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Welcome from the Head of Department of Science and Health

On behalf of the Institute of Technology Carlow, I would like to welcome you to the 17th Environ conference in association with the Environmental Sciences Association of Ireland. This conference provides a unique show-case of the best environmental research in Ireland and is the largest annual event of its kind.

I hope that you enjoy your stay in Carlow, which is the county of birth of John Tyndall the famous 19th century polymath and scientist. For those visiting Carlow, I hope you take the opportunity to explore the area and enjoy the amenities.

I would like to congratulate and thank this years organising committee for all of their hard work and a special thanks to our sponsors for their continued support of our research community. I would also like to thank the ESAI for their advice and support in preparation for this event.

I want to thank all of the presenters and participants for their research activity and for taking time to prepare presentations and posters. Through your efforts we gain an appreciation and awareness of the excellent research that is ongoing in the sector.

Finally, I hope that you will enjoy this colloquium and that you find the event scientifically stimulating.

David Ryan

Head of Department of Science and Health

ENVIRON Committee 2007

Dr. Martina McGuinness
Dr. Thomae Kakouli Duarte
Ms. Edel McGrath
Mr. Stephen Boyle
Dr. Dina Brazil
Ms. Mary Bates
Dr. David Dowling
Dr. David Ryan
Ms. Sarah Clarke
Dr. Rosemary O Hara

Important Information and guidelines for delegates and presenters at Environ 2007

- Registration takes place in the foyer of the Learning Resource Building (LRC) from 8.45am on Saturday January 27th
- Proceedings start at 9.30am on Saturday 27th and at 9.30am on Sunday 28th January
- Parallel sessions for the delivery of papers will take place in lecture halls A100, A102, C135 and D507 and D521
- Tea and coffee will take place at the poster area (ground floor CSB, near reception)
- Presenters of papers should be in attendance at least 15 minutes before the start of their particular session and ensure that their presentation has been successfully uploaded
- Presenters should make themselves known to the session chairperson prior to the start of the session
- All presentations will start promptly at the designated time and presenters are asked to keep to the designated time limits (15min)
- Posters must be in place by 11.00am on Saturday 27th and remain in place until 1.30pm on Sunday 28th. During this time viewing and judging will take place
- Presenters must be present at their posters during scheduled poster sessions
- Delegates must present their conference name tag at lunch which will be served on both Saturday and Sunday in the (CSB), upstairs on Sunday and on both floors on Saturday.
- The colloquium dinner will take place in the Dolmen Hotel, Kilkenny Road, Carlow, at 7.30 on Saturday 27th
- The keynote address and ESAI AGM will take place at 1.30 pm on Saturday 27th in A100
- Prizes will be awarded at lunch time on Sunday 28th
- Please note that all abstracts have been included in this document as submitted

Environ Programme

Date	Time	Event/Location			
26th	7.30pm - 9.00pm	Registration at the Dolmen hotel, Kilkenny Road, Carlow			
27th	8.45am – 9.30am	Registration at the Institute of Technology Carlow			
	9.30 am – 11.00 am	5 concurrent oral sessions			
	A100: Energy	A102: Invasive Species	C135: Conservation, Biodiversity & Ag Biota I	D507: Freshwater I	D521: Freshwater II
	11.00 am -11.30 am	tea/coffee + poster session			
	11.30 am -12.30 pm	5 concurrent oral sessions			
	A100: Sustainability	A102: Agriculture and Land Use I	C135: Waste management I	D507: Freshwater III	D521: Freshwater IV
	12.30 pm -1.30 pm	lunch (upper and lower floor, CSB) + poster session			
	1.30 pm – 2.30 pm	A100: Key note address, Bursary Winner address & ESAI AGM			
	2.30 pm - 3.30 pm	5 concurrent oral sessions			
	A100:Environmental impact I	A102: Modelling, geographical & information systems	C135: Waste Managment II	D507: Animal & plant Ecology I	D521: Waste Management III
	3.30 pm - 4.00 pm	tea/coffee + poster session			
	4.00 pm - 5.30 pm	4 concurrent oral sessions			
	A100: Environmental Impact II	A102: Environmental Change	C135: Environmental Management I	D521: Animal & Plant Ecology II	
	7.30 pm	Conference Meal, Dolmen Hotel			
28th	9.30 am – 11.00 am	4 concurrent oral sessions			
	A100: Environmental Policy	A102: Environmental management II	C135: Conservation/Biodiversity & Ag Biota II	D521: Animal & Plant Ecology III	
	11.00 am -11.30 am	tea/coffee + poster session			
	11.30 am -1.30 pm	4 concurrent oral sessions			
	A100: Pollution, Phytoremediation & Bioremediation	A102: Ecotoxocology	C135: Agriculture & Land use II	D521: Emerging Environmental Biotechnologies	
	1.30 pm - 2.30 pm	Lunch – upper floor CSB			
	2.00 pm – 2.30 pm	Prize giving and close of meeting (during lunch)			

Saturday 27 January 2007 Time: 9.30 – 11.00 am

Session 1

Title Energy

THE USE OF GIS AND GPS TO ENHANCE THE ACCURACY OF SEA-LEVEL RISE INUNDATION-MAPPING FOR THE PREDICTION OF FUTURE SALT MARSH CHANGE IN THE SHANNON ESTUARY.

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Global average temperatures have increased by approximately 0.6°C during the 20th century, and are projected to increase by at minimum additional 1.4 °C by 2100. The relationship between atmospheric warming and sea-level rise (SLR) is well documented, and is expected to lead to SLR of up to 1m by 2100. As predominantly sedimentary environments, estuaries are characterised by shallow-gradient coastal profiles, making them ideal environments for coastal salt marsh, and rendering them sensitive to even modest SLR. The Shannon estuary SAC and the Shannon / Fergus estuary SPA support a range of protected salt marsh species. These salt marsh areas are sensitive to SLR, and coastal squeeze seaward of existing reclamation barriers that protect low-lying sections of the estuary coast. SLR inundation sensitivity can be mapped relatively easily in Geographic Information Systems (GIS) using a Digital Terrain Model (DTM). However, the generation of meaningful inundation prediction mapping requires high vertical-accuracy DTM data. Height errors in the Irish national DTM dataset are quoted at ±5m, which are well beyond the maximum SLR predictions issued by the IPCC. Dual-frequency (survey grade) Global Positioning Systems (GPS) is capable of measuring height above datum to an accuracy of 1–2cm. Dual-frequency GPS surveys carried out in an area to the south of Shannon town containing four salt marshes confirms the unsuitability of the national DTM dataset, and provides a high point-density DTM dataset for the generation of enhanced-accuracy SLR prediction mapping. The extent to which DTM-derived variables including elevation, slope and coastal shape might serve as predictors for salt marsh occurrence is being tested against maps of present-day salt marsh, with a view to refining a model for the prediction of future SLR-driven salt marsh change.

Determining the Carbon Cycle of *Miscanthus giganteus* with implications for reducing greenhouse gas emissions.

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The United Nations Framework Convention on Climate Change Kyoto Protocol (1997) has driven research towards the reduction of carbon dioxide (CO₂) emissions and the development of alternative energy sources. The European Union (EU15) has set a target of 12% for the contribution of renewable energy sources to gross inland energy consumption by 2010 (European commission, 1997). The conversion of surplus agricultural land to bioenergy crops has been identified as providing the greatest potential for carbon mitigation across Europe (Smith *et al.*, 2000).

In Ireland *Miscanthus giganteus*, a perennial rhizomatous grass from Eastern Asia, has received considerable interest as a suitable energy crop. Field trials have displayed promising yields, up to 26 tDM ha⁻¹ yr⁻¹, with the potential to substitute up to 37% of Ireland's gross electricity generation (Clifton-Brown *et al.*, 2001). However, little research has been directed towards the potential of *Miscanthus* to mitigate carbon and reduce the greenhouse gas effect. Knowledge of the carbon cycles of bioenergy crops is critical for developing future energy policies. The objective of this study is to quantify the carbon budget of *M. giganteus* and investigate the potential of growing the crop as a means of contributing towards Ireland's Kyoto commitments.

In this project, we assess the long-term carbon fluxes from a *M. giganteus* crop located within Oakpark Crop Research Centre, Co. Carlow. The crop was established in 1989 under the EU 'Joule' initiative. Carbon dioxide and water vapour fluxes between the *Miscanthus* and the atmosphere are recorded using an open-path infrared gas analyser. The study includes diurnal measurements of soil respiration and CO₂ storage within the crop canopy. Gross primary production estimates are based on weekly biomass harvests and a light interception methods. In addition, a series of spot leaf and stem photosynthesis and respiration measurements are carried out along the profile of the plant. Data is currently being processed; preliminary results from July to December 2006 will be presented.

Land-use strategies that maximise Ireland's potential to develop a bioethanol industry in Ireland.

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The establishment of a bioethanol industry in Ireland is a current topic in agricultural, environmental and political circles. This interest is driven by concerns over anthropogenic global climate change, energy supply concerns and falling farm incomes over recent years. Bioethanol is a renewable fuel derived from the fermentation of hexose and pentose sugars, in commercial ethanol plants on the world market the source of these sugars are generally sugar and starch crops (Gray, 2006) such as sugarcane, maize corn and wheat. In Ireland's case, sugarbeet and are the most suitable crops for our climate and agricultural systems (Rice, 2001). There are many changes occurring in Irish agricultural land-use due to numerous market and policy drivers at the Irish, E.U. and world market level (Fapri, 2006). Within that land-share, if energy crops are destined to supply a biofuel plant then careful management and planning is needed to ensure both vibrant indigenous food and energy industries. This study considers the local land-use, soil types and topography to assess different proposed sites for locating a large (100,000t) bioethanol plant. In all, 9 potential sites and 4 different feedstock were tested in a model developed, which analysed the ability of the local land-base to supply the relevant feedstock of wheat, sugarbeet, miscanthus or cereal straw to each of the plant locations under different scenarios. It was found that of the sites assessed and using wheat as the feedstock, the site of the former Carlow sugar factory could supply 100% of a 100,000t ethanol plant in the shortest radius of 60km under all scenarios. The best port location was found to be Newross port, Co. Wexford, also utilising wheat as the feedstock. The process developed through this study can be utilised to assess other locations in the state not only for the supply of feedstock to bioethanol plants but also to other large-scale food and non-food industries.

A NATIONAL BIOENERGY STRATEGY BASED ON PEATLANDS AS THE BASE AREA FOR BIOMASS GROWTH

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Energy from renewable sources has started to gain increased momentum due to three main problems arising from non-renewable (fossil) fuels. Firstly the burning of fossil fuels causes Green House Gas (GHG) emissions. The second factor is the high levels of carbon dioxide (CO₂) that is emitted due to the combustion of such fuels and thirdly, our huge dependence on imported fossil fuels. At present Ireland imports 90% of its total energy required while the EU-25 imports 48%. Peatlands in Ireland cover approximately 1.34 million hectares and are extensively utilised for agriculture, forestry and peat production. 80,000 hectares of peatlands are currently being developed by Bord na Móna for peat extraction (electricity, peat briquettes and horticultural peat) and will gradually come out of production over the next 20 to 30 years. It is expected that *circa* 50,000 ha of cutaway peatlands could become available for afforestation and for energy crop production. The production of energy crops such as willow, miscanthus and reed canary grass on cutaway peatlands would aid in the generation of heat and electricity. It would also provide a sustainable means to providing fuel for power stations and domestic homes, thus improving the environmental impact on the atmosphere and reducing our dependency on imports. The objective of this research is to develop a realistic model to; determine the energy inputs v's energy yield into growing such crops on cutaway peatlands, the cutaway peatland area (ha) around peat fuelled power stations suitable for biomass production and the economics of establishing, growing, harvesting and transportation of such crops to their final destination. So far from research carried out on all three crops, miscanthus, reed canary grass and willow, energy ratios were, 20, 13 and 16 respectively. The cutaway peatland area (ha) from a 50 km radius around West Offaly, Lough Ree and Edenderry power plants, were, 15 500 ha, 14 700 ha and 10 800 ha respectively. Research work is ongoing into the economics of growing each crop, one factor that may increase the establishment cost is the deep ploughing of the sites, but this maybe balanced by the transport of the crops due an existing rail infrastructure that would have been constructed for milled peat transportation. From initial results, it can be seen that energy crops grown on cutaway peatlands yield positive results, and that there is available land around power stations for the growth of such crops. Further research into the practicality of these crops on cutaway peatlands is required

Session 2**Title Invasive Species**

WHAT PROMOTES SUCCESSFUL PLANT INVASION IN IRELAND?**Ann Milbau* & JC Stout**Department of Botany, Trinity College, University of Dublin, Dublin 2, Ireland
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Globally, invasive non-native (alien) species are important drivers of environmental change and can have profound consequences for native biodiversity. Often invading alien plants are only recognized as such once they have become established and are already very difficult to eradicate. Although it is notoriously difficult to predict which taxa will become invasive in the future, one of the targets of the National Plant Conservation Strategy for Ireland is to develop and implement mechanisms for early detection and rapid action against potentially new invasive species. This is particularly important in Ireland as approximately half of Ireland's flora is recorded as non-native. For that, however, we need to know what traits and circumstances make an alien plant more likely to become invasive.

Because reliable databases of alien species are especially helpful for understanding invasions and might be used to make some predictions about what alien species might become invasive, we created a **database** containing data on all alien plants in Ireland. It includes information on biological plant traits, taxonomy, origin, first record, current distribution in Ireland, way of introduction, invasive status, worldwide geographic distribution, habitat, etc. This information is currently being analyzed to answer the questions: "What differentiates established aliens from casual aliens?" and "Which traits enable established alien plants to spread and become invasive?". The results of these analyses will be presented at the conference. As a further step, differences in invasiveness between congeneric aliens will be studied, and we will also examine the invasibility of the different habitats in Ireland.

