitable sites for developing regional processing clusters.

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POSTER ID: MCR4

Analysis of metals in seawater using a portable voltammetric system

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Keywords: Seawater, speciation, trace metals, voltammetry

As a result of the OSPAR convention (1998) and The Water Framework Directive of the European Parliament (2000/60/EC), the concentrations of metals and their inputs into seawater must be monitored by each country of the European Union. While some metals act as micronutrients for marine species, most metals are toxic at high concentrations. Metal speciation is also crucial: both bioavailability and toxicity are highly dependent on speciation. The use of anodic and cathodic stripping voltammetry can permit the determination of both the total concentration of a given metal and the concentration of uncomplexed metals. This project is using existing voltammetric methods to develop a portable and semi-autonomous voltammetry system capable of making measurements of multiple metals simultaneously in marine waters over a tidal cycle using ASV, and of carrying out speciation analysis using CSV. Laboratory tests to optimize mercury drop size and deposition time, and diminish multiple metal and salinity influences were conducted using natural seawater spiked with Cd, Cu, Pb and/or Zn. Results from a deployment of the instrument in semi-automatic mode at an aquaculture research station in the west of Ireland (MRI Carna) are described. The suitability of the use of a mercury drop electrode versus a gold wire working electrode is discussed. This work has been funded by Science Foundation Ireland (SFI).

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POSTER ID: MCR5

The effect of algal-exuded organic ligands on metal bioavailability in seawater

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Keywords: Algae, bioavailability, electrochemsitry, organic ligands, trace metals, voltammetry

Aquatic organisms produce organic ligands via the active release of photosynthates, degradation of senescent cells, rupture of cells due to grazing, and cell lysis by pathogens. The release of organic ligands has important implications for metal toxicity in seawater, as such ligands are able to bind metals, altering their toxicity. While it is widely accepted that these ligands binds free metal ions, reducing their availability, some studies have concluded that they increase metal bioavailability. It is postulated that organic ligands bind the algal cell wall resulting in increased membrane permeability of metal complexes and hydrophilic substances. The same binding also increases the negative charge at the algal surface. This may result in the formation of a ternary complex between dissolved organic ligand, metal, and algae. Hence, it is at present unknown to what extent algal exudates may affect metal bioavailability. This work describes species-specific ligand profiles, which were observed for five macroalgae (*Laminaria hyperborea*, *Fucus spiralis*, *Fucus vesiculosus*, *Ascophyllum nodosum*, and *Pelvetia canaliculata*) as a function of exposure to multiple metals (Cd, Cu, Pb, Zn) and a range of environmental conditions. Phenolic and CDOM exudation were estimated by measurement of the absorbance of water at 274 nm and 440 nm, respectively. The determination of total dissolved metal, complexing ligands, glutathione and cysteine concentrations of the culture solutions by cathodic stripping voltammetry (CSV) are discussed. This work has been funded by Science Foundation Ireland (SFI) and the Irish Research Council for Science, Engineering and Technology (IRCSET).

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POSTER ID: EH1

POSTER ORAL SESSION: Session 8, Thursday, April 7th, 14.00 – 15.10 (Boole 6)

An investigation of the role played by cars in harbouring dust mite populations with particular reference to child car seats

Author(s): Clarke D, Byrne M, Gormally M

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Keywords Dust mites, allergens, asthma, car seats

2% of the world's population is sensitised to dust mite allergens derived mainly from mite fragments and faecal pellets. When mite fragments/faecal pellets become airborne, their associated allergens can easily be inhaled, contributing to diseases such as dermatitis, eczema and asthma. While this situation is aggravated by people's increased tendency to remain indoors, little quantitative research has been conducted on the role played by cars in harbouring dust mite populations. Although children in the western world spend increasing amounts of time in cars (approx. 225 hours per person per year from 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. In this innovative project, current understanding of mite-promoting conditions in cars with particular reference to child car seats as a possible habitat for dust mites will be determined by the following objectives: (i) Development of a mite sampling design strategy (ii) mounting, counting and subsequent identification of mites and recording of environmental variables (iii) Questionnaire design, piloting, modifications, final questionnaire (iv) Statistical analysis of mite populations and questionnaire data, followed by interpretation of the results (v) Development of mite mitigation strategies. 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.

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POSTER ID: EH2

POSTER ORAL SESSION: Session 8, Thursday, April 7th, 14.00 – 15.10 (Boole 6)

Cytotoxicity monitoring of cells using a multi-parameter fluidic platform

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Keywords: toxicity, cells monitoring, impedance, biosensors

This research presents the development of an integrated sensor platform to monitor cell behaviour for screening of toxic chemicals. This project involves the use of bioimpedance measurements applied to cell cultures, as concentration, growth and alterations of the physiological state of cells during cultivation can be detected as impedance change. When cells are placed on the electrode they block the current flow in a passive way and the bioimpedance increases. This system will include a multi-parameter, continuous on-line platform, integrating both optical and electronic devices for examining different toxic chemicals. The novelty lies in linking several modes of detection in one biosensor platform and coupling the developed technology with microfluidics. The two main components of the integrated platform will be: biochip sensor enabling both optical and electrical measurement and a microfluidic platform with channels for delivering of incubation media, analyte and wash solutions. The cell based biochip will consist of finger electrodes composed of indium tin oxide (ITO). ITO will be used as an impedance sensor that allows real time non-invasive *in-vitro* analysis of the physiological state of biological cells due to its conductive, biocompatible and transparent characteristics. Parallel optical analysis for real-time video monitoring will be used to complement the impedance measurement. It would provide useful information on the cell behaviour, such as morphology and distribution. This brings added value to the integrated system as it enables another mode of detection to be used. This technology will cover a wide range of applications, such as monitoring cytotoxicity of drugs, drug efficacy, nanomaterials and tumour invasion. This integrated platform will be applicable to clinical, biopharmaceutical and environmental monitoring; moreover it can be an alternate to animal testing, which is costly, time consuming and socially controversial.

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POSTER ID: EH3

POSTER ORAL SESSION: Session 8, Thursday, April 7th, 14.00 – 15.10 (Boole 6)

Public Awareness Regarding the Safe Disposal of Unwanted Medicines in Galway City

Author(s): Cormican S., Furey M., Vellinga A., Cormican M.

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Keywords: Pharmaceutical, safe disposal, environment, questionnaire, water contamination

Disposal of unused pharmaceuticals by flushing down sinks/toilets or disposal as domestic refuse may result in environmental contamination. Acute toxic effects are unlikely, but the potential health impacts of chronic exposure to low levels of multiple pharmaceutical agents are difficult to assess. Studies in the US, UK and New Zealand indicate that there is limited public awareness of the need for correct and safe disposal by returning unwanted drugs to a pharmacy or to other collection points. We have surveyed members of the public in Galway City. Ethical approval was received from the NUI Galway Research Ethics Committee. People in public areas of Galway City were surveyed. The questionnaire was completed by 207 people. Eighty three percent (83%) reported having medicines at home. Although 32% reported returning medicines to a pharmacy/GP on one or more occasions, most people reported placing unwanted medicines into household waste (51%), poured medicines down a sink (21%), burned medicines (9%), or flushed medicines down a toilet (8%). More people reported putting syrups directly into water systems (25%) when compared with pills (7%). Respondents who reported that they had been given advice by a health-care professional on how to dispose of leftover medicines were more likely to dispose of unwanted medicines, and, were much more likely to dispose of medicines correctly (59%; $p=0.001$). The likelihood of safe disposal increased with frequency of visits to a pharmacy $p=0.003$, and with the quantity of medicines prescribed in the previous year ($p=0.022$). There is little public awareness of the need to avoid disposing of unwanted medicines into the environment. However, obtaining the appropriate advice from health-care professionals is associated with greater likelihood of safe disposal. Measures to promote awareness of and access to safe disposal of medicines can be expected to reduce this source of environmental contamination with pharmaceuticals.