This project is part of **BioChange**, which is integrative, multi-disciplinary research framework to support national and local biodiversity policy in Ireland, funded by the EPA. The alien plants database will be available on-line from January 2007 at www.biochange.ie.

Comparing trophic interactions of brown trout (*Salmo trutta* L.) and roach (*Rutilus rutilus* L.) in eutrophic and non-eutrophic Irish lakes using stable isotopes analysis

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Ireland's freshwater fish fauna was historically dominated by salmonids. Among the native species the wild brown trout (*Salmo trutta* L.) represents an economically important resource with high socioeconomic value making a significant contribution to the local tourism industry. Brown trout population density often fluctuates markedly because it is regulated by a complexity of environmental and biological factors. The sensitive natural balance is potentially threatened by introductions of non-indigenous fish species and water pollution.

One introduced species roach (*Rutilus rutilus* L.) has become widely distributed in freshwater systems due to its high adaptable ecology. Roach has been regarded as a possible threat to salmonid species because of competition for food and space due to their high recruitment rate and high population density. To characterize the trophic interactions of brown trout and roach, populations of both species were sampled in two non-polluted lakes, Lough Corrib and Lough Ennell.

The other main threat to brown trout populations is cultural eutrophication. Field evidence suggests that eutrophication enhances competitiveness where roach and salmonids co-exist and induces a shift in the food web trophic levels. To assess the consequences of eutrophication on fish communities the trophic interactions among different age classes of brown trout and roach populations were compared in a group of eutrophic lakes, Lough Conn and Lough Cullin and of the two non-eutrophic lakes, Lough Corrib and Lough Ennell. This investigation was carried out using gut analyses and stable isotopes analyses.

The impacts of an alien plant (*Impatiens glandulifera*) on native bumblebees in Ireland

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Alien plants constitute 44% of the Irish flora and can negatively affect native plant communities by altering ecosystem processes and community interactions and physically damaging, competing and hybridising with native species. Our knowledge of the interactions between alien flowering plants and native bumblebees in Ireland is limited.

Bumblebees rely on the nectar and pollen produced by plants as a primary food source. Some invasive alien plants have large floral displays and produce great volumes of nectar, and act as important forage resources. However, it is not known whether these resources are suitable for native bumblebees nor if pollinator switching to aliens affects native plant pollination.

We investigated bumblebee visitation rates to three native plants (*Epilobium hirsutum*, *Filipendula ulmaria* and *Stachys palustris*) and *Impatiens glandulifera* in experimental sites where the alien was either absent, present or had been removed. In addition, nectar secretion rate and sugar concentration were measured in all plant species and mark-recapture studies were conducted to estimate bumblebee numbers in all sites. Preliminary results suggest that although the presence of *I. glandulifera* does not seem to affect bumblebee visitation rates to native plants and bumblebee numbers, bumblebees show increased visits to the alien in invaded sites. Bumblebees could be attracted to *I. glandulifera* by its high nectar secretion rates and sugar concentration compared to native plants. Future work will determine the nutritional value (protein & caloric content) of floral rewards in terms of nectar & pollen offered by *I. glandulifera*.

Development of measures for the control of *Gunnera tinctoria* on Achill Island, Co. Mayo.

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Giant Rhubarb (*Gunnera tinctoria*) was probably introduced in to Ireland over 100 years ago as an ornamental plant. Currently, on the West Coast of Ireland, it is considered an invasive plant species. Invasive alien species (IAS) are known to have irreversible effects on an ecosystem, the Convention on Biological Diversity proposes to prevent, eradicate and control IAS. On Achill Island the problem is significant and if measures are not introduced there is the likelihood of further range expansion.

Greenhouse and field experiments in Dooega, Achill Island were carried out, by applying plants with glyphosate-based herbicide RoundUp[®]. The success of the herbicide is being monitored, as was the efficacy of the different methods of application. Preliminary results have shown that of the herbicide is successful for controlling of *G. tinctoria* under greenhouse conditions. Subsequent experiments will investigate timing and rate of application along with restoration of native species on cleared areas. In conjunction with the field experiments a mapping project has taken place to establish the distribution, as well as the major habitats invaded by *G. tinctoria*. This will identify the areas most susceptible to invasion and loss of biodiversity. This will establish a baseline for future monitoring and control programs.

Session 3**Title Conservation/Biodiversity & Agricultural Biota (Part I)**

Title

Investigation of a low cost, biocatalytic material for use in RAPid Oil Spill TrEATment applications, (inland and coastal) to dramatically improve bioremediation efficiencies and protect high risk receptors through pathway activation.

Introduction

For many years petroleum hydrocarbons have entered the environment through natural seepage, accidental spills and inappropriate disposal practices. Increasing environmental legislation has resulted in industrial practices becoming more strictly regulated so reducing the number of accidents occurring. It is impossible to prevent spills in their entirety and so provisions must be made for these eventualities. There are several strategies for oil pollution cleanup and elimination including physical, chemical and biological techniques. This study focuses on the manipulation of biological techniques (biocatalysis and biostimulation), through the addition of a low cost biocatalytic material to enhance the biodegradation of petroleum hydrocarbons in soils and aquatic systems.

*Matson, R., Baars, J-R., Callanan, M. and Kelly-Quinn, M.

Using surrogate taxonomic groups to assess headwater streams: are macrophytes and benthic invertebrates concordant?

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Single taxonomic groups are often used in freshwater systems to represent the ecological condition of the entire biological component. The assumption that single-group indices make is that all biological components respond to similar environmental pressures. If several taxonomic groups do indeed respond to similar environmental variables then certain groups may provide surrogate ecological information for other groups within that habitat. As a pre-requisite of the Water Framework Directive, type-specific biological reference conditions are being derived for different freshwater types occurring in Ireland. Although First and second order streams often do not fall within the monitoring requirements of the WFD, they are estimated to constitute over half of Ireland's entire river network and potentially can have a significant impact on downstream water quality.. We investigate whether macrophytes and benthic macroinvertebrates respond to similar environmental variables in headwaters using CCA analyses. In addition, type-specific classifications were derived using TWINSpan, for macrophytes (aquatic and semi-aquatic combined and aquatic species on their own), and benthic invertebrates collected either in spring or summer. Classifications were then assessed to determine if one group can predict the composition of another taxonomic group (using self-tests as a benchmark). Concordance between groups was tested using standard classification techniques and by assessing the end-groupings using analyses like classification strength (MEANSIM). The latter uses similarity indices and verifies between and within group similarities in classifications using MRPP and IndVal. Species matrices were also assessed by similarity tests like Mantel and Procrustean analysis.

Diversity and Evenness of Agronomic Swards increases yield and reduces weed invasion across 28 European sites.

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Abstract

One of the key aspects of current biodiversity debate is the determination of the value of biodiversity from the point of view of its contribution to the proper functioning of ecosystems. We report the first year results of an agro-diversity experiment with 4 species at 28 sites in Europe. At all sites, mixtures consisted of two legumes and two grasses; with each site using one of four standard species mixture types (Mid European (ME), North European (NE), Moist Mediterranean (MM) and Dry Mediterranean (DM)). The relative abundance patterns of the species were experimentally manipulated using a simplex design. Past experimental designs have manipulated species richness among experimental communities, but have largely ignored the evenness among species. This results in the effects of richness and evenness being confounded in any subsequent data analysis. The advantage of the experimental approach used in this project is that we can disentangle the effects of species richness and evenness. We have developed models that can estimate the effects of species identity, diversity effects and can test for different levels of complexity among species interactions (e.g. species versus functional group interactions). Results from the first year data of this project indicate that:

- Mixture above ground biomass was consistently greater than that expected from monoculture performances and frequently exceeded the yield of the best monoculture.
- Mixtures had a strong suppressive effect on unsown species and the proportion of unsown species in the mixtures was frequently lower than that of the best monoculture
- Diversity benefits were not just due grass-legume interaction. Interactions were detected among all four species and the interactions between two grasses or between two legumes were as strong as those between grasses and legumes.
- The broad climatic, environmental and productivity gradient across which this common experiment was conducted, provides generality in the inference of consistent productivity and weed suppression benefits from more diverse swards.
-

BIODIVERSITY IN THE LAND-LAKE ECOTONE**Elaine McGoff*, Kenneth Irvine**

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The major anthropogenic pressure affecting lakes in Ireland is land use change. The intensification of agricultural practices leads to the direct loss of terrestrial vegetation form and function, which in turn can impact on the trophic pathways within aquatic systems. Other impacts at the land-water interface include the development of water side structures, urbanisation, increased recreational use and the disturbance of wetlands bordering water bodies. The Water Framework Directive requires that all water bodies reach 'good status' by 2015, with the inclusion of benthic macroinvertebrates as part of the assessment. There is a fundamental lack of understanding of the ecological requirements of the species and biotic communities being utilized as ecological indicators of pressure or quality, and the impact of habitat structure upon them. Invertebrates with both an aquatic and terrestrial component to their life cycle are subject to pressures within both environments, and within the transitional ecotone. However, despite this connectivity between habitats, there is little research which links the biodiversity of the terrestrial and aquatic habitats.

The Lake Habitat Survey (LHS) was developed to fulfil the hydromorphological assessment needs of the Water Framework Directive. It involves recording the shoreline features of the lake at ten survey sites around the lake perimeter, known as hab-plots. This survey method may prove a useful tool in assessing the land-lake ecotone, and the impact of this habitat area upon macro-invertebrates. Within the first phase of this study invertebrates were collected from both the littoral and riparian zones of ten hab-plots in Lough Carra, Co. Mayo. An LHS survey was carried out for the lake as a whole. Relationships between the aquatic and terrestrial invertebrates within differing habitats will be examined.

Session 4**Title Freshwater & Fisheries (Part I)**

Feeding Interactions of Cyprinid Fishes in Lough Corrib.

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Lough Corrib is the largest lake in the republic of Ireland (170km²). It is oligotrophic with a mixed geology. This study uses stable isotope analysis to assess the feeding interactions of the three most common cyprinid fishes in the lake. The bream, *Abramis brama*, is Ireland's largest cyprinid, although not native it has been resident in the country for three hundred years and is found in every major waterway. The roach, *Rutilus rutilus*, is an invasive species, although it was introduced to Ireland in the late 1800's it remained confined to one watercourse until the 1960's before expanding its range rapidly. A roach population was established in L. Corrib by the mid 1980's. *A. brama* and *R. rutilus* can breed together to form a hybrid. The roachXbream hybrid is viable and although rare elsewhere in Europe it is one of the most common fish in Ireland. Few studies have been carried out in Ireland to assess the interactions of these three species.

Sampling was carried out on two occasions in 2006. Species were divided into three size classes representing young, mature and old fish. Where possible, twenty fish in each size class were sampled. Stable isotope analysis was used to identify the trophic position of the various size class of each species. Invertebrate sampling was also carried out to provide an isotopic baseline.

Summary

This study uses stable isotope analysis to assess the feeding interactions of the three most common cyprinid fishes in Lough Corrib, the bream (*Abramis brama*) the roach (*Rutilus rutilus*) and the roachXbream hybrid. Sampling was carried out on two occasions in 2006. Stable isotope analysis was used to identify the trophic position of each species. Possible areas of competition are identified.

Tracking seasonal variation in the diet of macroinvertebrate grazers using stable isotopes

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Much research on aquatic macroinvertebrates has focused on their role as water quality indicators. Mayflies are often the most abundant macroinvertebrate in streams and are well established as indicators of water quality. In the search for a holistic understanding of this key group it is crucial that ecological traits such as feeding habits and food resources are understood to complement knowledge of water quality preferences. In the literature, ephemeropteran nymphs are traditionally classed as grazers and herbivores, with algae as their main food source. It was hypothesised that there would be a seasonal shift between detrital and algal components with a change in the availability of food sources. However, a year-long study of the gut contents of two ephemeropteran species, *B. rhodani* (Pictet) and *E. venosus* (Fabricius), indicated that detritus was the dominant resource at all times of the year. To address this issue further this study monitored the natural abundance of isotopic signatures of mayfly species and their putative food sources in the Glencullen River, Co. Wicklow. These results were compared and contrasted with food present in the gut. Stable isotopes of ¹³C and ¹⁵N reflect the food sources that were assimilated by the study species for growth and development in the long-term while gut content analysis reflect the food sources consumed by each individual at the time of sampling. The results of this study will help to clarify if detritus can be an important resource for mayfly nutrition or if its presence in the gut is simply a by-product of the feeding process.

Phosphorus, algal and zooplankton relationships across a lake productivity gradient.

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The amount of primary production carried out by phytoplankton depends on a variety of factors including light, nutrient supply and temperature, with phosphorus being one of the most important limiting nutrients in freshwater systems. Significant changes in lake ecosystem structure and function occur across nutrient gradients, with systematic changes in phytoplankton and zooplankton species composition, the importance of macrophytes and the types of fish found. Data compiled from a variety of regions suggest that organism abundance – total phosphorus (TP) relationships change in slope across three ranges (<10, 10-100 and >100 $\mu\text{g TP l}^{-1}$) with non-linearity having been recognized for phytoplankton but limited zooplankton biomass data also suggest a levelling off above 100 $\mu\text{g TP l}^{-1}$. The aim of the investigation is to confirm or identify patterns in phytoplankton and zooplankton composition and biomass as a function of TP concentration and to identify the causes of these patterns.

Published data indicate that across the nutrient gradient cyanobacteria increase in abundance and phytoplankton cells increase in size with increasing TP. Data suggests that phytoplankton species composition, edibility and size structure change rapidly around 100 $\mu\text{g TP l}^{-1}$. Significant changes in zooplankton species composition and size structure have also been shown to occur around 100 $\mu\text{g TP l}^{-1}$.

Forty lakes in Northern Ireland have been selected with TP concentrations ranging from 10 – 1000 $\mu\text{g TP l}^{-1}$, of varying area, retention time, altitude, underlying geology and fish occurrence. Water samples were collected seasonally in 2005 and 2006 and analysed for TP and total nitrogen (TN), silica, chlorophyll *a* (Chl *a*), colour and dissolved oxygen using standard methods. Phytoplankton and zooplankton are currently being analysed using standard techniques to determine species abundance, composition and size structure.

The results should help to clarify the processes important in lacustrine ecosystems. In addition they should characterise the biological assemblages characteristic of different nutrient levels and lead to improved lake quality bioassessments.

Session 5**Title Freshwater & Fisheries (Part II)**

EPILITHIC DIATOMS AS NUTRIENT ENRICHMENT INDICATORS IN THE NATIONAL SOURCE PROTECTION PILOT PROJECT, CO. MONAGHAN.

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1. ABSTRACT

Diatoms are extremely abundant in freshwater ecosystems and form a major component of benthic algae in river systems. They are of great ecological importance as they are photosynthesisers and are important part of the base of the food web. Although widely distributed, most species occur in habitats with specific physical, chemical, and biological characteristics. Diatom species are pollution sensitive and have been successfully used as indicators of eutrophication in rivers in many European countries and in North America. Furthermore, the EU Water Framework Directive (WFD) (Directive 2000/60/EC) has specified that phyto-benthos be used as one of the biological quality elements for determining ecological status in waterbodies.

The National Source Protection Pilot Project based at Churchill and Oram, Milltown Lake, Co. Monaghan aims to protect and improve the quality of drinking water sources through catchment management and community involvement. Phase 1 of the project involves a detailed baseline water-quality survey of Milltown Lake's catchment, in which this sub-project forms an essential role. Epilithic diatoms are being used to establish the trophic status of the catchment and identify areas suffering from diffuse pollution. The composition of diatom assemblages in the headwaters of three tributaries forming the inflow to Milltown Lake indicate high nutrient input to the catchment, giving rise to the presence of mostly nutrient and pollution tolerant diatom communities.

A PALEOLIMNOLOGICAL INVESTIGATION OF MILLTOWN LAKE IN COUNTY MONAGHAN, IRELAND

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2. Abstract

Milltown Lake in County Monaghan is 22ha in size, with a catchment area of 34km² and provides the source of drinking water for the Churchill and Oram Group Water Scheme. Water quality assessments carried out over the past twelve months have shown the lake to be in a consistently eutrophic state. In addition, over the past number of years the lake has repeatedly demonstrated evidence of eutrophication-induced persistent algal blooms.

A series of sediment cores from the deepest basin of the lake were obtained in November 2006 and were dated with ¹³⁷Cs and ²¹⁰Pb and analysed for selected pigments, phosphorus content and a variety of other variables. Separation techniques were applied to quantify pigment compositions and the resulting data used to hindcast the recent productivity of the lake and trends in trophic status over time. Relative concentrations of selected pigments have reflected changes in algal productivity in recent years.

All results to date suggest that eutrophication of Milltown Lake is not a recent phenomenon and is continuing to deteriorate and affect water quality and treatment costs to the Group Water Scheme reliant on the lake.

Can we build lakes? Investigating the trophic status of artificial Irish cutaway peatland lakes

Lally, Heather and Colleran Emer. Environmental Microbiology Research Unit, Department of Microbiology, National University of Ireland, Galway.

Since 1946, the Peat Development Board, Bord na Mona, have intensively harvested various peat types produced from Irelands extensive boglands. As a result, in 2030, Ireland will be home to in excess of 80,000 hectares of redundant, worked out bogland commonly known as cutaway peatlands. However, in recent years lake creation has represented a major post-harvesting land-use option for industrial cutaway peatlands. Now Bord na Mona have proposed to flood and revegetate 40,000 hectares, resulting in the formation of a semi-natural wilderness extending throughout the Irish midlands. The focus of this research is on four experimental lakes developed using three different lake creation strategies based on cutaway peatlands in county Offaly. These lakes are to be monitored over the next three years to obtain baseline data of their water quality and trophic status. This data will be used to help select a particular lake creation strategy for any future lake development in the midlands. Results generated to date indicate that the physio-chemical environments in cutaway lakes are primarily determined by two factors a) the nature of the lake sediments and b) the hydrological regime. Both of these factors are directly related to the specific lake creation strategy used. Furthermore, nutrient levels in these cutaway lake systems are strongly influenced by there surrounding catchment landuses. For example lakes surrounded by agricultural land or forestry often exhibits increases in nitrogen and phosphorus levels. In naturally occurring lakes the micro- and macrobiota each play an important role in ensuring overall lake stability. Whereas the microbiota in these artificial lakes plays an elevated role in the development of these lakes where the macrobiota is limited. Furthermore the microbiota also serves as a valuable bio-indicator of water quality and this can help identify futher eutrophication problems that may arise in the new lake systems.

Saturday 27 January 2007 Time: 11.30 – 12.30pm

Session 6

Title Sustainability

Development of a multiple endpoint bioassay using *Hydra attenuata* to assess the acute (sub)lethal effects of pharmaceuticals in the environment.

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Abstract

Pollution by pharmaceuticals entering the environment has been identified as a major problem, and has developed into a key area of research in the field of environmental toxicology. As yet relatively little research has been undertaken to assess the effect these pollutants have on organisms in the environment. The freshwater Cnidarian *Hydra attenuata* is an important component of freshwater ecosystems and has previously been used in biomonitoring assays. In this study the acute and chronic toxicity potential of 10 pharmaceuticals (cotinine, trimethoprim, carbamazepine, sulfamethoxazole, sulfapyridine, ibuprofen, naproxen, benzaifibrate, gemfibrozil, novobiocin and oxytetracycline) found in treated municipal effluent from a treatment works was measured (individually and as a mixture) using a microplate-based assay. The acute lethal toxicity was measured by determining the 96h LC50. Sub-lethal effects included attachment to substrate, bud formation and the development of a feeding test. The feeding test examined the chronic effects on the ability of *H. attenuata* to capture and ingest its prey *Artemia salina* after exposure. Results indicate that the LC50 of pharmaceuticals were considerably above concentrations found in the environment ($>2 \text{ mg L}^{-1}$) and do not present a lethal risk. However a significant decrease in prey ingestion can be seen at lower more environmentally relevant concentrations and may potentially have a chronic effect at the population level. This study demonstrates the suitability of *H. attenuata* for assessing the acute and sub-acute toxicity of pharmaceuticals in the freshwater environment.

A GIS TOOL FOR VISUALIZATION AND SCENARIO MODELLING OF SUSTAINABILITY INDICATORS

Jennifer Donlan, Dr. Bernadette O'Regan, John Morrissey, Walter Foley, John Leonard and Prof. Richard Moles (University of Limerick, Limerick, Ireland)

This project will use a Geographic Information System (GIS) to map and model sustainability indicators for 71 settlements across three regions of Ireland. It will further develop the comprehensive database created over the last two years at the Centre for Environmental Research (CER) University of Limerick within a recent Irish Environmental Protection Agency-funded project, *Sustainability and Future Settlement Patterns in Ireland*. This new database includes published national, regional and localised data with a substantial amount of information collected directly by CER researchers through 3,900 questionnaires administered in each settlement within the study regions. It contains data on 175 environmental and socio-economic indicators for each of the 71 settlements in the study. Further spatial and temporal simulation analysis of this data will provide valuable insight for policy makers.

A Geodatabase data model was used to store and model the sustainability indicators and indices. Database schema was generated using Universal Modelling Language, so database and framework are more easily shared, modified and updated. Simulation models will be built within the Geodatabase to project the effects of policy changes on the sustainability indicators of a settlement or area. A custom, interactive, user-friendly interface will be developed to facilitate and encourage use by policymakers and other stakeholders.

This Geodatabase will allow visual comparison of sustainability across regions, identification of regional tradeoffs between certain indicators, and highlight sustainability issues, including 'hotspots' where policy and resources will be most effectively targeted across the study areas. The custom, interactive GIS environment will assist stakeholders in accessing and understanding sustainability indicators, indices and simulation analysis results. This will provide policymakers with a powerful tool for examining which policies will best provide the desired movement towards sustainability at a regional level.

Action research on sustainable development indicators: stakeholder participation and indicator selection

Paul Kearney*, Dr. Donnacha Doody, Dr. Bernadette O'Regan, Prof. Richard Moles.,
Centre for Environmental Research, University of Limerick.

Public participation in the selection of sustainable development indicators has been identified as a suitable method for enabling the public to have a more effective role in policy making. The objective of this research is to develop an action-orientated methodology for enabling stakeholders to play a more significant role in the selection of sustainable development indicators. The process will lead to increased community and stakeholder awareness and understanding of issues central to sustainable development, thus enhancing opportunities for successful implementation of policy initiatives towards sustainability goals. Stakeholder analysis was carried out to identify groups often excluded from such processes; measures were taken to encourage the participation of these groups. From stakeholder participation, sustainable development indicators were identified that are relevant to local communities. This was achieved by use of focus groups where statements are gathered. At follow up meetings the stakeholders perform Q-sorts based on statements arising from the first meeting. The Q-sort is a forced ranked distribution enabling participants to effectively make tradeoffs through their choices by weighing the different issues identified against each other. Ideal Q-sorts are thus identified, these are then used to develop indicators; a further evaluation step to ensure accuracy of indicators was also carried out. The effectiveness of this methodology is being demonstrated within a city (Limerick) and a village (Freshford, Kilkenny). This highlights the differences and similarities at different scales and between urban and rural based stakeholder groups. Q-method is used to analyse the data to identify the ways in which stakeholders articulate their own understanding of sustainable development. The Q-method provides results that can be effectively integrated into policy making, so as to develop more effective policy and increase stakeholder commitment to the sustainable development strategy.

Session 7**Title Agricultural & Land Use (Part I)**

The effect of spreading method on ammonia emissions from cattle slurry applied in summer.

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Agriculture accounts for 98% of Ireland's ammonia emissions. Cattle account for 80% of this total of which half is as a result of the land spreading of cattle manure. Therefore, reducing emissions from land spreading can decrease their negative impact on fragile ecosystems. Low emission slurry spreading techniques such as the trailing shoe have been shown to reduce ammonia losses by approximately 43% compared with the standard splashplate method. The reduction is achieved by decreasing the surface area of slurry exposed following application. The objective of this experiment was to compare the emission from these two techniques used to apply cattle slurry to Irish grassland in summer. Cattle slurry (dry matter - 83 g kg⁻¹; total ammoniacal nitrogen - 1.7 kg t⁻¹) was applied to four pseudo-circular grassland plots (30 m diameter) using either the trailing shoe or splashplate methods in July 2006. Emissions from all plots were measured over a seven-day period using a micrometeorological mass balance technique. This involves the use of passive flux samplers located down and upwind of the area to which the slurry is applied. The results showed significantly higher emissions (18.6% of total nitrogen (N) applied) over the first three hours from the splash plate treatment compared with the trailing shoe (8.2% of total N applied). At the end of the measurement period 25% of the total N applied by splashplate was lost indicating a subsequent decline in emission rates. The emissions from the trailing shoe reached 19% of the total N applied suggesting emissions continued at a higher rate compared with the splashplate during this period. These results suggest the trailing shoe method has the potential to reduce ammonia emissions from slurry spreading however, the magnitude of the reduction is likely to be effected by factors such as climatic conditions on the day of application and the rate at which slurry infiltrates into the soil.

PREFERENTIAL FLOW IN IRISH GRASSLAND SOILS

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The unsaturated zone of the soil system forms the link between the atmosphere, ground- and surface water, and regulates most hydrological discharges (infiltration, evaporation, evapotranspiration) between these components. Movement of water through this zone has a direct influence on plant growth, ground- and surface water recharge and the retention and release of nutrients and pollution in the soil system. Preferential flow of water in the unsaturated zone can cause accelerated leaching of nutrients and pathogens. This study was designed to assess the occurrence and character of preferential flow under three grassland soils in Ireland. In this field experiment blue food dye was used to visualise infiltration patterns in the soil in three different soils (Loam, Sandy loam on Loam, Loam on Clay Loam) in Spring and in Summer. Dye was applied to the soil followed by irrigation with a rainfall simulator. The soil was excavated and profiles with infiltration patterns on them were revealed. Photographs were taken of the profiles and these images were analysed to quantify and characterize the soil infiltration patterns. Infiltration rates were also measured with a tension infiltrometer. The results indicated that preferential flow occurred in all three soil types and both seasons, although there is little difference between the seasons. Deeper infiltration of the dye was observed in the heavier soils than the lighter soil. The importance of preferential flow for the leaching of nutrients and pathogens is being investigated further in lysimeter studies.

Hydrogeological investigations to establish an experimental site on minimisation of nitrate leaching losses from tillage land

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Nitrate occurrence in surface and groundwaters continues to be an environmental concern and nationally it is subject to ongoing research. Nitrate losses can be considerable within spring arable cropping systems. This project aims to investigate the effect of natural regeneration and mustard cover crop mitigation measures on nitrate loss to groundwater associated with spring barley cultivation. This paper will present the preliminary site investigations at Sawmills Field and nearby area at the Oakpark Research Centre, Carlow. Three experimental plots were established during 2006 and instrumented with ceramic cups and groundwater monitoring wells for the quantification of nitrate leaching. Prior to plot establishment, preliminary geological and hydrogeological site investigations were conducted in order to describe the aquifer system and enable an appropriate monitoring network to be devised. Water table maps were produced based on surveyed water table heights from the installed monitoring wells and maps were produced using GW-Contour 1.0 visualisation and interpolation software. The cross section strata model diagrams supported the existence of a sand and gravel aquifer with localised clay layers in the chosen area. In addition to demonstrating marked vertical variations in the sediment sequence, the results showed that lateral changes from gravel to sand to clay can occur over short distances. The modelled 2D groundwater watertable maps indicated the existence of a relatively flat water table, with evidence of groundwater flow from the north and east. The maps also provided evidence of seasonal variation in the direction of groundwater flow, with flow from north-west to south-east appearing to dominate for much of the year. These data were used to position the three experimental treatment plots and replicated groundwater monitoring network. The preliminary groundwater chemistry results from the monitoring network will be presented.