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POSTER ID: EH4

POSTER ORAL SESSION: Session 8, Thursday, April 7th, 14.00-15.10 (Boole 6)

Extraction & Characterisation of Polyphenols from various Sphagnum Moss species with application to the food & health industries

Author(s): Connole L, McKeon-Bennett M.M.P., Stutte G.W

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Keywords: Bioactives, Polyphenols, Sphagnum Moss, SCFE, Fenton, ORAC, RAD

Sphagnum moss is known historically for its role in the preservation of foods, as well as animals and even man. Bogs were commonly used for storing parcels of meat, milk and cheese which were kept well preserved by the moss. The moss provided cool, dark storage that was also resistant to the action of microbes and fungi. Famously, the Lindow man is a prime example of this. The remains of this man were discovered in 1984 in Cheshire, England buried in the bog amongst the moss. The well preserved remains are thought to date back to around the 1st Century A.D. Today, Sphagnum moss is used mostly as a planting material, though its value measures far beyond this. Numerous studies have shown that Sphagnum moss has high polyphenol antioxidant content. Polyphenols are important to the food industry due to their strong antioxidant ability. As general consumers become more health aware, natural foods and health promoters are high on the agenda for food manufacturers. Therefore, new sources of natural antioxidants and antimicrobials from abundant, cheap raw materials are of primary concern to manufacturers to keep ahead of the competition. In addition to this, Sphagnum has strong resistance to the actions of microorganisms and a strong preservative ability. It is thought that these attributes are linked to the polyphenolic network found in the moss. A comparison of solvent extraction versus Super Critical Fluid Extraction (SCFE) for polyphenols in sphagnum is currently under investigation and will be followed by characterization using LC/MS and GC-MS. Antioxidant activity will be assessed by use of the Fenton test & ORAC assay, while antimicrobial activity will be determined by a modified Radial Agar Diffusion (RAD) test.

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POSTER ID: EH5

POSTER ORAL SESSION: Session 8, Thursday, April 7th, 14.00-15.10 (Boole 6)

Applications of Pyrrolizidine Alkaloids (PAs) from *Senecio Jacobaea* (Ragwort) to the food & health Industries

Author(s): O'Keefe C, McKeon-Bennett M. M. P., Stutte G. W.

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Keywords: Pyrrolizidine Alkaloids; *Senecio Jacobaea*, Ragwort, Bioactive, Growth Chamber, Enclosed Ecosystems, SCFE, LCMS

Ragwort, otherwise known as *Senecio jacobaea*, has long been identified as a threat to Irish horse breeders and farmers due to the seriously toxic effects suffered by these animals when it is ingested. Legislation is in place enforcing the removal of all traces of ragwort from fields where livestock are grazing. However from a remedial point of view; folk remedies suggest the use of Ragwort as an external remedy for ulcers and wounds as well as a rinse for throat infections indicating an antimicrobial aspect to some compound found in the plant. The question is, are the toxicity and remedial properties of this plant due to a single one compound or family of compounds? The toxicity of ragwort is caused by compounds known as Pyrrolizidine Alkaloids. Pyrrolizidine Alkaloids (PA's) are complex molecules named for their inclusion of a pair of linked pyrrole rings. Pyrroles are incorporated into the chlorophyll molecule within plants however the role of PAs in plant metabolism is still unknown. PAs are of special interest as several have been shown to have toxic effects on humans and most agrarian animals causing disease of the Liver. No links have been made to their remedial effects. In this study, the qualitative and quantitative analysis of pyrrolizidine alkaloids is being investigated with a view to both wild Irish ragwort and hydroponically grown Ragwort. The optimum hydroponic growing conditions have been established to date; these include temperature, light and humidity. A comparison of extraction methods is presently underway for the pyrrolizidine alkaloids; these methods include a solvent extraction and supercritical fluid extraction. Analysis is carried out on an Agilent QTOF LC-MS system. A literature review has been conducted on possible applications of these alkaloids in the food and medicinal industries.

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POSTER ID: EM1

Using ordinary cokriging with magnetic susceptibility data to produce high resolution maps of heavy metal contamination at South Park, Galway, Ireland

Author(s): Golden N., **Zhang C.S.**, Gibson P.J., Morrison L.

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Keywords: metal contamination, magnetic susceptibility, GIS, Geostatistics, Ordinary Cokriging.

The production of maps for metal distribution in urban soils is important for both understanding the processes involved and implementing the environmental management of such pollution. The aim of this study was to produce maps of metal (Cu, Pb and Zn) contaminants at an increased resolution in a contaminated urban sportsground (South Park, Galway) in Ireland. This study was carried out using the geostatistical technique of ordinary cokriging with magnetic susceptibility (MS) as a covariate. The MS was examined using a Bartington MS2 susceptibility system equipped with a MS2D probe for in situ analysis at a grid density of 10 x 10 m. Soil samples were collected at a lower density of 20 x 20m grid and the metal content was determined using an Innov-X Alpha Series 6500 portable X-ray fluorescence (P-XRF) system. Strong positive correlations were found between MS and concentrations of Cu, Pb and Zn in the soil. The ordinary cokriging method allowed for the enhanced estimation of map values when the distribution of a secondary variable (MS) is sampled more intensely than the primary variable of interest (concentrations of Pb, Cu and Zn). Cross-validation demonstrated that the cokriging predictions facilitated the generation of more accurate prediction maps of each metal concentration (Cu, Pb and Zn) using MS data than maps produced using metal concentrations alone in ordinary kriging. Prediction maps of individual metal contaminants (Cu, Pb and Zn) were also produced for comparative purposes.

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POSTER ID: EM2

The Study of the Nitrogen Footprint in the Vicinity of the Shannon River Basin

Author(s): Marrinan LM, Treacy JT

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Keywords: River Management, Nitrogen Footprint, Nutrients, Metals

This research is being addressed to determine whether the nitrogen cycle has an impact in contributing to global warming by comparing distinctive geological locations. One of the main objectives is to determine if more rigorous monitoring of the levels of nitrogen species is required in our environment especially in the vicinity of river basins. The nitrogen cycle is being overshadowed by a large policy focus on the carbon cycle. Disturbances in the nitrogen cycle can give rise to acidification, eutrophication, nitrous oxide emissions and human health problems. Another stance which has been taken on the project after the findings during my literature review is the affect of various key trace metals which are essential for the biological requirements of organisms on the nitrogen cycle. This research involves examining the river management systems of distinctive geological locations, namely in the river Shannon region in Ireland. The initial investigation involved using environmental forensics to forensically examine point and diffuse sources of pollution in both locations. The scope of this research involves analytical quantifying the levels of ammonium, nitrites, nitrates and total nitrogen levels in ecosystems around the river's catchment. The analysis of the nitrogen samples taken from the river, soil and air involves the use of instrumental techniques such as ultraviolet-visible spectrometry which includes the use of instrumentation such as Lachat QuikChem 8000 FIA (Flow Injection Analyser) and the Hach DR/2010 spectrophotometer. Other instrumentation techniques such as Flame Atomic Absorption Spectroscopy and Graphite Furnace Atomic Absorption Spectroscopy are used to analysis the metals. The analysis of metals such molybdenum (Mo), vanadium (V) and iron (Fe), copper (Cu), nickel (Ni) and zinc (Zn) in water samples is being undertaken. These trace metals are believed to be crucial for nitrogen fixation. Thus the availability of these trace metals may impact on controlling the earth's nitrogen cycle. This poster will highlight the sampling points along the river Shannon being investigated. This project involves sampling in the vicinity of both point and diffuse sources of pollution entailing both rural and urban locations. The trends between the levels of ammonium, nitrites, nitrates and total nitrogen levels in ecosystems around river catchments and the levels of key trace metals, to date will be highlighted. The overall outcomes will help develop better river management and increased awareness of pollution issues. **Email:** lisa.marrinan@lit.ie