Title **Waste Management (Part I)**

THE USE OF RECYCLED GLASS IN RAISED MOUND ONSITE WASTEWATER TREATMENT SYSTEMS TO ACHIEVE UNIFORM PERCOLATION

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Abstract

On-site wastewater treatment in Ireland is increasingly prevalent due to the burgeoning spread of rural housing over the last decade. The EPA guidelines, *Treatment Systems for Single Houses*, have been adopted by most county councils which provide a rigorous approach to site assessment and the design of the most appropriate treatment system. In situations where conventional gravity-fed septic tanks are not suitable - high water table, shallow depth of subsoil to bedrock or poor subsoil percolation - alternative approaches must be proposed to improve the quality of the effluent before discharge to the subsoil. One option promoted in the guidelines is the use of a raised mound soil percolation area, either as a secondary treatment unit or as a polishing filter. Although raised mounds are often being proposed at the planning stage, a survey found that most were either not being constructed at all or being made from the local soil of incorrect percolation characteristics (i.e. T-test value) using *ad hoc* construction practises resulting in unsatisfactory percolation rates.

A research project has been looking at the concept of mixing recycled glass into the subsoil used for the mound in order to achieve greater certainty and uniformity to its percolation characteristics. Three different grades of recycled glass were investigated and mixed into a soil with slow percolation characteristics (SILT/CLAY from Co. Monaghan) in varying quantities and combinations. The permeability of the different mixes was studied both in the laboratory and on-site. The addition of the glass into the matrix promoted a significant improvement in both the rate and uniformity of percolation and an optimum blend of glass to soil identified. In addition, the physico-chemical properties of the glass as a media (surface roughness etc) have assessed using an electron microscope, as well as studies carried out on its phosphate removal capacity.

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THE EFFICACY AND SUSTAINABILITY OF REED BED TREATMENT SYSTEMS FOR ON-SITE WASTEWATER TREATMENT IN IRELAND

3. Abstract

Domestic wastewater from over one third of the Irish population is treated in small-scale independent systems where connection to a sewer is deemed unfeasible. In situations where a conventional septic tank is considered unsuitable according to current EPA guidelines (shallow subsoil depth, high water table etc.), some form of secondary treatment system has to be installed to improve the effluent quality before discharge to the subsoil. Reed bed treatment systems are one such technology which has seen significant growth recently, being deemed an effective and low-cost alternative treatment system which can be used either for secondary or tertiary treatment applications in place of the percolation area. However, a scarcity of reliable, long-term performance data in an Irish climate has contributed to the reluctance of a number of councils to sanction routinely its use for on-site treatment.

An EPA funded project is therefore being carried out to assess the performance efficiency of horizontal subsurface-flow reed beds for the treatment of on-site wastewater to refine the current EPA guidelines with regard to design specifications, installation and maintenance. Two separate reed beds have been constructed; one receiving septic tank effluent, the other receiving effluent from a secondary treatment system. In addition, a packaged reed bed receiving secondary effluent has been installed on a third site. The performance of each system over a two-year period is being monitored in terms of chemical determinants (COD, phosphates etc.) and indicator micro-organisms (Total Coliforms and *E. coli*). The water balance across each reed bed is being monitored by continual inflow and meteorological measurements (rainfall and evapotranspiration) to ascertain the seasonal effects on performance efficiency. Tracer studies have also been carried out to analyse variations in hydraulic retention time. Results to date have shown both reed beds to be under-performing both chemically and microbiologically due to suspected short-circuiting.

Technical and Economic Feasibility of Utilising Construction and Demolition Waste and Dredge Material as Landfill Liner

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ABSTRACT

Construction and Demolition (C&D) Waste and Dredge Material are significant bulk waste streams in Ireland. This project studies the feasibility of combining these waste streams to produce a viable geotechnical clay liner for landfill for which there is a significant demand.

Experience in a demonstration C&D waste recycling project in Cork (DemCon 20/20) showed that there was an excess of fine material. Of 700,000 tonnes of C&D waste processed from 1999 to 2002 approximately 500,000 tonnes was less than 50mm size. The National Waste Database for 2004 reported that approximately 11.2 million tonnes of C&D waste were consigned to registered landfills suggesting the generation of up to 8 million tonnes of fine material. Ireland generates approximately 1.8 million wet tonnes of dredge material annually of which approximately 1.2 million wet tonnes is silt and clay.

This paper presents current practice in liner provision in Ireland including the quantification of the liner requirement.

This paper presents the results of tests on samples of C&D fine material and dredge material to establish relevant characteristics including particle size distribution, consistency limits and permeability. C&D samples have been taken from the Kinsale Road Landfill Site, the location of the DemCon 20/20 recycling project in Cork. Dredge material samples have been taken from Cork Harbour and Castletownbere Harbour, Co. Cork. Preliminary results are presented on the combination of the waste streams into a material suitable as a geotechnical liner.

Session 9**Title Freshwater & Fisheries (Part III)**

Karstification and Groundwater-Lake Interactions in Glacially Modified Lowlands, using the Meath-Westmeath Lakelands as an Example

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The intensity of Karstification varies, from highly karstic (The Burren, etc.) to slightly karstic (Parts of Offaly, Laois and other midlands counties). Determining the degree to which an area is karstified can be complicated if the area has been modified through other processes, e.g. glaciation. In such landscapes the movement of groundwater may be complex, with turbulent, relatively high velocity conduit flow in the bedrock and a saturated zone in the overburden characterised by slower, laminar-type flows. Groundwater divides may not be spatially coincident to surface catchment divides in these areas due to geologic controls on karstic conduit development. This may lead to surface discharge from catchments that are either relatively larger or smaller in volume than would be expected, based on the spatial extent of such catchments. In this type of landscape, permanent surface water bodies, as opposed to seasonal lakes (turloughs), may be the main groundwater-surface water interconnection pathway. Parts of the Meath-Westmeath Lakelands exhibit isolated residual limestone hills that may be evidence of past large-scale karstification. It is unclear whether karstification is still occurring in these areas and if so, what the nature of such karstification is. Using part of this area as an example, this research is focused on three main aims; 1) to quantify the degree of karstification in the study area in relation to similar glaciated karsts internationally, 2) to establish whether groundwater and surface water catchment boundaries are spatially coincident, and 3) to examine connectivity between groundwater and lakes. These aims are being addressed through an extensive field work programme involving field identification and mapping, dye tracing, well monitoring at various temporal scales, and surface discharge measurement.

RECOVERY OF THE BENTHIC MACROINVERTEBRATE COMMUNITY IN A FORMERLY ACID IMPACTED UPLAND STREAM IN IRELAND – 2 YEARS ON.

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Abstract

The Annalecka Stream in Co. Wicklow, is located on a base poor granitic geology covered with peaty (brown) podzolic soil. Up until recently, the catchment was also characterised by 33% coverage of Sitka Spruce (*Picea sitchensis* (Bong.) Carr.). The streams of the Wicklow area are known for their degree of acid-sensitivity, especially through forest-mediated acidification. A small number of these are known to be acid-impacted in terms of hydrochemical and biological parameters (Kelly-Quinn *et al.*, 1997). The Annalecka stream was included along with a number of Wicklow sites in the AQUAFOR Project during the early 1990s, which characterised the hydrological, hydrochemical and biological conditions of the streams (Kelly-Quinn *et al.*, 1997). The authors highlighted the acid-impacted status of the Annalecka, with consistently low pH and alkalinity levels being detected. There was also a complete paucity of all mayfly species (Ephemeroptera) (Kelly-Quinn *et al.*, 1997).

Continued sampling of the Annalecka in later years revealed the recovery of the mayfly species *Baetis rhodani* (Pictet) in the stream, which coincided with the beginning of a forest clearing operation (Cruikshanks *et al.*, 2006). This discovery was the impetus for a closer examination of the probable macroinvertebrate recovery in the Annalecka. Spring sampling over the period of 2002-2003 revealed the presence of four mayfly species, suggesting continued recovery in the stream, along with the appearance of several other acid-sensitive macroinvertebrate taxa previously unrecorded at the site. Cruikshanks *et al.* (2006) noted a clearance of 5% of the spruce coverage on the catchment. However the authors noted the possibility that the recovery may only be a temporary effect due to forestry clearing and reduced seasonal rainfall over the study period.

This paper attempts to examine the potential on-going recovery of the macroinvertebrate community in the Annalecka stream, two years on from the initial signs of recovery.

**AN ASSESSMENT OF THE WATER QUALITY IN THE MILLTOWN LAKE CATCHMENT
USING A COMBINATION OF MACROPHYTE AND MACROINVERTEBRATE INDICES**

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ABSTRACT

Macrophytes and macroinvertebrates are being used simultaneously in this study of the Milltown Lake catchment, Co. Monaghan in order to fully assess water quality throughout. Macrophytes are being analysed using the Mean Trophic Rank and macroinvertebrates using the EPA Q-value system. While the two systems are not designed to be directly comparable (Kelly, 1998), simultaneous use of both macrophyte and macroinvertebrate indices can provide a wider picture of water quality within a system (Caffrey, 1987).

Macrophytes were collected from 30 individual sampling locations across the catchment during two separate sampling periods (Summer 2006), one early in the growing season, the second later. Macroinvertebrates were collected from the lowland sites of the catchment on three separate occasions on a seasonal basis (Autumn 2005, Spring 2006, Autumn 2006). On average, Q values of between 3 and 4 have been recorded throughout the catchment. Chemical and physico-chemical parameters were monitored at all stations during all sampling periods.

This project forms part of the larger National Source Protection Pilot Project at Churchill and Oram Group Water Scheme, Co. Monaghan which was set up to develop low cost, low tech solutions to water pollution problems. A marked decline in the water quality of Milltown Lake and the occurrence of problematic algal blooms in the Summer months, resulted in increased costs to the community of treating the water and the commencement of the study.

Session 10**Title Freshwater & Fisheries (Part IV)**

The influence of variations in water availability on two Burren plant species

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Mycelis muralis and *Teucrium scorodonia* grow abundantly on the shattered limestone pavement of the Burren. The water-holding capacity of this substrate is limited; consequently plants growing under these conditions are frequently subjected to soil water deficits during the growing season. Hence, the degree of drought resistance exhibited by these plants is thought to be a major contributor to their success in this “semi-arid” region. Whilst water deficits are common in the Burren, waterlogging is a less frequent phenomenon, for the most part localised and largely restricted to areas surrounding Turloughs. Flooding of Turloughs can, however, lead to the waterlogging of surrounding populations of *T.scorodonia* and *M.muralis*. The effects of these two contrasting stresses were investigated using chlorophyll fluorescence. The onset of both waterlogging and water deficits appear to have little effect on the most commonly used stress parameter; Fv/Fm. Thus it would appear that photochemistry is unaltered in the short term. This is due to protective mechanisms, which dissipate excess energy, preventing over-reduction of the photosynthetic electron transport chain. In the long-term, however, waterlogging and water deficits both result in a decline in Fv/Fm. It was observed that the magnitude of diurnal variation in Fv/Fm increased as the experiment progressed. The decline in Fv/Fm depended on the duration of exposure and the stress applied, as well as on plant species and age. Waterlogging and water deficits may be considered as contrasting stresses but their effects on the photochemistry of the terrestrial plant species studied appear to be quite similar indicating common signalling pathways. The similar photochemical responses are possibly due to short-term survival strategies employed by the plant to protect the photosynthetic apparatus from photo-oxidative damage.

Patterns in the size structure of lake littoral macroinvertebrate communities in stony habitats

Bláithín Ní Ainín[†], Louise Quin, Ian Donohue, Kenneth Irvine

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The distribution of body sizes in ecological communities scales with the abundance and density of species in communities, is inherently linked to community rates of production, metabolism and nutrient turnover and plays an important role in nutrient competition, resource availability and use, and predator prey relations. Studies of the size distribution of lake plankton communities have reported the slopes and intercepts of the Normalised Size Spectrum (NSS) to vary systematically with total phosphorus (TP) concentrations. However, few authors have examined changes in the size distribution of lake littoral macroinvertebrate communities with nutrient enrichment.

In this study, stony habitats of twenty lakes representing a gradient of total phosphorus concentrations ($1 > 119 \mu\text{g L}^{-1}$) and three alkalinity ranges, (0-20, 20-100, $>100 \text{ mg CaCO}_3 \text{ L}^{-1}$) were sampled for water chemistry and macroinvertebrates in August 2005. It was hypothesized that with increasing nutrient concentrations at lakes (a) the slope of the NSS would increase significantly reflecting greater biomass in larger size classes, as observed for lake plankton communities and benthic invertebrates in streams and (b) the total biomass of the larger size classes would significantly increase reflecting a shift towards larger organisms. The size distributions of macroinvertebrates were compared among lakes and both hypotheses were rejected for the communities of these study lakes. Abundance of animals per sample and total biomass correlated with TP and with chlorophyll *a*. The biomass of the small fraction of the spectrum correlated with chlorophyll *a*. These relationships, coupled with the positive correlation observed between the NSS slope and average biomass and negative correlation observed between average biomass and nutrients and chlorophyll *a*, suggest that with increasing nutrient concentrations, abundance of macroinvertebrates increased, resulting from an increase in density and biomass of smaller animals, causing an increase in total biomass, and a decrease in average biomass at these lakes.

DEVELOPING TOLERANCE VALUES FOR LITTORAL MACROINVERTEBRATES TO NUTRIENT ENRICHMENT OF IRISH LAKES**Louise A Quin^{*}, Bláithín Ní Ainín, Ian Donohue, Kenneth Irvine**

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Nutrient enrichment is one of the major threats to freshwater environments. Tolerance scores of macroinvertebrates to pollution are used widely to assess the biotic integrity of rivers. However these do not provide a good indication of eutrophication in lakes. This study developed and tested the tolerance of lake littoral macroinvertebrates to nutrient enrichment in Irish lakes. Forty-five lakes were sampled seasonally during 2005 for water chemistry and macroinvertebrates and this data was used to develop taxon-specific tolerance scores. Principal components analysis (PCA) indicated two major pressure gradients across these lakes, pH/alkalinity and nutrient stress. Tolerance scores to this nutrient gradient were developed within 'low', 'moderate' and 'high' alkalinity categories using abundance-weighted averaging in order to characterize tolerance of taxa to nutrient pressure in lake littoral zones. Taxon tolerances were then used to generate nutrient enrichment scores for each of the 164 original macroinvertebrate samples. As would be expected, these scores were significantly correlated with TP, TN, DTOC and colour, the four water chemical variables that contributed most strongly to the nutrient stressor gradient.

Saturday 27 January 2007 Time: 2.30 – 3.30pm

Session 11

Title Environmental Impact (Part I)

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Assessing a c. 200 year record of nutrient enrichment at Lough Currane Co. Kerry: a multiproxy palaeolimnological approach

Lough Currane Co. Kerry has been classified as mesotrophic based on intensive water quality measurements carried out at the lake since 2001. These measurements indicate that the lake is in the higher reaches of mesotrophic status and may reach eutrophic status in the relatively near future. No obvious cause for this nutrient enrichment or eutrophication has been identified within the lake catchment. Through the adoption of a multiproxy palaeolimnological approach, the research described here (1) aims to establish variations in nutrient status over a far longer time scale than currently available time series measurements, and (2) establish the most likely causes (e.g., anthropogenic or climate) of any phases of oligotrophication and eutrophication evident.

Palaeolimnology is the study of lake histories. In the absence of long term monitoring, palaeolimnological techniques allow retrospective examination of variations in water quality. Diatom and sedimentary pigment analysis will be used to reconstruct changes in Total Phosphorus (TP) and primary productivity throughout the last c.200 years. Pollen analysis and historical census data will be used to reconstruct changes in catchment land use. Records dating to c.1870 on precipitation, storminess and sunshine hours from the Valentia observatory will provide an historical climate record for the research. ²¹⁰Pb dating will be used for chronological control.

Fieldwork has to date involved extruding samples from the deepest point of Lough Currane; sediments in shallower basins will be sampled to account for inter-basin variations in sedimentation. A control site, Barrfinnihy Lough, will be cored and analysed under the same protocol as for Lough Currane. Deviations from the sediment and documentary records, and from the control site, will be correlated with significant historical events in the Lough Currane catchment in order to help understand the sediment record of variations in nutrient status.

**CHARACTERISATION OF FRESHWATER AQUATIC
MACROINVERTEBRATE FAUNA ALONG A POLLUTION GRADIENT
WITHIN INTEGRATED CONSTRUCTED WETLANDS**

This paper presents a comparison of macroinvertebrate fauna along a gradient of pollution in Integrated Constructed Wetlands (ICW). The aim was to characterise the main differences in aquatic fauna between ponds of similar pH, hydroperiod, water depth, area and shoreline complexity but different levels of organic pollution.

Five ICW systems in the Anne Valley, Co. Waterford were sampled during spring and summer 2006. Two methods were used to collect samples: three, 3-min multihabitat net sampling and Horizontal Activity Traps (HATs). A combination of these two methods has been shown to collect a more complete representation of the pond macroinvertebrate biodiversity.

Results show differences in macroinvertebrate community composition between ponds in the same system. The effect of habitat differences within and between ponds is also considered. Finally, this study also questions whether an approach consisting in a combination of the above-mentioned methods is needed for assessment of pollution status.

Callanan, M.C., Baars, J-R., Kelly-Quinn, M.

Between season variability in the water quality status of headwater streams assessed using various metrics: is there a window period for assessment of headwaters?

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Fifty small streams were sampled in 2004 to derive a reference based typology and to provide a valuable baseline dataset improving our knowledge of the distribution and ecology of taxa characteristic of unimpacted headwater streams in Ireland. These fifty headwater streams occurred within the first 2.5 km of the watercourse from its furthest upstream source. It is unlikely that the headwater streams surveyed represent pristine biological conditions but were considered to be minimally impacted. In the verification of the high water quality status of these streams distinct seasonal differences were observed in the water quality status assigned using commonly applied biotic indices. Headwaters are considered to have high heterogeneity and present a somewhat extreme and variable habitat for benthic invertebrates. In this paper we use the data to assess the between season variation in water quality status derived using various rapid bio assessment metrics such as the EPA Q-value, Small Stream Risk Score, percentage EPT taxa, BMWP and ASPT. These results indicate that some metrics are more reliable, and that water quality assessments in small streams are best conducted during spring as a result of characteristic community phenology.

Session 12**Title Modelling and Geographic Information Systems**

Modelling and Monitoring Multivariate Spectral Reflectance Profiles

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A forest seedling remote sensing experiment was laid down in UCD during a growing season with the objective to objectively quantify, model and monitor the mean spectral reflectance profiles of three conifer species Sitka spruce, Japanese larch and lodgepole pine on 17 successive Julian dates from 115 to 320. Five spectral reflectance at wavelengths 480, 560, 640, 720 and 800nm defined a five dimensional spectral reflectance profile for each experimental unit on each Julian date. The experimental design was a split-plot-in-time design. The spectral reflectance profile data were analysed using multivariate analysis of variance (MANOVA) in Mathematica 4.0 (Wolfram, 1999).

The primary multivariate hypothesis of interest was the interaction hypothesis of no species by Julian date interaction and was highly significant. MANOVA provides a concise partition of the 5x5 total sums of squares and cross products matrix, \mathbf{T} , associated with each identifiable source of variation. The union-intersection principle and Roy's critical test statistics lead directly to the construction of 95% Roy-Bose simultaneous confidence intervals and the testing of all unique dependent and independent interaction multivariate pairwise comparisons and the associated component hypotheses. Two new multivariate concepts: an ordered difference, Θ , and an ordered difference component vector, Δ , allowed the results of every multivariate pairwise hypothesis to be reported clearly, objectively and with simultaneous confidence. When combined with MANOVA and Roy-Bose simultaneous confidence intervals, these new concepts provide the basis for modelling and monitoring of multivariate profile data with simultaneous confidence of at least 95%. The spatial dynamics of modelling and monitoring of multivariate profile data may be integrated into a GIS.

Identifying HNV farmland in the west of Ireland**Sullivan, C^{1,2,3}., Sheehy Skeffington, M¹., Gormally, M²., Finn, J³. and Kelly, S⁴.***Department of Botany¹, Centre for Environmental Science² and Environmental Change Institute⁴ NUI, Galway and Teagasc³, Johnstown Castle.*

In recent times farming in Europe has become increasingly more intensive, with a negative impact on the range of habitats on farmed landscapes throughout the EU. Intensive agricultural practices in certain regions have resulted in others, such as western Ireland, becoming marginalised. However these regions, through their low-intensity agriculture, support a wide range of biodiversity and may be termed High Nature Value (HNV) areas. In Ireland this is most likely to be either farmland with a high proportion of semi-natural vegetation. (Type 1) or farmland dominated by low intensity agriculture or a mosaic of semi-natural and cultivated land and small scale features (Type 2). A third category (Type 3) refers to farmland supporting rare species or a high proportion of European or world populations of species and would not be widespread in Ireland.

East Galway has been selected as a study region as, judging by farm size, it comprises relatively low-intensity farmland. Yet it has comparatively few designated areas (e.g. Special Areas of Conservation) compared to e.g. Connemara. Eight District Electoral Divisions (DEDs) were selected using stratified random sampling. Roughly 10% of farms will be surveyed in each, using ground-truthing, GIS and aerial photographs to map all habitats that occur in each Grasslands and hedgerows were assessed in more detail in order to map the distribution of those of high biodiversity within these DEDs.

A representative sub-sample of these HNV farmlands will be selected for consultation with land-owners on management practices. Work to date suggests that grasslands in east Galway are not very species-rich, but that there may be an intermediate grassland type between improved grassland and semi-natural grassland. Data gathered also shows the existence of a range of habitats on farms has potential for HNV Type2 designation.

A MATHEMATICAL MODEL OF THE SEALING OF EARTH -BANKED TANKS WITH ANIMAL SLURRY

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Abstract

The objective of the research described in this paper is the development and experimental validation of a mathematical model to quantify the extent of sealing of earth-banked tanks by animal slurry. A model is developed from first principles to describe the flow of a suspension through a semi-permeable membrane. The key parameter in the model is the specific resistance to filtration (SRF) of the suspension, a parameter widely used in water engineering to characterise the dewaterability of water and wastewater sludges.

Experimental validation of the model was undertaken by constructing a laboratory-scale test column, 2m high and 0.074m diameter. The soil liner was simulated in the laboratory by a filter paper. Two suspensions were tested: inorganic waterworks aluminium hydroxide sludge and organic cattle slurry. The experimental results show that the mathematical model predicts a reduction in seepage due to the formation of a suspended solids 'cake' at the suspension/filter-membrane interface. The model is conservative i.e. it under-predicts the extent of membrane sealing by cake formation. Only membrane sealing resulting from advection of suspended solids is accounted for, while sealing due to sedimentation of solids is not incorporated into the proposed simple model.

Session 13**Title Waste Management (Part II)**

TITLE: Low-temperature anaerobic biotreatment as a core technology for the remediation of groundwater and low-strength industrial waste streams containing chlorinated and hydrocarbon pollutants.

AUTHORS: McKeown, R., Collins, G., Mahony, T. and O'Flaherty, V

INSTITUTION: Microbial Ecology Laboratory, Department of Microbiology and Environmental Change Institute, National University of Ireland, Galway (NUI, Galway), Galway, Ireland.

Low-temperature (4-20°C) anaerobic digestion (LTAD) is an emerging technology, offering a cost-efficient alternative to less-sustainable mesophilic (20-45°C) or thermophilic (>45°C) AD. Presently, full-scale application of LTAD technology is limited by a lack of quantitative/qualitative information on bioprocess considerations and on the nature and *in situ* functional role(s) of the microbial consortia involved.

We investigated the application of LTAD for the treatment of synthetic wastestreams containing the priority pollutants pentachlorophenol (PCP) and toluene. An anaerobic granular sludge was obtained from a full-scale, mesophilic bioreactor, with which, two pairs of laboratory-scale bioreactors, R1 and R2, and R3 and R4, were inoculated, and were employed for the mineralization of an acidified wastewater at 12°C and an applied organic loading rate (OLR) of 5 kg COD m⁻³ d⁻¹. Upon the conclusion of the respective start-up periods, the R1 and R3 influent wastewaters were contaminated with PCP and toluene, respectively, at concentrations of 2 mg l⁻¹ and 5 mg l⁻¹, respectively. R2 and R4 were used as control systems. Reactor performance was assessed by Chemical Oxygen Demand (COD) and PCP/toluene removal efficiency, and biogas quality (% methane) and yield. Influent toxicant concentrations were increased stepwise in response to improving reactor performance during the trials. Physiological and molecular ecological characterisations, of the seed sludge and temporal biomass samples from R1-4, were achieved by specific methanogenic activity (SMA) testing and 16S rRNA gene sequencing.

During the reactor trial, PCP and toluene loading rates of 5.0 and 40 kg m⁻³ day⁻¹, respectively, were successfully applied in R1 and R3, respectively. Gene sequencing data supported conclusions drawn from the physiological characterisation of reactor biomass, providing an insight into both community structure and functionality of cold-adapted anaerobic sludge. These results clearly illustrate the potential for LTAD as a sustainable, economical attractive bioremediation strategy for the treatment of PCP-toluene-contaminated groundwater/wastestreams.

Generation of Commercial Point-Source Food Waste for the Dublin Region

Mary Purcell and William L. Magette

School of Architecture, Landscape & Civil Engineering, University College Dublin.

Food waste generation can vary widely depending on the nature of individual commercial establishments. The objective of this research was to develop a reliable and realistic model for determining the food waste generation from the commercial sector within the Dublin region. Food generation was predicted within a diverse 'landscape' of point-sources (*i.e.* commercial establishments). The sizes and main activities of commercial establishments were hypothesized as the key determinants contributing to the spatial variability of food waste generation. A GIS 'model' of food waste generation was created using ArcGIS 9. The types of commercial activity likely to produce a high organic fraction (restaurants, hotels, hospitals, etc.) were identified and mapped on an electoral district basis for the Dublin region. Each sector was assigned a waste generation rate determined from scientific literature. Quantitative estimates of food waste generation were predicted as a function of faculty size, number of employees, number of beds etc.

The effect of filter depth and media on the removal of bacteria, organic carbon and nutrients

M.G. Healy, P. Burke, M. Rodgers, E. Clifford

Civil Engineering Department, National University of Ireland, Galway

Engineering Faculty Fellowship Study

The aim of this study was to examine the removal of bacteria, organic carbon, suspended solids (SS) and ammonia from secondary-treated wastewater using 0.65 m and 0.35 m deep sand and glass filter columns. Wastewater from a horizontal-flow biofilm system (HFBR) was applied to the surface of the filters in 24 doses each day from a feed tank using peristaltic pumps and spiral distribution manifolds. The wastewater was applied to each column at a rate $100 \text{ l m}^{-2} \text{ d}^{-1}$, giving an average organic loading rate of $3.2 \text{ g filtered chemical oxygen demand (COD}_F\text{) m}^{-2} \text{ d}^{-1}$, based on the surface area of each. Over the 10-month study duration, the filters were loaded with an average influent concentration of 7×10^6 colony forming units (CFU) of bacteria per 100 ml, $99 \text{ mg COD}_F \text{ l}^{-1}$, 22.4 mg l^{-1} SS and 7.5 mg l^{-1} of ammonia. At near steady-state conditions, nitrification and SS removal was complete in all columns and sand performed better than glass for organic carbon and bacteria removal. For the 0.65 m deep columns, effluent COD_F and bacteria concentrations were 53 mg l^{-1} and 1.0×10^6 CFU per 100 ml, respectively, from the sand column versus effluent COD_F and bacteria concentrations of 38 mg l^{-1} and 1.3×10^6 CFU per 100ml, respectively, from the glass columns. A similar trend was noted in the 0.35 m deep columns where effluent COD_F and bacteria concentrations were 53 mg l^{-1} and 1.4×10^6 CFU per 100ml, respectively, from the sand columns versus effluent COD_F and bacteria concentrations of 52 mg l^{-1} and 1.5×10^6 CFU per 100 ml from the glass columns.