POSTER ID: EM3

**Effect of increasing sawdust to separated pig manure solid ratio
on the quality of compost produced**

Author(s): Nolan T., Troy S., Healy M.G., Lawlor P.G

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Keywords: Oxygen Uptake Rate, Germination Index, Sawdust, Stability, Phytotoxicity

A trial was conducted to assess the effect of increasing sawdust to separated pig manure solid (SPM) ratio on the quality of compost produced. There were three treatments: SPM only (T1), SPM + sawdust mixed 4:1 by weight (T2) and SPM + sawdust mixed 3:2 by weight (T3). Each treatment was replicated four times. Mixtures were composted (with regular turning) in insulated compost tumblers for 56 days. The temperature of the piles was recorded daily. Compost stability was investigated using an oxygen uptake rate (OUR) test and compost maturity was investigated using a germination index (GI) test. Temperatures above 50°C were achieved by Day 2, followed by a thermophilic phase which lasted for 1 to 2 weeks, followed by a cooling phase. The thermophilic phase for T1 was shorter than that of T2 and T3. This can be attributed to the absence of a C-rich bulking material in T1. This also negatively impacted on the stability of this treatment. Oxygen uptake rate for T1 at Day 56 was significantly higher than OUR for T2 and T3, however OUR values for T2 and T3 were similar. The OUR values were 26.4, 11.8 and 8.0; and standard error (s.e.) was 1.85 mmol O₂ .kg⁻¹ OM hour⁻¹ (P<0.001) for treatments T1, T2 and T3, respectively. Germination Index values for T1, T2 and T3 were 61, 61 and 83, and s.e. was 13.93 % (P>0.05), respectively. In conclusion, the 4:1 SPM to sawdust mixture had low levels of phytotoxicity and an OUR that was lower than the proposed Irish limit of 13 mmol O₂ .kg⁻¹ OM hour⁻¹. Therefore, composting of SPM with sawdust at a ratio of 4:1 (w/w) can reduce the quantity of sawdust used while still producing a stable end-product.

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Water Quality - Poster

POSTER ID: WQ1

POSTER ORAL SESSION: Session 1, Thursday, April 7th, 11.30 – 12.40 (Boole 1)

Flow and Suspended Sediment Analyses for the River Bandon

Author(s): Hickey J, Harrington J

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Keywords: Suspended Sediment Analyses

Sediments are particles carried in suspension or transported as bed load in rivers and are an essential natural feature of all aquatic systems. Sediments originate from erosion processes and are transported through river and estuary systems. Sediment quantity and quality from source to sink affect the hydrological, geomorphological and ecological functions of both river and estuary systems. This research project aims to estimate the total suspended sediment load for a number of selected local river basin systems located within the South Western River Basin Management District (as outlined under the EU Water Framework Directive). The River Bandon is the primary focus of the work undertaken to date. The River Bandon is approximately 71 km in length and drains a catchment of 608 km² into Kinsale Harbour. A flow analysis for the river using statistical approaches has been undertaken to determine representative flow conditions. An analysis of flood frequency has been determined using both the annual maximum series and partial duration series approaches. Surface grab sampling and depth-integrated sampling have been undertaken to monitor suspended sediment conditions in the River Bandon at the Curranure Gauging Station. Continuous turbidity monitoring has also been undertaken with turbidity used as a surrogate for suspended sediment concentration. Ultimately, sediment fluxes into the transitional waters of Kinsale Harbour will be determined from this work.

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Water Quality - Poster

POSTER ID: WQ2

POSTER ORAL SESSION: Session 1, Thursday, April 7th, 11.30 – 12.40 (Boole 1)

Dynamic modelling to explore management options in Milltown Lake catchment (DYNAMO)

Author(s): Veerkamp V, Jennings E, Linnane S

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Keywords: Modelling, Nutrients, Agriculture

Nutrient loading is one of the principal drivers in the deterioration of water quality in Ireland. Two main sources contributing to nutrient pollution in rural catchments are agricultural practices, particularly fertiliser use and slurry spreading, and single house on-site wastewater treatment systems. The aim of this study is to assess the performance of two different dynamic models to explore changes in catchment pressures in the Milltown Lake catchment, Co. Monaghan. The catchment consists of a lake which is supplied by three inflowing tributary streams. The lake is used as a domestic water supply for the local community and is also part of the National Source Protection Pilot Project (NSPPP). Management initiatives in the catchment have included the installation of streamside fencing on one tributary. An intensive monitoring programme has been established within the catchment since September 2005 by the NSPPP. As part of the requirements of the current research, gaps in data required to run the models have been identified and a sampling program been established to fulfil those needs. Further high frequency sampling is being carried out at the inflow to the lake to collect data for the validation and calibration of the models to be used. The impact of fencing on phosphorus loads is also being assessed. Past work on the lake has also indicated that the lake may be polymictic and that sediment phosphorus release may play a role in the eutrophic classification. The project has also included the deployment of a chain of temperature loggers in the lake and sampling of lake waters, together with deployment of lake sediment traps, will commence this year.

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Water Quality - Poster

POSTER ID: WQ3

POSTER ORAL SESSION: Session 1, Thursday, April 7th, 11.30 – 12.40 (Boole 1)

Distinguishing sewage and manure derived nitrate

Author(s): Fenech C, Rock L, Nolan K, Tobin J, Morrissey A

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Keywords: nitrate, source determination, isotopes, pharmaceuticals, surface waters

Nitrate is naturally found within the environment as part of the nitrogen cycle. However, anthropogenic sources such as synthetic nitrate fertilizer have greatly increased nitrate loads within ground and surface waters. This has had a severe impact on aquatic ecosystems and has given rise to health considerations in humans and livestock. Therefore the identification of sources of nitrate is important in preserving water quality and achieving sustainability of our water resources. Nitrate sources can be determined on the basis of the nitrogen (N) $\delta^{15}\text{N}$ of nitrate. However, sewage $\delta^{15}\text{N}$, δ and oxygen (O) isotopic compositions ($\delta^{18}\text{O}$ values, making their differentiation $\delta^{15}\text{N}$ and δ and manure have overlapping on this basis problematic. Hence, the use of co-occurring discriminators of nitrate sources is required to differentiate between sewage and manure nitrate sources. Pharmaceuticals and their metabolites have been detected within surface waters. In the present study, human and veterinary pharmaceutical residues are being assessed as markers of sewage and manure contamination respectively. The careful choice of pharmaceuticals allows for distinct identifiers in relation to $\delta^{15}\text{N}$ of sewage and manure nitrate sources, which could then be integrated with the $\delta^{18}\text{O}$ values of nitrate to disentangle point and diffuse sources of nitrate δ and pollution. LC-MS methods for the determination of a suite of human and veterinary derived pharmaceuticals and their metabolites at detection limits suitable for pharmaceutical loads within surface waters will be developed. IRMS $\delta^{15}\text{N}$ and δ (Isotope ratio mass spectrometry) methods will be used to determine the $\delta^{18}\text{O}$ values. Initially, a monitoring database of N and O isotopic compositions δ and pharmaceuticals within surface waters from single-use watersheds within Ireland and Northern Ireland will be set up. A model which can be used to disentangle point and diffuse sources of nitrate pollution could subsequently be developed and applied to multi-use watersheds.