Keywords: Sand and glass filter columns; filtered chemical oxygen demand; colony forming units.

Session 14**Title Animal & Plant Ecology (Part I)**

Integrating Harbour Seal Movement data in Web Visualisation tools**Iban Ameztoy**

Coastal & Marine Resources Centre, University College Cork.

An exciting study on seals behaviour at sea off southwest Ireland started earlier this year. The project funded by the Marine Institute under the National Development Plan will provide for the first time ever information on the movements and behaviour of seals in Irish waters.

Irish researchers from UCC, working with world leading experts in marine mammal research from the Sea Mammal Research Unit in Scotland are using sophisticated tags to study the seals offshore movements and behaviour. The tags use a novel telemetry system (fast acquisition GPS) together with mobile phone technology to relay the information back to a base phone.

Fine scale information on where the seals have travelled to offshore, along with data on dive depths and duration, will help scientists determine the foraging or feeding behaviour of seals.

One of the objectives is to make available all the information via a website and to display the data using different web-mapping based options.

The display and data integration methods are different depending in which option is chosen. These can be classified into three groups;

- Static Maps.
- Common Geographic Servers (e.g. MapServer, ArcIMS)
- Virtual 3d globes and 2d mapping systems (Google Earth, Google Maps)

The information available via Internet will be accessible to researchers, organizations and the general public interested in seals and Geographic Information Systems, making it possible to raise awareness of harbour seal behaviour in southwest Ireland and providing a medium through which the user can be informed of our research and of any exciting news regarding the project.

Oribatid mites (Arachnida, Acari) in arboreal habitats of one Irish Sitka Spruce stand

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In this communication some results about the oribatid mite populations found in the canopy of several trees from an Irish Sitka Spruce (*Picea sitchensis*) stand are shown.

After centuries of deforestation, the government policy currently encourages afforestation in the country, mainly with exotic species such as Sitka Spruce.

Little is known of the fauna of these plantations so it is of interest to know the composition of the biological communities because no native species would have co-evolved with the trees.

The oribatid mite fauna was collected in one Irish Sitka stand about 80 years old from Baunreagh (Co. Laois) in 2005 and proved to be of considerable interest and as speculated the data suggest that the fauna on non native stands in Ireland is depauperate.

Twenty four species of Oribatida were recorded from two arboreal microhabitats (branches and epiphytic moss) at different heights, being two of them new records for the Irish fauna. Several biological remarks about two species found in canopy *Eupelops acromios* and *Phauloppia lucorum* were done too.

Results showed a lower species richness in the Irish stand in comparison to those occurring in native Sitka forests from North America. Equitability values were generally low at all heights due to the dominance of few species. These most abundant taxa have been found previously in the country which may suggest that the great absence of co-evolved species. Several multivariate analyses were performed too.

Response of arbuscular mycorrhizal fungi to long-term phosphate applications in a grazed grassland

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Arbuscular mycorrhizal (AM) fungi are common root-colonising fungi that promote plant uptake of phosphorus (P). Roots of *Holcus lanatus* (Yorkshire-fog grass), *Lolium perenne* (perennial ryegrass) and *Trifolium repens* (white clover) were sampled bimonthly during 2004 and 2005 from plots of a long-term P application trial at Johnstown Castle, Wexford. These plots have received either 0 (P0), 15 (P15) or 30 (P30) kg P ha⁻¹ yr⁻¹ as superphosphate since 1968. Plots of a fourth treatment (P0-30) initially received no P, but since 1999 have been given 30 kg P ha⁻¹ yr⁻¹. Roots were stained and assessed for AM colonisation. Colonisation was quantified as the percentage of root length occupied by AM hyphae, arbuscules (the primary sites of P exchange), vesicles (fungal storage structures) and coarse and fine endophytes (two morphological groups of AM fungi). Colonisation varied throughout the year, with a reduction in November of both years. Levels of AM colonisation differed between the three plant species, being highest in *T. repens* and lowest in *H. lanatus*; this was consistent at all P levels and sampling times. P addition reduced AM colonisation in all species. Also, P application caused a shift in the AM community away from the fine endophyte morphotypes. This may be an indicator of functional change in the AM fungal populations associated with plant species in these grasslands.

Session 15**Title Waste Management (Part III)**

Domestic Waste Recycling in Cork County Council (Southern Division)

Over the past sixteen months, a co-mingled collection Kerbside service has been operating in the South Cork Division of Cork Co. Council. This has been introduced in addition to the 110 bring sites and 5 civic amenity sites currently in operation, in order to increase recycling rates throughout the County. Domestic waste recycling rates have increased from approximately 15% to 24% in 2006 due to the introduction of the Kerbside collection. Indeed since the full roll out of the service earlier this year following a 6 month pilot in 2005, the amount of material collected per household has risen from 192kg to 232kg. Participation rates (based on one participation per month) are running at in excess of 85% with a regular set out ratio of in excess of 75% being achieved. No doubt the introduction of user based charges on a pay by weight system have both educated the public and increased their awareness.

The service is provided to in excess of 28,000 households in South Cork with another 11,500 households now in receipt of a similar service in North Cork since August of this year. The Service accepts paper, magazines, cardboard, food tins, beverage cans, plastic packaging and plastic bottles.

The service is an alternate weekly collection with refuse on the other week. Crews are required to monitor the bins prior to emptying them. By now they can tell suspectably over weight bin. The proof of this is that contamination rates are running at 6%.

The materials recovery facility (MRF) that receives the materials collected across South Cork, is able to handle all of the materials presented. The quality of the material is quite good with 95% of the non-contaminated material being recycled.

South Cork are now examining the feasibility of introducing a third bin but if history is anything to go by, it will be introduced relatively easily with substantial public acceptance and utilisation.

EFFECT OF AERATION RATE ON NUTRIENT REMOVAL FROM SLAUGHTERHOUSE WASTEWATER IN INTERMITTENTLY AERATED SEQUENCING BATCH REACTORS

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The effect of aeration rate on nutrient removal from slaughterhouse wastewater was examined in two 10 litre laboratory-scale sequencing batch reactors (SBR1, SBR2) that operated at room temperature. The contaminants in the slaughterhouse wastewater had average concentrations of 4000 mg/L chemical oxygen demand (COD), 350 mg/L total nitrogen (TN) and 26 mg/L total phosphorus (TP). The duration of a complete SBR operation cycle was 8 hours and comprised four operational phases: fill (7 minutes), reaction (393 minutes), settle (30 minutes) and draw/idle (50 minutes). During the reaction phase, the reactors were intermittently aerated four times at 50-minute intervals, 50 minutes each time. Dissolved oxygen (DO), pH and oxidation reduction potential (ORP) were continuously monitored in the reactors. Four aeration rates - 0.2 L air/minute in SBR1 for 68 days, 0.4 L air/minute in SBR1 for 51 days, 0.8 L air/minute in SBR2 for 145 days and 1.2 L air/minute in SBR1 for 30 days - were applied to the two reactors, which were both operated at an average organic loading rate (OLR) of 1.2 g COD/L/d. The experimental data showed that when the aeration rates were 0.2 and 0.4 L air/minute, TN removal from the wastewater was less than 43%. When the aeration rates were 0.8 and 1.2 L/minute, average effluent concentrations were 125 mg COD/L, 20 mg TN/L and 0.8 mg TP/L, giving COD, TN and TP removals of 97%, 94% and 97%, respectively. In addition, it was found that nitrite-type nitrification and denitrification occurred in the intermittently aerated SBR systems.

O'Reilly, J., Collins, G. and O'Flaherty, V.

The Enigma of Anaerobic Sludge Granulation

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Anaerobic granulation describes the phenomenon, in which several microbial groups aggregate into dense, granular biofilms. Granules develop in, and underpin the operation of, high-rate bioreactors, used to convert organic matter in wastewaters to biogas (a renewable energy source) by anaerobic digestion (AD). Currently, most AD bioreactors are operated mesophilically (heated to 37°C). However, economic considerations have focused research towards developing low-temperature AD (LTAD; <20°C). Precise environmental and biological factors influencing anaerobic granulation are poorly understood, while virtually nothing is known about the potential for granulation under low-temperature conditions. This study addressed this knowledge gap. A mesophilically-cultivated, anaerobic granular sludge was obtained from a full-scale bioreactor treating dairy waste. The biomass was crushed to aggregates of <0.6 mm diameter and used to inoculate two laboratory-scale, low-temperature (15°C) bioreactors and one mesophilic (37°C) bioreactor. The bioreactors treated a synthetic, glucose-based, wastewater and were operated with a 12-hour hydraulic retention time and an organic loading rate of 5.8 kg chemical oxygen demand (COD)/m³/d, for 220 days. Bioreactor performance was assessed by COD removal efficiency and biogas production, and granule growth was assessed by periodically determining biomass size distribution profiles. The temporal methanogenic activity, of reactor biomass was also determined, in response to changes in reactor operating conditions.

The mesophilic bioreactor consistently achieved >90% COD removal, while this was >50% by day 10, and 60-75% by day 120, for the LTAD bioreactors. Mesophilic granulation proceeded rapidly and >50% of the granules were >1 mm by day 65. Limited LTAD granulation occurred, but a well-settling, biofilm developed, which was retained within both bioreactors; nevertheless, the specific conditions for mesophilic granulation did not encourage LTAD granulation. Based on these data, a LTAD granulation strategy for future trials was developed.

Saturday 27 January 2007 Time: 4.00 – 5.30pm

Session 16

Title Environmental Impact (Part II)

Millane, M.*, Kelly-Quinn, M., O’Grady, M., and Champ, T.

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Impact of the zebra mussel *Dreissena polymorpha* on the ecological integrity of Lough Sheelin

The zebra mussel, *Dreissena polymorpha* is perhaps one of the most notable freshwater invasive species of recent years. This is largely due to the rapid colonisation and proliferation capacity of the mussel, as well as the subsequent ecological and economic impacts that can occur as the species becomes established in previously unimpacted water bodies. Moreover, the introduction of the zebra mussel in North America (circa 1986), and more recently to Ireland (circa 1994) has resulted in a great deal of focus being placed on this invasive species.

The principal study site for the project is Lough Sheelin, a midlands lake on the upper Shannon catchment. This was originally an excellent trout fishery of high water

quality. Since the early 1970s, the lake has been under considerable environmental stress from eutrophication. On top of this, the recent introduction of the zebra mussel *Dreissena polymorpha*, is now exerting an additional pressure as it becomes established in the lake. This project is attempting to assess the impact the invasive species is having on particular aspects of the ecology of Lough Sheelin. The distribution, extent of colonisation and population characteristics of the mussel are being determined over the three-year duration of the project. In addition, changes to the fish, macroinvertebrate and plankton communities as well as to physiochemical parameters and fish diet are being assessed. Over 20 years of background biological and physiochemical data are available to aid in the assessments.

A Sediment Budget Analysis for Cork Harbour

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A sediment budget is the quantification of sediment sources and sinks within a natural physical system such as a river or estuary or a coastal cell. Sediment budgets may be used to identify the potential for sediment erosion or deposition. This study has developed a sediment budget for Cork Harbour. An extensive study of riverine suspended sediments discharging into Cork Harbour has been undertaken for the Glashaboy, Owenabue, Dungourney, Lee and Owennacurra Rivers. Both volume averaged and flux averaged sediment samples were collected, tested and analysed. The sampling consisted of two collection methods; surface grab sampling and depth-integrated sampling. A comparison of suspended sediment concentrations using both methods has been completed and a relationship between both methods developed. It is estimated that over 27,000 tonnes of suspended sediment is discharged into the Harbour annually from these rivers. All other quantifiable sediment sources and sinks have been studied to develop the sediment budget. These include dredging quantities, effluent discharges, marine exchanges and resident suspended sediment in the estuary.

Histopathological comparison of brown trout (*Salmo trutta*) sampled upstream and downstream of sewage treatment plants (STP) for potential effects of endocrine disrupting chemicals

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Recently, considerable concern has been expressed over the fact that a multitude of man-made chemicals have the ability to mimic the effects of endogenous hormones. These endocrine (hormone) disrupting chemicals - EDCs, particularly oestrogen-mimics may adversely affect reproduction rates and population levels in wildlife and humans by disrupting the organisms' endocrine system. EDCs can produce biological responses qualitatively similar to those produced by endogenous hormones. The group of EDCs includes synthetic steroid oestrogens such as ethynylestradiol-a potent oestrogen, which is of particular concern due to its role as the active ingredient in the contraceptive pill and in hormone replacement therapy. Endocrine disruption has been reported worldwide in freshwater fish populations. The phenomenon of endocrine disruption ranges from subtle changes in physiology and sexual behaviour of the fish to permanently altered sexual differentiation and impaired fertility.

Many EDC compounds inevitably find their way into rivers via sewage treatment plants (STPs). Research has demonstrated that sewage effluent is oestrogenic to fish. Biological effects in wild freshwater fish that have been attributed to the effects of EDCs include: (i) feminisation of male fish by the action of female hormones on the male endocrine system, (ii) intersex, the simultaneous appearance of both male and female gonadal cell types in the male testes, (iii) inhibition of testicular growth, (iv) inappropriate production in males, of, the female-specific hormone vitellogenin which is the protein precursor for the female egg yolk and (v) delayed spermatogenesis, which is the development of the spermatocytes to spermatozoa.