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Water Quality - Poster

POSTER ID: WQ4

POSTER ORAL SESSION: Session 1, Thursday, April 7th, 11.30 – 12.40 (Boole 1)

An Environmental Forensic investigation into the levels of Disinfection By-products and Organic Compounds in Drinking Water Supplies - Preliminary Review

Author(s): Sanawar H, Treacy J, Vesey P

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Keywords: drinking water, contaminants, disinfection, disinfection by-products

The purpose of drinking water treatment is to produce an adequate and safe supply of water that is chemically, bacteriologically and aesthetically pleasing. But how safe is our drinking water? The focus of this poster is to review a relatively new class of chemical contaminants found in drinking water known as Disinfection By-products (DBPs). DBPs are formed when disinfectants, such as chlorine, react with the natural organic matter and inorganic substances in raw water. Since their discovery in 1974, over 600 DBPs have been identified and numerous DBPs have also been implicated as potential human mutagens, carcinogens, and teratogens. However, very few disinfection by-products are regulated and addressed by research – reword research does not regulate. This inter-disciplinary project aims to examine the state of the drinking water supplies and quality in Limerick, Ireland, with regards to Trihalomethanes (THMs) and Haloacetic Acids (HAAs) which are the two most abundant groups of DBPs in chlorinated finished water. Analytical techniques such as GCMS and LCMS will be used to study the levels of disinfectant by products found in drinking water. Water treatment processes will be studied to understand the operations affecting the formation of DBPs in drinking water supplies. The information gathered through this research may provide a framework for water treatment plants process upgrades in relation to the control and management of drinking water contaminants.

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Water Quality - Poster

POSTER ID: WQ5

POSTER ORAL SESSION: Session 1, Thursday, April 7th, 11.30 – 12.40 (Boole 1)

A comparative analysis of a range of synthetic and real wastewaters

Author(s): O'Flaherty E, Gray N.F.

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Keywords: synthetic wastewater, characterisation, wastewater research

Wastewater research relies heavily on the use of synthetic formulations of wastewater for laboratory-scale treatment analyses. Such research typically uses these artificial formulations for testing the biodegradability of various substances in wastewater. Other uses of synthetic wastewaters include toxicity analysis, design and simulation studies for various wastewater treatment technologies as well as testing the modelling and characterisation of wastewater treatment processes. Synthetic wastewaters have some significant advantages over real wastewater: they can provide reproducible results; it may not always be practical or indeed possible to continuously obtain a feed of real wastewater; depending on the formulation they can be cost-effective; they can be sterile and/or pathogen-free thus reducing the environmental and health hazards associated with pathogen contamination; they can also be less malodorous than real wastewater. The study compares synthetic wastewater formulations with real wastewaters in terms of their physico-chemical and biological characteristics. Eleven synthetic wastewater formulations were selected for analysis using criteria such as; prevalence in literature and standards; application in wastewater treatment assessment; cost for formulation; relative complexity of formulation. Two real wastewaters (settled influent) from Ringsend and Leixlip Wastewater Treatment Works were also characterised. The wastewaters are discussed in terms of their chemical oxygen demand, 5-day biological oxygen demand, nitrogen (total nitrogen, ammonia, nitrate and nitrite), phosphorus (total phosphorus and ortho-phosphorus), pH, alkalinity, total suspended solids and a selected number of metals. Other biological characteristics such as BOD decay rate (K₁), specific oxygen uptake rate and readily biodegradable COD were also evaluated. The paper explores the relative merits and limitations of using the selected synthetic wastewaters in comparison to real wastewaters and ranks the synthetic formulations according to their suitability as substitutes for actual wastewater. Still not really clear what real advantage of synthetic over real wastewater. Text needs to be formatted fully

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Water Quality - Poster

POSTER ID: WQ6

POSTER ORAL SESSION: Session 1, Thursday, April 7th, 11.30 – 12.40 (Boole 1)

A paleolimnological examination of the recent environmental history of Moynalty Lough, Co. Monaghan, a lake used for drinking water abstraction by the local group water scheme (GWS)

Author(s): McCabe P.

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Keywords:

Moynalty Lough is a shallow, ecologically poor, eutrophic lake situated in County Monaghan. The lake covers an area of 16 hectares and has a maximum depth of 5.6 meters. Agriculture is the predominant activity within the catchment and consists mainly of dairy and beef production. The lake itself is used for drinking water purposes by the local group water scheme, but as a result of deteriorating water quality, the costs associated with water treatment are increasing. Therefore, a better understanding of the lake's trophic status - both current and historical - is required to ensure that the lake can be managed effectively in the future. In order to establish reference conditions for Moynalty Lough, a sediment core of 35 cm was taken from the deepest basin of the lake in July 2010. This core was dated using ¹³⁷Cs and ²¹⁰Pb and analysed for selected biological and chemical variables, including total phosphorus (TP) and biogenic silica. In addition, a full diatom stratigraphy was established and the diatom inferred TP transfer function (DI – TP) applied. The relationship between possible causative factors, such as recent anthropogenic nutrient enrichment will be assessed in order to account for observed changes in diatom species assemblages and diatom inferred TP transfer functions. Paleolimnological methods may, therefore, prove to be an important tool in reconstructing past environmental conditions in Moynalty Lough, in the absence of long-term water quality data.

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POSTER ID: WQ7

POSTER ORAL SESSION: Session 6, Thursday, April 7th, 14.00 – 15.10 (Boole 2)

Development of photosensitisers for the removal of selected Endocrine Disrupting Pesticides from water and wastewater using photocatalysis

Author(s): O'Dwyer R.

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Keywords: TiO₂ photocatalysis, Endocrine disrupting compounds, pesticides, porphyrins, phthalocyanines.

For the most part, the level of pesticides found in both the raw water sources and the treated water monitored in Ireland is below the limits required. However, periodically, specific failures (i.e. a single pesticide or a combination of pesticides in any one sample above the Drinking Water Directive parametric value of 0.5µg/ (for total pesticides) and 0.1 µg/limit (for individual pesticides) have been reported, despite the addition of activated carbon in the water treatment plants. At 7 of these sites, where the individual pesticide parametric value was exceeded, Endocrine Disrupting Pesticides (EDPs) were detected. EDPs interfere with the synthesis, secretion, transport, binding action and elimination of natural hormones in the body. Moreover, simply removing the pesticides using activated carbon still leaves a disposal problem, with the spreading of the spent carbon and pollutants on land being the norm. An alternative removal method using photocatalysis using relatively cheap and non-toxic titanium dioxide (TiO₂) has been recently used to degrade pharmaceuticals and pesticides in water and was found to be superior to conventional wastewater treatment methods using activated carbon. Comparative studies on two pesticides, 2,4-dichlorophenoxyacetic acid (2,4-D) and 4-chloro-2-methyl phenoxyacetic acid (MCPA) using integrated photocatalytic adsorbents (IPCAs) and activated carbon have been completed. The results were non-conclusive despite IPCAs showing improved degradation on famotidine and indomethacin. Alternative studies involving the development of a novel photocatalytic technology based on porphyrin/phthalocyanine dyes and TiO₂ for the removal of selected EDPs from water and wastewater using the chosen pesticides has been completed. Ongoing work will establish improved degradation efficiencies of the chosen analytes when compared to TiO₂ and activated carbon controls.

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Water Quality - Poster

POSTER ID: WQ8

POSTER ORAL SESSION: Session 6, Thursday, April 7th, 14.00 – 15.10 (Boole 2)

An Investigation of the Effects of Enzymatic Additions on Anaerobic Sludge Dewatering Properties

Author(s): Anders YA

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Keywords: wastewater, municipal sludge, enzyme, solids, dewatering

The present research study was undertaken to assess the potential for enzyme additions to improve wastewater sludge dewatering. Wastewater sludge is subjected to stabilisation and de-watering treatment processes prior to reuse or disposal. Sludge dewatering efficiency is highly dependent upon the sludge's nature and treatment, as demonstrated in this study. In addition to enzymatic treatment, the impacts of sludge sampling, storage, blending, freeze-thaw, digestion, pH, and polyelectrolyte conditioning were investigated. Sludge samples were collected pre- and post-anaerobic digestion, (from an aeration tank and drying bed, respectively), and a range of single and mixed enzyme preparations added to each. Polymeric organic substrates such as cellulose, starch, protein and fats can be hydrolysed to monomeric units by appropriate enzymatic activities. The specific enzymes used were amylases, cellulase, lipase, pepsin A, papain, protease, peptidase and pancreatin. Dewatering efficiency was determined by centrifugation and Capillary Suction Time (CST). Variables affecting centrifugation were also investigated. Enzyme additions were found to impart varying improvements to sludge dewatering rates. The greatest improvement, 15.52%, was achieved with an amylase-cellulase mix, while addition of amylase alone achieved a 12.10% increase. All other enzymes or enzyme combinations achieved dewatering improvement under 3%. Full-plant scale experiments produced similar results. In addition, lipase and cellulase additions to an anaerobic digester were found to be highly effective in improving biogas production. 1.02% cellulase achieved 73.66 % higher biogas production.

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POSTER ID: WQ9

POSTER ORAL SESSION: Session 6, Thursday, April 7th, 14.00 – 15.10 (Boole 2)

Investigation of Polyhydroxyalkanoate (PHAs) production by an activated sludge microbial consortium treating dairy wastewater

Author(s): McCullagh M. A., Dobson A. D. W., O'Leary N. D.

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Keywords: Polyhydroxyalkanoate (PHAs), mixed culture, dairy wastewater.

Polyhydroxyalkanoates (PHA) are biodegradable polymers of 3-hydroxyalkanoate that accumulate intracellularly in various micro-organisms under nutrient limited growth conditions. The production of these “bioplastics” has received significant, global research interest as they offer a potential replacement polymer for environmentally recalcitrant, petrochemical plastics. Attempts at commercial microbial production of PHA have focused on pure culture approaches, but high fermentation and downstream processing costs have resulted in poor market competitiveness to date. As a result interest is shifting to low cost alternatives such as the use of mixed culture systems. Activated sludge processes offer one such opportunity, in conjunction with nutrient rich industrial wastewaters as a source of cheap carbon substrates. The current project seeks to investigate the potential for PHA accumulation by an activated sludge microbial consortium exposed to high COD and inorganic nutrient wastewater streams typical of dairy processing facilities.

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Water Quality - Poster

POSTER ID: WQ10

POSTER ORAL SESSION: Session 6, Thursday, April 7th, 14.00 – 15.10 (Boole 2)

Optimising Activated Sludge Wastewater Treatment Plant Efficiency

Author(s): Gordon G., McCann B.

Corresponding Author Institution: Institute of Technology Sligo

Keywords: Optimisation, Efficiency, Activated Sludge, Process Control, Existing Facility, Wastewater, Sustainable, Sludge Mass Control, Sludge Distribution Ratio, Data Based Decisions, Performance Potential, Capacity Capability.

In recent times, the optimisation of activated sludge wastewater treatment plants (AS WwTPs) has become the focus of many utility providers internationally. WwTP optimisation has the potential to reduce public expenditure through tapping the full performance potential of the facility. Not only is optimisation likely to reduce the economic burden on public funds, it is also likely to result in significant improvements to the environment as a direct consequence of improved treatment plant performance. Studies to date indicate that optimisation techniques result in reduced treatment costs and energy consumption, increased plant rating, reduction in capital expenditure for plant upgrades, manufacturing facility throughput increase, improved effluent quality, and compliance with discharge standards. The outcome of this optimisation programme should allow local authorities/industry to reduce or even avoid capital expenditure on upgrading/expanding the plant infrastructure and potentially reduce current operating costs. Optimisation of AS WwTPs is also likely to improve the reliability, flexibility and robustness of the works and should demonstrate the performance potential and capacity capability as in previous studies. Phase 1 investigates the effect of specific AS WwTP process control variables on effluent quality, plant rating and treatment efficiency. A questionnaire will assess the current level of optimisation at Irish plants. Phase 2 involves the selection of suitable AS WwTPs to implement an optimisation programme using sampling and analysis equipment as well as computer software. Cause and effect relationships will be identified in conjunction with process control adjustments. A framework based on the consistent application of process control concepts will be implemented in order to maintain optimised performance. In Phase 3, the incentives for local authorities/industry to adopt optimisation practices will be identified through analysis of historic and measured operational data, observations made on site and seminars for wastewater professionals. Recommendations for the application of optimisation procedures will be developed for a range of AS WwTP types.

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POSTER ID: WQ11

POSTER ORAL SESSION: Session 6, Thursday, April 7th, 14.00-15.10 (Boole 2)

Characteristics of nitrous oxide emissions from aerobic granular sludge-sequencing batch reactors (SBRs) treating synthetic wastewater

Author(s): Zhang M., Quan X., Shen Z., Lawlor P., Zhan X.

Corresponding Author Institution: National University of Ireland, Galway

Keywords:

The application of aerobic granular sludge to wastewater treatment is a promising technology due to the excellent settleability and high microbial concentrations in the granules. However, incomplete denitrification in the anoxic interior of granules could lead to the generation of nitrous oxide (N_2O), a greenhouse gas. In this study three identical laboratory-scale sequencing batch reactors (SBRs), containing granular sludge with an average particle size of 650nm, were established at temperatures below 15°C. The SBRs were used to treat synthetic wastewater containing 700 mg chemical oxygen demand (COD)/L and 100 mg ammonium-N ($\text{NH}_4^+\text{-N}$) /L, which simulated a mixture of municipal wastewater and agricultural wastewater. The reactors were operated at three different aeration rates: 0.2, 0.6 and 1.0 L air/min, respectively. The operation cycle lasted 4 hours, comprising 5 min fill, 220 min react, and 5 min decant. In the three reactors, more than 97% of the influent $\text{NH}_4^+\text{-N}$ was removed, and average removals of 30%, 24% and 15% of total nitrogen were achieved, respectively. N_2O emissions started as soon as the aeration commenced and a significant decrease in N_2O concentrations was found after 2 hours. The phase study shows that in a cycle, on average, 3.7, 3.3 and 2.6mg of N_2O were emitted, equivalent to 2.4%, 2.1% and 1.6% of influent nitrogen loadings, respectively. The heterotrophic denitrification pathway contributed to 68.2%, 65.8% and 59.9%, and 59.9%, 55.6% and 52.0% of N_2O emissions with nitrite or nitrate as the electron acceptor, respectively. The poly- β -hydroxybutyrate (PHB) content in granular sludge rose by 16.8 ± 0.5 mg/g biomass when COD was exhausted, and PHB might be the carbon source instead of influent COD to encourage N_2O emissions during endogenous denitrification. Acknowledgement: Mingchuan Zhang is supported by Teagasc Walsh Fellowship (Ref: 2008022). Other supports are from NUI Galway RSF Fund (Ref: RIF011), and State Key Joint Laboratory of Environment Simulation and Pollution Control, China (Beijing Normal University) (Ref: 10K04EPCN).

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POSTER ID: WQ12

Geochemistry of a coastal karstic groundwater resource located in the West of Ireland.