In this paper the gonadal histological analysis and gross morphology of the native brown trout (*Salmo trutta*) sampled upstream and downstream of treated sewage effluent point sources will be presented. The fish investigated in this study were sampled in conjunction with the Shannon Regional Fisheries Board by electrofishing.

Interactions between the phosphorus content of manures from dairy cows and losses of phosphorus to surface runoff

Intensive Irish dairy systems are in phosphorus (P) surplus. Regular over application of P to soils accelerates the risk of P loss in runoff to surface water bodies. Animal overfeeding through inorganic supplementation of dairy rations supplies cattle in excess of their metabolic needs. Dietary strategies manipulate animal diets to effectively reduce the P concentration in manure and could be an important mitigation option for future P-based management plans. This research aims to assess how variations in the P content of dairy cow manure affects the forms and concentrations of P in surface runoff from grassland swards. Rainfall simulation studies were undertaken on a hillslope site at Hillsborough Co. Down to investigate the persistence of the P signal over time during the summer and winter of 2006. Preliminary results are encouraging and show that lowering the level of P content in the manure of dairy cows lowers the P concentration in surface runoff and clearly has environmental benefits.

Session 17**Title Environmental Change**

THE USE OF GIS AND GPS TO ENHANCE THE ACCURACY OF SEA-LEVEL RISE INUNDATION-MAPPING FOR THE PREDICTION OF FUTURE SALT MARSH CHANGE IN THE SHANNON ESTUARY.

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Global average temperatures have increased by approximately 0.6°C during the 20th century, and are projected to increase by at minimum additional 1.4 °C by 2100. The relationship between atmospheric warming and sea-level rise (SLR) is well documented, and is expected to lead to SLR of up to 1m by 2100. As predominantly sedimentary environments, estuaries are characterised by shallow-gradient coastal profiles, making them ideal environments for coastal salt marsh, and rendering them sensitive to even modest SLR. The Shannon estuary SAC and the Shannon / Fergus estuary SPA support a range of protected salt marsh species. These salt marsh areas are sensitive to SLR, and coastal squeeze seaward of existing reclamation barriers that protect low-lying sections of the estuary coast. SLR inundation sensitivity can be mapped relatively easily in Geographic Information Systems (GIS) using a Digital Terrain Model (DTM). However, the generation of meaningful inundation prediction mapping requires high vertical-accuracy DTM data. Height errors in the Irish national DTM dataset are quoted at ±5m, which are well beyond the maximum SLR predictions issued by the IPCC. Dual-frequency (survey grade) Global Positioning Systems (GPS) is capable of measuring height above datum to an accuracy of 1–2cm. Dual-frequency GPS surveys carried out in an area to the south of Shannon town containing four salt marshes confirms the unsuitability of the national DTM dataset, and provides a high point-density DTM dataset for the generation of enhanced-accuracy SLR prediction mapping. The extent to which DTM-derived variables including elevation, slope and coastal shape might serve as predictors for salt marsh occurrence is being tested against maps of present-day salt marsh, with a view to refining a model for the prediction of future SLR-driven salt marsh change.

The effects of Climate Change on grass yields and carbon sequestration.

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Abstract:

Changing levels in global atmospheric CO₂ concentrations has lead to an interactive effect on temperature and precipitation regimes. Current climatic models (IPCC, 2001) for 2055 have estimated that there will be a 15% increase in precipitation levels during winter months and a 15% decrease in the precipitation levels during the summer months. The predicted changes in rainfall patterns are expected to lower the mean and increase the variability in soil water content which may in turn impact on plant growth, yields and quality as well as the ability of vegetation and soils to sequester carbon. As 67% of Irish agricultural land is currently under pasture it is essential that the impact of such changes be investigated as this will have significant consequences for Ireland's ability to trade in carbon credits and impact current and future management schemes.

Using an existing mesocosm system located in Oak Park Co. Carlow, with an automated temperature and water control, swards of *Lolium perenne* var. *Cashel* are currently growing in simulated 2055 precipitation levels and also ambient conditions .

This is done by experimentally altering the rainfall inputs to the 2055 chambers where the timing of and quantity of rainfall is held at either 15% above (winter) or below (summer) compared with ambient conditions. The mesocosm system allows for measurement of gross component carbon fluxes – photosynthesis and respiration - which can be used to determine total net carbon flux and sequestration into the soils. Harvesting will allow for estimation of grass yields during the different growing seasons and grass quality will also be determined.

The final output of this project aims to make a direct assessment of the impact of the climate treatment on the *L. perenne* swards grown over a two year period. Results to date have shown that eight weeks after sward establishment, net CO₂ fluxes were 50% lower at future climatic conditions when compared to ambient conditions, reflecting decreased soil water status during the summer period.

Reference:

IPCC (Intergovernmental Panel on Climate Change) 2001 Climate change 2001: The scientific basis. J.T. Houghton, Y. Ding, D.J. Griggs, M. Noguer, P.J. van der Linden and D. Xiaosu (eds). Contribution of Working Group 1 to the Third Assessment Report of the Intergovernmental Panel on Climate Change. Cambridge, England. Cambridge University Press.

Soil CO₂ diffusion chamber for use in monitoring soil CO₂ efflux

Fabrizio Albanito and Mike B. Jones

Soil contains the largest active terrestrial carbon pool on Earth, and through soil respiration, contributes an annual flux of CO₂ to the atmosphere that is 10 times greater than that from fossil fuel combustion (Schlesinger, 1997). Due to the magnitude of this flux, soil respiration, has a potential role either to amplify global warming due to its sensitivity to environmental conditions (Cox et al., 2000) or to mitigate climate change due to enhanced soil carbon sequestration and reduced CO₂ effluxes (Goh, 2004).

Numerous methods have been used to sample soil gases at varying depths below the soil surface. Only recently methods of soil CO₂ efflux measurement have started to use gas permeable polymers such as polypropylene, silicone or porous Teflon.

In this study we use a new method to monitor continuous soil CO₂ profiles in a *Miscanthus x giganteus* crop ecosystem in central Ireland. Soil CO₂ diffusion chambers enclosed within a micro-membrane of polypropylene (PVDF) were buried at different depths in the soil.

Previous methodologies of measuring soil CO₂ profiles include the use of small solid-state sensors. Although these sensors can operate under humid conditions the sensing element of these instruments must be protected from liquid water with a membrane that is permeable to CO₂. Moreover, in long term studies undisturbed soil conditions are essential and the solid-state sensors may need to be retrieved from the soil profile for essential maintenance work. Therefore the burial of diffusion chambers is likely to be more reliable over time.

Based on the measurement of soil CO₂ profiles, we have measured seasonal patterns of CO₂ concentration in the soil varying from 2435 $\mu\text{mol mol}^{-1}$ to 20010 $\mu\text{mol mol}^{-1}$ with depth, up to 80 cm, between days 271 and 305 in 2006.

The vertical soil CO₂ concentration showed similar temporal variation at all depths and had significant variation correlated to soil temperature, soil volumetric moisture and atmospheric pressure changes at all depths. The daily mean values at 10cm depth varied from 2851 $\mu\text{mol mol}^{-1}$ to 6434 $\mu\text{mol mol}^{-1}$. Over the same period at 20cm depth the daily mean CO₂ values varied between 7013 and 14120 $\mu\text{mol mol}^{-1}$, from 10935 to 17148 $\mu\text{mol mol}^{-1}$ at 40 cm depth, and from 12325 to 18870 $\mu\text{mol mol}^{-1}$ at 80 cm depth.

Knowledge of CO₂ concentration at depth within the soil, coupled with a gaseous diffusivity model, can allow estimates of soil CO₂ flux and its temporal variation. Based on soil CO₂ concentration gradient and the diffusion coefficient estimated from the Millingtoun-Quirk model, continuous soil CO₂ effluxes will be calculated. Moreover, estimation of change in isotopic ratio of soil respired CO₂ in the soil profile will be assessed in an attempt to partition the sources of CO₂ efflux from the soil

Fluxes of Greenhouse Gases from Agricultural Soils

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Keywords

nitrous oxide, emission factor, grassland, spring barley, reduced tillage

Abstract

Results are presented from a two year study on a cut and grazed pasture and a spring barley crop managed under conventional and reduced tillage. The aim of the study was to determine seasonal fluxes of N_2O using static chambers, emission factors and major environmental variables. Annual flux was highest in the cut and grazed pasture at a rate of $2.4 \text{ kg N}_2\text{O -N ha}^{-1}$. Emission factors ranged from 0.4 to 0.8% of the applied inorganic N-fertilizer. No effect of tillage was observed for both flux and emission factor. A multiple regression of N_2O flux against soil nitrate, soil ammonia, soil temperature and moisture content for the two-year data sets from both crop types revealed only soil nitrate as the significant determinant of N_2O flux.

A further study was investigated into the effect of decreasing N-fertilizer application rate on crop yield and emissions of N_2O from the spring barley crop. An exponential relationship was determined between grain yield and cumulative emissions of N_2O where the proportional increase in N_2O emissions was greater at higher crop yields. Reducing the field application rate of inorganic N by 50% had little effect on grain yield over the two years, but decreased the cumulative N_2O flux by a half.

Data from both crops and management regimes were used to validate the mechanistic model, DNDC.

Session 18**Title Environmental Management I**

EVALUATION OF STABLE ISOTOPE ANALYSIS AS A TOOL TO DETERMINE NITRATE SOURCES IN IRISH GROUNDWATERSMinet, E. ^{*1} and Coxon, C.E. ²

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This work explores the use of isotopic analyses ($\delta^{15}\text{N-NO}_3^-$ and $\delta^{18}\text{O-NO}_3^-$) as a tool to identify sources of groundwater nitrate. Research was carried out in the Barrow Valley where unsewered dwellings and farmyards (organic point N sources) are scattered in agricultural areas subjected to large applications of artificial fertiliser (inorganic diffuse N sources). The testing of isotopes was motivated by the fact that artificial and organic N-derived nitrates display distinctive isotopic signatures.

Sampling sites were first classified into two groups (inorganic diffuse vs organic point source contamination) according to two independent methods: i) hydrochemistry (based on the exceedance/non-exceedance of contamination thresholds), and ii) spatial characteristics (based on the presence/absence of organic point sources within 100m and 300m radius). But the comparison of both site classifications showed some contradictions at high nitrate sites. Subsequently, $\delta^{15}\text{N-NO}_3^-$ and $\delta^{18}\text{O-NO}_3^-$ values were analysed in relation to both site classifications. However, most $\delta^{15}\text{N-NO}_3^-$ values lay within a narrow range (4‰ to 9‰), corresponding to values reported in the literature for soil organic N-derived nitrate, regardless of the classification and the associated N source. Similarly, most $\delta^{18}\text{O-NO}_3^-$ values were consistently low (0‰ to 5 ‰), which was attributed to the occurrence of Mineralisation-Immobilisation Turnover (i.e. remineralisation of nitrate assimilated by bacteria). Nevertheless, $\delta^{15}\text{N-NO}_3^-$ was significantly lower at the 0.05 level at sites associated with artificial diffuse source contamination when sites were classified according to spatial characteristics. When sites were classified according to hydrochemistry, the significance of the difference between sites associated with artificial diffuse and organic point source contamination was improved to the 0.0005 level. The significance of this difference further improved to the 0.0001 level when comparing sites where hydrochemistry and spatial characteristics agreed.

CALCULATING NITRATE LEACHING LOSSES UNDER DIFFERENT STOCKING RATES AND SOIL TYPES

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Nitrate leaching is a serious issue for agriculture in Europe. Legislation aimed at mitigating nitrate losses from agricultural sources has been implemented recently in Ireland. In order to identify areas of high nitrate leaching risk and to assess methods of reducing leaching, accurate data on nitrate leaching from different farming systems and soil types is required. Within grassland systems, stocking rate and soil type have been shown to be important factors contributing to nitrate leaching. Nitrate leaching can be measured in the field through either grazed lysimeters or soil solution sampling. However measuring nitrate leaching within one field only gives results relevant to that farming system (stocking rate) on that soil type, requiring many field trials to assess leaching losses from different soil types and different farming systems. Within grazed grassland systems most nitrate leaching comes from animal urine patches, where there is a high concentration of nitrogen in the soil. Leaching is considerably lower from areas of the paddock that have not received urine. A paddock can therefore be divided into two distinct regions (urine and non-urine), with markedly different nitrate leaching losses. The major effect of stocking rate on nitrate leaching is to change the proportion of the field that has had urine deposited on it. This trial determines leaching losses from urine patches and from non-urine areas using lysimeters, on three different soil types. The spatial and temporal distribution of urine patches is determined separately, under different stocking rates, by recording urine patch distribution using GPS equipment. This data is then combined to model field scale nitrate leaching on a range of soil types. The model can then be used for scenario analysis to identify sustainable grazing management practices for a range of stocking rates and soil types.

Estimation of imported methane.

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Carbon dioxide (CO₂) has been the focus of many environmental and resource management studies. Indeed estimations of CO₂ emissions have often been adapted as an important indicator of environmental impact. However methane (CH₄), with its associated global warming potential (GWP) of 21 times carbon dioxide should not be neglected as an environmental indicator for informed environmental management. Subak (1995) calculates embodied organic CH₄ based on imported animal products and selected plant products (such as rice). While this is a significant component, the CH₄ associated with imported embodied energy should not be dismissed. This study is an attempt to include the inorganic methane associated with imported embodied energy. An attempt was made to account for differences in methane intensities from exporting countries. Methane intensities for OECD countries were calculated using emission and energy consumption estimates taken directly from National Inventory Reports (NIR), published in conjunction with the IPCC (Intergovernmental Panel on Climate Change). For other countries the methane intensities were estimated using energy balances published by the International Energy Association (IEA) and IPCC default emission factors. The calculated intensities included the direct emissions due to fuel consumption and the indirect (fugitive) emissions due to fuel production and consumption. As fuel production is geographically dependant, all fugitive emissions are retained in the country that produces them, treating them as indirect emissions of energy consumed within that country. The methane intensities estimates based on NIR data were considerably lower (.0001 kg CH₄/Mj) than the global average (.0003 kg CH₄/Mj). This can be attributed to differences between country specific and default emission factors as well as the geographically specific fugitive emissions which are considerably higher for certain regions.