Author(s): Petrunic B.M., Duffy G.P., Henry T., Cave R.

Corresponding Author Institution: NUI Galway

Keywords: karst, groundwater, seawater intrusion, nitrates

The groundwater resource within the Burren and Gort lowland karst regions is important for agricultural, commercial, and domestic activities in the West of Ireland. The hydraulic connection between the groundwater and the coastal zone is apparent at several locations where it is possible to directly observe groundwater springs discharging into the coastal waters. This hydraulic connectivity makes these coastal aquifer systems particularly vulnerable to seawater intrusion. The area under investigation extends along the southern coast of Galway Bay near the town of Kinvarra, Co. Galway to the town of Ballyvaughan, Co. Clare and approximately 10 km inland from the coastline. The overall objective of this study was to build on previous work and assess the groundwater chemistry in these coastal karstic regions. These data were used to understand the spatial variation in major ion chemistry and nutrient levels of the groundwater, and the extent of seawater intrusion within the groundwater environment. Based on Na and Cl concentrations, five near-coastal wells were determined to be within the seawater influenced zone. Three of these wells contained <1 % seawater and the extent of seawater influence was dependent on the seasonal conditions. Water levels were monitored in six unused wells and at four of these locations the groundwater levels responded to the tides in Galway Bay. One of the wells was also geochemically influenced by seawater based on measured conductivity values. Major ion chemistry of the background water varies mainly in the Mg content with higher concentrations in some of the wells located in the Gort lowlands, likely due to contact with dolomitic layers. Nitrate and dissolved organic carbon concentrations suggest anthropogenic contamination occurs in the study area.

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POSTER ID: WQ13

Phosphorus load apportionment in Irish water-bodies

Author(s): Crockford L C, Jordan P, Taylor D

Corresponding Author Institution: University of Dublin

Keywords: Phosphorus eutrophication lake river LAM

Sustainable use of EU water resources and maintaining a high ecological status in water bodies are key aims of the Water Framework Directive. A widespread water quality challenge in developed countries is eutrophication from point and diffuse loadings of nutrients, such as phosphorus (P) and nitrogen (N), from land to water. Daughter directives such as the Nitrates and Urban Waste Water Treatment Directives are the main regulatory instruments to manage these transfers and the efficacy of the measures are being evaluated in national monitoring programmes. This project is investigating two phenomena linked to the recovery of ecological status in freshwaters and especially from the impacts of P loading. Firstly, the project will determine the comparative impacts of both point (end of pipe discharges) and diffuse (storm driven from soils) loadings on river ecology in the Glyde catchment. This 380km² drumlin catchment covers parts of Cos. Meath, Monaghan, Cavan and Louth and tributaries with known Ecological Quality Ratios can be compared with the magnitudes of point and diffuse loads using Load Apportionment Modelling. The robustness of the model can be tested with high resolution (sub-hourly) P data from one of six catchments operated by the Teagasc Agricultural Catchments Programme. The second part of the project is investigating the role of external and internal P loading to a meso-eutrophic inter-drumlin lake. Seasonal anoxia and wind induced resuspension of sediments are both linked to the ongoing eutrophication of lakes where historical external P loads have accumulated in lake sediments. A database is being built showing the extent of catchment derived P loading (external pressure), wind influences and stratification/mixing (internal pressure). This will be augmented using water column monitoring of algae and ancillary parameters. Untangling the comparative effects of point/diffuse P loads in flowing waters and external/internal P loads in sensitive standing waters will provide policy makers with expectations of recovery from eutrophication episodes against the targets set out in the Water Framework Directive.

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POSTER ID: WQ14

Development of a standard industry method for Total Petroleum Hydrocarbon (TPH) monitoring which fully meets regulatory requirements

Author(s): Elordui-Zapatarietxe S, Moore B, Bowkett M

Corresponding Author Institution: TE Laboratories

Keywords: Water, Total Petroleum Hydrocarbons, monitoring

Petroleum hydrocarbons are one of the most common water contaminants in Europe. That is why Marine Strategy Framework Directive (2008/56/EC) and Water Framework Directive (2000/60/EC) envisage that regular monitoring is required to ensure the quality and safety of different water bodies. TPH measurements are conducted to determine the total amount of hydrocarbon present in the environment and are useful to determine if there is a problem, assessing the severity of contamination and aid in the progress of any remediation process. The lack of a standardization of analytical methodologies for regulatory purposes makes the comparison of the TPH results between laboratories and different techniques nearly impossible, undermining thus the validity of this measurement. Several standardization organisms such as USEPA and ISO have published their own methods for the analysis of the TPH in water, but they still don't reach all the requirements established by international directives, national legislation and environmental regulators. The main objective of this research project is to develop an improved method for TPH detection in water, with the ability to produce reproducible results in a wide carbon number range (C6-C40) at low detection limits and which can be implemented in the environmental laboratories and companies for the regular TPH monitoring. The work is organized in four main stages: (i) practical revision of the existing methodologies (ii) determination of the critical parameters in the determination of the TPHs in water (iii) development of a new method and (iv) validation of the proposed method with river, ground and sea water real samples (v) dissemination of the results to international standardization organizations i.e. Standard Methods for the Examination of Water and Wastewater (SMEWW).

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POSTER ID: WQ15

A point-of-need water quality monitoring system

Author(s): Twomey K, Ogurtsov V., Papkovsky D.

Corresponding Author Institution: Tyndall National Institute

Keywords: electrochemical, quenched-fluorescence, sensor

The Water Framework Directive (WFD), Directive 2000/60/EC, on achieving good water status by 2015, is being hindered by the limited point-of-need monitoring tools that are available. Need to reword – the WFD does not ‘achieve’ the good status rather it directs member state countries to ensure that their water bodies reach good status level by 2015. Biological contamination of water is a growing problem, and this is of particular concern for the monitoring of bathing water quality (2006/7/EC) and drinking water quality (DWD 98/83/EC). The methods of detection are mainly lab-based, and the resources that are tied up in labs could be employed more effectively close to the water body if portable analysis tools were developed. The presented approach is based on a combination of technologies that have the potential to be deployed at point-of-need e.g close to rivers. The tool can provide a rapid assessment of water quality. The first technology is based on an electronic tongue methodology, which is an electrochemical multi-sensor system that incorporates high sensitivity sensors and pattern recognition-based signal processing routines for analysis of complex signals. The ability of the electronic tongue to detect very low levels of faecal content in water has been demonstrated. The second technology is based on a contact-less quenched-fluorescence sensing of dissolved oxygen in water samples. In the presence of living microorganisms, the dissolved oxygen concentration decreases (fluorescent signal increases), due to their respiration, producing a characteristic sigmoidal profile, which is used for their quantification. The potential use of the technology is two-fold 1 - it could be used to detect a contamination in the drinking water source. 2 - it could be used to assess the effectiveness of the water treatment procedures on the water quality. We gratefully acknowledge European Commission NDP and Enterprise Ireland for funding of this work (CFTD 05/112, CFTD 07/124, PC 08/0184)

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**ENVIRONMENTAL SCIENCES
ASSOCIATION OF IRELAND
ANNUAL REVIEW**



ESAI ANNUAL REVIEW

CHAIRPERSON'S ADDRESS:

From Dr. Shirley Gallagher

As I finish my time at the ESAI helm, I would like to say it has been an honour and a pleasure to have been involved with the ESAI and its council. I am delighted to leave behind a thriving, committed and diverse council.



The strength of the association is in our diversity, reflected in the council with a wide range of disciplines and experience. Whilst we have always had a strong academic council which is core to our aims, the interaction with business and industry is key to the future of the organisation. Our recent strategy was to collaborate with professional bodies along the gamut of what is environmental science.

We have formed agreements with bodies such as CIWM, IEEM and IEMA and Soil Science Association who have provided student prizes for many years. We also incorporate workshops that we hope enhance the ENVIRON experience. I would like to gratefully acknowledge everyone who contributes their time freely. Recent contributors include Gearóid Ó Riain at Compass Informatics, Ailbhe Harrington, Dr Brian Quinn and Dr Duncan Laurence. The EPA gets a special mention as it has always been supportive of the ESAI, and this year it is providing significant funding towards ENVIRON, which is very welcome. Other bodies who have supported us include COFORD, Teagasc, The Marine Institute and SEAI. Sponsorship and grants are critical to keeping our delegate and membership fees down and I am grateful for the funds we have received through the years. There are seven prizes for students this year at ENVIRON, providing recognition of their hard work. On funding, we applied to IEN for membership and were turned down. I was deeply disappointed but believe, going forward, other streams of revenue will be of enormous benefit.

There are many people to thank and I will name a few: our administrator, Sinéad, is ever efficient and helpful and I will miss our chats; Paul and Brian who became directors of the company with me; the editor, John, whose editorial has improved the newsletter no end. Thanks also to Cóilín, our

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typesetter, and Adrian, our webmaster. Finally, to the council, for their contributions, opinions and time. The fact that we are a voluntary organisation must be recognised and how grateful we are that people can give their time willingly and freely. ESAI is in good hands with Paul at its helm; he is measured, focused and a good manager. I would like to see more student participation in the Council as you are the reason ESAI exists.

I will remain very much in the environmental field. I enjoy outreach on a number of levels and have always been focused on the applications of science. I am currently focusing on Green Works, a Department of Education/ESF-funded programme developing knowledge and skills in jobseekers towards the green economy. Running the Cork hub in Farranferris College is a great joy to me as I know we are making a difference to people's lives and our ecological footprint. Working with the CleanTech network, establishing links for and with companies to market their products abroad, adds another layer and the sustainability project, Eco10, that I have been working on in a voluntary capacity for some time is starting to come together. In between times I stick my water quality hat on and do the odd bit of consulting.

So, here's to the 21st ENVIRON and to Paul, our Vice Chair, who will be elected at our AGM during the event in UCC. Hope to see you there!

A handwritten signature in dark ink, appearing to read 'Shirley Gallagher', with a long horizontal line extending to the right.

Shirley Gallagher
ESAI Chairperson

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MEMBERSHIP

Make the most of your Membership

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 association provides a network for people in the environmental area, promotes good environmental practice and better understanding of the environment and provides an expert and up-to-date lobby platform for the environmental concerns in Ireland and abroad.

Benefits of Membership

By becoming a member of ESAI, you will also have access to:

- Discounted rates at Environ, 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.
- Networking at your finger tips by featuring in a Directory of Expertise on the ESAI website.
- Access to ESAI listserver
- Learn from others and absorb best practice
- Raise the profile of you and your business
- Stimulate new business opportunities

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



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2010 EVENTS

January: ESAI Selects Chairperson to sit on EPA Advisory Council

17th-19th February:

Environ 2010;
20th Annual Environmental
Researchers Colloquium hosted by
Limerick Institute of Technology.
Venue for Environ 2010: LIT Enterprise
Acceleration Centre



Photo: Kieran Clancy (PicSure)

18th February:

GIS in Environmental Management Workshop
Life Coaching Workshop
Scientific Writing: A Beginners Guide Seminar
Careers and the Environment Seminar
Environ 2010, LIT

19th February:

Wastewater Treatment Plants: (The Drivers, Practicalities and New
Technologies) Workshop, Environ 2010, LIT

24th-25th July:

Cool Earth Festival
Dun Laoghaire, Dublin



6th September:

Launch ESAI Photography
Competition "Autumn Harvest"
Noel Browne 2009 Winner

13th-14th October:

5th International Water and Sustainability Workshops:
"Innovative and Sustainability – Technology for Smarter Living"
"Water – Quality and Movement"
Resource Ireland; RDS Simmonscourt, Dublin

13th – 16th November:

Cork Science Festival, City Hall, Cork

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ESAI SELECTS CHAIRMAN TO SIT ON EPA ADVISORY COUNCIL - January 2010

Members of EPA Advisory Council:

from L-R Brian Meaney, Evelyn Moorkens, Brendan Dunford, Mary Kelly, Brian Buckley, Eanna Ni Lamhna, Elizabeth Cullen, Vincent Cleary, Shirley Gallagher, John Sweeney.

- Mr. Brian Buckley
(nominated by the Chambers of Commerce of Ireland)
- Mr. Brendan Dunford
(nominated by the Heritage Council)
- Dr. Shirley Gallagher
(nominated by the Environmental Sciences Association of Ireland)
- Professor Margaret O'Mahony
(nominated by the Institution of Engineers of Ireland and the Royal Irish Academy)
- Professor John Sweeney (nominated by NUI Maynooth)
- Ms. Eanna Ni Lamhna (nominated by the Irish Environmental Network)
- Cllr. Brian Meaney (nominated by the Association of Municipal Authorities in Ireland)



Nominated directly by the Minister

- Mr. Vincent Cleary
- Mr. David Ball
- Dr. Elizabeth Cullen
- Ms. Evelyn Moorkens

Chairperson

Dr Mary Kelly, Director General, EPA

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ENVIRON 2010, LIT

Environ 2010 was hosted by the Limerick Institute of Technology from Wednesday 17th to Friday 19th February. The conference was jointly organised by the Limerick Institute of Technology and ESAI. The colloquium was opened by Dr Maria Hinfelaar, President of the Limerick Institute of Technology.



The question and answer session “*The Green Economy opportunities for or threat to Ireland*” on the opening night in the Radisson Hotel was well attended and informative. The panellists (photographed above L-R) for the opening night were Prof. Frank Convery (Comhar), Dr Mark Costello (Ecoserve), Mr Conor Buckley (LongshipE), Mr Richard Douthwaite (FEASTA), Dr Pheobe Bright (Vivid Logic) and Mr Brian Meaney (Green Party Councillor). 224 delegates attended. The scientific programme comprised 82 oral presentations and 59 posters covering five themes namely: Climate Change and Energy, Ecology and Biodiversity, Environmental Entrepreneurship, Environmental Management and Monitoring and Sustainable Management of the Natural and Built Environment. Each theme had a keynote speaker namely, Mr Enda Kiernan, Executive Engineer with Cork County Council, Dr Brian Donlon, Research Manager EPA STRIVE programme, Dr Barry McDermot, Head of

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Cork Office Environment and Safety Department PM Group, Dr Mark Costello, presently Associate Professor at the University of Auckland New Zealand and Mr Conor McGovern, Environmental Scientist working in the sustainability, energy and waste management sectors.

The preliminary session of the colloquium *"How Sustainable is the Green*



New Deal" involved very interesting speakers pictured above with ESAI Chairperson Shirley Gallagher are (L-R); Mr Hugh Kelly, Director of Murray O'Laoire Architects, Mr Michael Ewing, Coordinator of the Environmental Pillar of Social Partnership, Mr Noel Casserly, Director of Comhar Sustainable Development Council, Mr Declan Meally of Sustainable Energy Ireland and Dr Enna Nolan, BRE. During the colloquium an interesting variety of workshops and seminars were available for the delegates. These comprised of; Scientific Writing, Careers in the Environment, Coaching - What is it and how it can help us reach our potential, Waste Water Treatment (The Drivers, Practicalities and New Technology) and GIS in Environmental Management. The conference dinner was held in the Radisson Hotel.

The prize giving ceremony was facilitated by Dr. Marie Hinfelaar at the close of the Colloquium. The conference was enjoyable, informative and

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educational. From the ENVIRON 2010 organising committee best wishes to the ENVIRON 2011 organising committee.

Student Prize Winners at ENVIRON 2010

Environ 2010 was held in Limerick IT in February. It was a well-organised, well-attended event, for which ESAI would like to thank the local committee for a job well done especially Dr Josephine Treacy. The ESAI ran a student competition judging all student talks and presentations making the difficult decision to find the best posters and talks and 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 (sponsored by LifeTime Lab) went to **Ciaran O'Carroll, NUIM** for his talk "Development of New Biodegradable Hydrogels to Deliver Dicyandiamide".

ESAI Best Overall Poster Presentation was awarded to **Rosie Mangan, UCD** with her poster entitled "A leaf feeding fly, *Hydrellia* sp. (Ephydriidae) imported into quarantine as a candidate biological control agent on *Lagarosiphon major* (Hydrocharitaceae)".

COFORD Best Forestry Oral Presentation was presented to **John Devaney, UCC** for his talk on "The ecophysiological factors controlling the regeneration of yew (*Taxus baccata*) in Ireland".

COFORD Best Forestry Poster Presentation was given to **Phillip Fanning, UCD** with his poster entitled "The eucalyptus leaf beetle, *Paropsisterna gloriosa* (Chrysomelidae: Paropsine) a new pest of *Eucalyptus* species (Myrtaceae) in Ireland".

IEMA Best Environmental Management Presentation went to **Ronan Kennedy, NUIG** for his presentation "Environmental Regulation through Information and Communications Technology".

Our sponsorship for prizes was greatly appreciated with over €1,000 to present to students this year. Many thanks to the continued support from our sponsors COFORD, Institute of Environmental Management and Assessment (IEMA) and the Lifetime Lab in Cork.

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CONVERGENCE - RETHINKING EDUCATION DECLARATION - May 2010

At a convention held at Tipperary Institute in Thurles, County Tipperary as part of the Convergence Festival of 2010, upwards of one hundred participants considered how education provision must change in order to play its part in addressing the urgent issues faced by our planet and in order to contribute to the emergence of communities with the beliefs, insight, knowledge and skills that will allow their members to live rich and fulfilling lives in a radically changed local and global environment.

This declaration is an outcome of that convention and is informed by the views expressed by participants though it is not suggested that every participant necessarily assents to every clause. It must also be remembered that this declaration addresses issues relating to education only – it is not a declaration on all aspects of sustainability. This is available from outgoing Chairman, Shirley Gallagher.

RESOURCE IRELAND 2010 - October 2010

ESAI and CleanTech Network co-hosted two workshops at the biennial event held in the RDS sponsored by SEAI and EPA. The themes of 'Innovative Sustainability - Technology for Smarter Living' and 'Water Quality and Movement' provided insight on current research and innovations in both areas.



Above: Anna Nielsen & Shirley Gallagher at Launch of 'Shirley's Vision'

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The impact of the first major hurdle in the water framework directive (WFD) coming down the track in 2015, and how to fund the programme of measures, in order to meet our commitments to Europe and to ourselves was the keynote for the water session. This was followed by the various potholes and steps in the system and innovative solutions to the struggle. Including companies such as Roofchute who look at rainwater harvesting.

The sustainability conferences showcased a number of Irish and international companies for their innovative products, ideas and concepts. From Dublin based Solarprint and Eaga, Cork based Nualight to London based Pavegen; all with innovative solutions for the 21st century in energy generation or energy saving. The use of smart metering, and IT, web based platform solutions was promoted by Sentaca in order to pull the solutions together in a measureable and manageable method.

The drawing by renowned artist Anna Nielsen called 'Shirley's Vision' was launched at the inaugural CleanTech Network GALA dinner. 'Shirley's Vision' is a representation of a sustainable community which is possible today. It is used as an educational tool to show anything is possible with co-operation and teamwork. It is part of a pan European project working towards LA21 with others in Ireland including Cork County Council on a sustainable suburbs concept.

CORK SCIENCE FAIR - November 2010

What will you do to change the world? was the question posed to hundreds of young students at the Science Fair at the City Hall in November 2010. They were asked to create an image or an idea to promote change in the world. Young people are the life-blood of our communities and will be the future leaders, teachers and managers. Lots of creative ideas were produced and it shows that creativity is alive and well in our young people.

The winner (right) for the best idea was Amy Mc Carthy, Scoil Mhuire, Wellington Rd., Cork.



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The winner (left) of the best picture was Ruby Miles, St. Gobans, Co. Cork

SMILE – RESOURCE EXCHANGE - November 2010 & March 2011

SMILE Resource Exchange is a free service for business that encourages the sharing and exchanging of resources in order to reduce costs and help the environment. Based on the concept that “one’s waste could be another’s resource”, businesses will have opportunities to identify potential partnerships through networking exchange events and an

online exchange facility. All resources offered are either free of charge or below market value.

Membership of SMILE Resource Exchange is free for businesses and is supported by the EPA, Cork County and City Enterprise Boards, Cork County Council, Cork City Council and MacroomE.



At the last meeting attended by ESAI Chairperson Shirley Gallagher (pictured above with James Daly, CleanTech Network), there were 256 potential matchers identified on the day.

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PHOTOGRAPHY COMPETITION 2010

Available online www.esaiweb.org

Many thanks to all entrants for their submissions to this years, ESAI photography competition "The Energy of Nature". We received over 100 entries, a record for this competition, now in its sixth year. Entries have been received from all corners of the world and all entrants are to be commended on the quality of submissions. The quality of the entries was very high, which made for a lengthy deliberation as to the final winners.

First prize was awarded to Juliette Giannesini from Canada for the capture of the Iguazu Falls in Brazil entitled "The Energy of Water". Second prize was awarded to Rajyaguru Dhaval Dinesh from India for the lightening strike entitled "Easy Recharge". Third prize was awarded to Vladimir Borrisov from Russia for the simple yet elegant interpretation entitled "Energy of Life: Dandelion & Asphalt".



1st Prize: "The Energy of Water"

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2nd Place: “Easy Recharge”



3rd Place: “Energy of Life: Dandelion & Asphalt”

Winning entries will be exhibited at Environ 2011 colloquium in UCC in April. The winner will receive a voucher for €250 for a photography online store, kindly sponsored by the Environmental Research Institute at UCC, along with their winning entry being professionally framed and free membership to the ESAI for 2011.

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ESAI INCOME AND EXPENDITURE ACCOUNT

For the year ended 31 December 2010

Opening balance as at January 1st 2010		4,404.69
	€	€
<u>Income</u>		
Membership	4,116.92	
Environ 2010	32,109.00	
Sponsorship	5,350.00	
CIWM/ESAI workshop 2008	380.00	
Total Income	41,955.92	
<u>Expenditure</u>		
Environ 2010	31,535.86	
Web Design/Software	1,261.69	
Administration Fees	6,634.50	
Environ 2009 Marketing	1,200.00	
Accommodation and Travel	721.57	
Audit and Accountancy	2,425.00	
Company Registration Office fee	686.00	
Bank fees and Charges	853.11	
EUCSEA	150.00	
E-zine	500.00	
Total Expenditure	45,967.73	
Excess Expenditure over Income		4,011.81
Balance		392.88
Bank Balance on 31/12/2010		392.88

*The draft set of ESAI accounts for the year ending 31/12/10 have been prepared by the ESAI Treasurer and are subject to audit by an independent auditor.

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ESAI GOALS AND OBJECTIVES: 2010



- 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.

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