Key Words: Methane, intensities, fugitive emissions,

An Evaluation of existing and potential measures to sustain an increased biodiversity and water quality on Irish farms

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Abstract

The Rural Environmental Protection Scheme (REPS) was initiated in Ireland in 1994 as the Irish government's response to the EU Agri-environmental Regulation (90/20788/EEC). Since its establishment almost 2 billion euro has been paid to farmers under REPS. The REPS addresses the protection and maintenance of field and watercourse margins by incorporating a number of measures (1, 2, 3, 5, 6, 9, SM4). Measures involving field margins affect all farmers who join REPS. Despite this, little empirical research has been undertaken in Ireland into the effect these measures have on biodiversity. The present study aims to develop and improve the effectiveness of existing field and watercourse margin measures from both a biodiversity and water quality point of view. This will be achieved through a combination of theoretical and practical studies. It will combine relevant existing Irish and European studies with new knowledge based on an Irish context.

The project will contribute to maximising field and water course margins as a habitat for biodiversity and also ensuring an increased water quality.

Session 19**Title Animal & Plant Ecology II**

The Status of the Twite *Carduelis flavirostris* in Ireland**Derek McLoughlin*, Dr. Don Cotton**
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Despite being a resident species here, remarkably little is known about the ecology, movements or even current population status of twite *Carduelis flavirostris* in Ireland. Twite populations in Ireland have thought to be in decline since the beginning of the last century. However, serious declines have taken place over the past thirty years with the 1988-1992 Breeding Atlas showing a drop of 52% on the 1968-1972 Atlas. On foot of this decrease, twite has been listed in the Irish Red Data Book and on the Red List of Birds Of Conservation Concern in Ireland. This project aims to determine the habitat requirements of the twite and investigate its ecology here. The study is focusing on breeding populations in west county Donegal and north county Mayo. Preliminary results indicate an estimated national population of between 100-150 breeding pairs. Since January of 2006, over 300 twite have been colour-ringed. Recoveries from some of these birds have so far illustrated short distance local movements between breeding and wintering sites. Colour-ringing has also generated important data on breeding home ranges and feeding sites. This study is being carried out with a view to establishing effective species management and conservation plans that will attempt to halt its decline and enhance its population in Ireland.

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Title: Conservation Biology of *Saxifraga hirculus* (Marsh saxifrage) in Ireland.

Abstract

The aim of this project is to investigate the ecology, population demography, reproductive biology and genetic variation within and among Irish populations, providing the baseline information on the species' current status and requirements in Ireland. As a result of its sharp decline in the past century throughout EU it has been listed in the 1992 Habitats Directive as a species requiring special conservation measures. This current project is therefore driven in part by the national obligation to monitor this species.

In the Republic of Ireland, *S. hirculus* is currently found only in County Mayo with eight sites documented. All Mayo sites lie within an area of c. 14 km by 14km. In Northern Ireland *S. hirculus* is recorded from one location in the Garron Plateau in Co. Antrim. In Ireland the plant appears to be restricted to mineral flushes in what is otherwise ombrotrophic blanket bog.

In marginal populations like those of the *S. hirculus* inbreeding is a very real risk and can place such populations in danger of extinction. This can have important consequences for associated conservation policies. In addition, populations that have experienced unpredictable levels of pollinator activity on a historical level may overproduce flowers and ovules to take advantage of years with excessive pollinator activity. These populations may suffer from pollen limitation in intervening years.

Pollination work was carried out in 2005 and 2006. Studies that were used were Pollen limitation experiments and hand pollination experiments (autogamy, geitonogamy, xenogamy with pollen transfer within a site and xenogamy with pollen transfer between sites).

Population censuses have been carried out for each known site and the associated vegetation classified. Grazing levels are high with up to 77% loss of flower heads observed in one year. In order to examine the extent of clonal spread, AFLP finger printing will be used. In all eight known sites, random plant samples have been taken..

As a result of these investigations the project aims to develop suitable monitoring methods and undertake a population viability analysis, with an overall aim of producing a management plan for the species in Ireland.

Quantitative Assessment of Turlough Vegetation - Preliminary Findings

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Turloughs are temporary lakes over karst limestone that fill and empty mainly in response to groundwater fluctuations. They are included as Priority Habitats on Annex I of the EU Habitats Directive (92/43/EEC), and are also protected as Groundwater Dependent Terrestrial Ecosystems under the EU Water Framework Directive (WFD) (2000/60/EC). Ireland is, therefore, under obligation to conserve and maintain these valuable habitats. Turloughs are subjected to regular inundation with calcium-rich groundwater, exerting a highly selective pressure on their biota, which has resulted in the unique flora and fauna of these ecotones. Regular zonation of vegetation is evident in turloughs, which is related to depth, frequency and timing of inundation.

As the first phase of a three-year project, field surveys were carried out in two turloughs, recording plant species cover/abundance (using the DOMIN scale), along with information on mean vegetation height, amount of grazing and/or poaching and type of herbivores present. Information on soil depth, type, rooting density and mottling were also recorded. The relevé data were then analysed using ordination, hierarchical clustering and indicator species analysis.

Preliminary results indicate the presence of discrete vegetation units occurring in areas with a similar flooding regime (height above water level), grazing intensity and soil type. Different species and vegetation types were found in the two turloughs, Caranavoodaun and Garryland. This might be expected, as these sites were selected because of their differences in both nutrient status and management regime: Caranavoodaun is one of the more oligotrophic turloughs in the study and is stocked at a relatively low density with cattle, while Garryland is relatively eutrophic and has a large number of both cattle and sheep, and has a history of being overgrazed. These factors, among others, will have an affect on the vegetation communities present.

Sunday 28 January 2007 Time: 9.30 – 11.00 am

Session 20

Title Environmental Policy and Recommendations

Assessing Access to Environmental Justice

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The presentation begins with a brief outline of the Environmental Democracy Project, and the current legal measures that are relevant to the research.

The legal background to access to environmental justice in Ireland is discussed. The influence that international developments have had on the barriers to justice in general, and environmental justice in particular, will be examined. The research will look at the situation with regard to access to environmental justice in Ireland at the moment, through the courts, administrative tribunals and alternative avenues of complaint and redress, and attempt to identify the gaps in the provision and barriers to access. The purpose of the research is to identify these clearly and make recommendations that can help to instigate change.

Application of the Principles of Industrial Ecology on a cluster of Small to Medium Sized Enterprises (SMEs) in the Mid West Region.

Yvonne Ryan, Dr. Bernadette O'Regan, Prof. Richard Moles.
Centre for Environmental Research, University of Limerick.

A key feature of the Irish economy is the strong presence of SMEs. Their environmental impact is often overlooked; however it is estimated that they could contribute up to 70% of industrial pollution. Supply Network Shannon (SNS), a network of SMEs, anxious to improve their environmental performance approached the Centre for Environmental Research. Rising costs especially in the areas of energy, transport and waste were of concern to the SMEs involved and establishing an eco-industrial network, if successful was envisaged as a solution both to economic and environmental problems.

Site visits, environmental reviews, surveys and individual environmental reports for each company were completed. The data collected provided an invaluable insight to the operations of each company in the network. Using the principles of industrial ecology, the most viable and realistic collaborative opportunities were identified.

This paper will display some of the collaborative opportunities identified and the case for greater encouragement of cluster development with specific focus on industrial ecology amongst SMEs.

National Parks and Protected Areas: Ireland's "honeypot" approach to protected area management

Noel Healy, NUIG

Considerable debate exists over whether nature-based tourism can be sustainable, and what management regimes can be employed, to minimise the negative impacts associated with anthropogenic influences on natural ecosystems. Maintaining the balance between attracting tourists to threatened environments, while simultaneously conserving, protecting and implementing sustainable tourism practices has proved difficult. Proposed and current visitor centre developments in Ireland's National Parks and protected areas have led to an unprecedented level of controversy at local, national and indeed international level, causing some of the longest drawn out acrimonious environmental debates in Ireland's history.

These developments have highlighted the gap in knowledge in relation to best management practices and visitor management strategies in Ireland's protected areas. This paper therefore, questions the role of visitor centres in the management, conservation and utilisation of the landscape, through a critical assessment of two of the more controversial visitor centre controversies; Mullaghmore in the Burren National Park and the current visitor centre developments at the Cliffs of Moher.

This paper examines how these developments have led to the commodification of certain protected landscapes, and highlights the extent to which monetary concerns seem to be the driving force behind the development and protection of these areas. The paper concludes that Ireland's protected landscapes are at risk of becoming homogenised, losing their richness, minimising their distinguishing cultural features and ironically their unique selling point. The paper argues that a more holistic, integrated regional approach to protected area management is needed whereby whole landscapes are protected and managed, not just individual 'honeypot' tourist destinations.

Greening The Personal Computer

José Ospina
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The importance of developing a Green Computer can best be understood in relation to the impact of the IT industry on the environment and society.

The Greenpeace web site (www.greenpeace.org) suggests that by 2010 there will be 716 million computers in use, including 178 million new users in China and 80 million in India. The break-neck speed of technological developments and their in-built obsolescence is constantly reducing the life span of PCs and peripherals. The average life span of a PC was 6 years in 1997, but by 2005 it was only 2 years. This has resulted in growing E-waste problem, which is also a serious environmental and social problem. The US exports from 50-80% of its electronic waste (as do most industrialised countries) to less-developed countries that do not have the infrastructure to recycle, manage or dispose of this waste safely. This is having significant consequences on the health and environmental sustainability of these regions, and this situation is likely to get worse.

The development of a Green Computer, one that contains no toxic waste, is relatively easy to reuse or recycle, is a persistent dream for environmentally aware IT developers. Over the past 16 years, a number of computer manufacturers have claimed one or more of their products to be more or less “green”. Some models have indeed secured one or more of the many energy and environmental labels available on a world-wide basis.

One notable example is the Siemens Nixdorf PCD-4Ls (1993) which Siemens described as “the world’s first Green PC”. This model was produced “using recyclable materials, and claimed to have an energy consumption up to 90% less than earlier PC’s, without any noticeable effect on functionality and processing power”.

Project HEATSUN strongly believes that the process of developing the Green Computer by a small and local SME, supported a EC supported Partnership, is a good and replicable example of how the European Commission, government agencies and SME’s can create a genuine opportunity for growth and competitiveness, on the basis of environmental innovation.

Session 21**Title Environmental Management (Part II)**

***Hannigan, E. and Kelly-Quinn, M.**

Hydrochemical characteristics of open-water habitats in Irish Peatlands

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The present study is part of a national project developing a protocol for sustainable peatland management. We are examining the hydrochemical and biological characteristics of open-water habitats in Irish peatlands. This paper will present the chemical characteristics of these waterbodies. In Ireland peatlands are normally divided into three categories; blanket bogs, raised bogs and fens. Blanket bogs can be further divided into lowland and mountain blanket bog. Both blanket bogs and raised bogs are considered to be ombrotrophic. Ombrotrophic bogs generally have a low pH, making them quite acidic, and a poor nutrient supply as they rely on rainfall and precipitation to obtain nutrients. Fens are minerotrophic as they are fed mainly by groundwater, resulting in a plentiful supply of mineral-rich water. Generally they have a near neutral pH. In the present study eight study sites were chosen to represent all categories of peatland and included two raised bogs, two fens, two Atlantic blanket bogs and two mountain blanket bogs. The parameters measured were: pH, alkalinity, conductivity, nutrients (nitrate, phosphate and ammonia), cations and anions. The total organic carbon was also measured. The hydrochemical results obtained from each site were used to highlight any variations that may be present between the water bodies found within each site and also any variations that occur between the different categories of peatland. The results may enable a more accurate classification of aquatic habitats in peatlands in Ireland.

Documenting variations in environmental quality indicators over the last c.a. 150 years in Ireland; a multi-proxy approach

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Over the last 200 years, humans have greatly manipulated the environment through processes of industrialisation, urbanisation, and agricultural intensification. As a result, anthropogenic air pollution has increased dramatically. In the last 20 years, air pollution has re-emerged as a major environmental health issue with concern now focussing on the effects of both short-term (acute) and long-term (chronic) exposures to ambient levels of pollutants. Particulate matter (PM) is a key ingredient of polluted air and is a contributing factor to a wide range of acute and chronic health problems. PM is derived from both natural (e.g. soils, sea salts, pollen) and anthropogenic (by-products of the incomplete combustion of fossil fuels) sources and can be classified according to size. Course PM ($>2.5\mu\text{m}$) originates primarily from natural sources while fine PM ($<2.5\mu\text{m}$) and ultra-fine PM ($<0.1\mu\text{m}$) are sourced primarily from anthropogenic sources. Fine and ultra-fine PM are potentially the most dangerous, due to particle size, which increases their potential for long-range transport and allows them to penetrate deep into the lung. Therefore, PM is not only a local, or national problem, but a global problem. Currently, long-term time series data from monitoring programs in Ireland are lacking. Palaeolimnology is a multi-disciplinary science that uses the physical, chemical and biological information preserved in lake sediment profiles to reconstruct past environmental conditions in inland aquatic systems. In addition, lake sediments provide a reliable record of atmospheric deposition to a lake and its catchment. Utilising multiple palaeolimnological proxy evidence, this research will reconstruct variations in atmospheric pollutant deposition in Ireland, both temporally and spatially, over the last c.a. 100-150 years. Furthermore, it will assess the validity and reliability of the palaeolimnological approach to examining atmospheric pollutant deposition, against available documentary records of atmospheric quality in Ireland.

Quantifying Dissolved Carbon Losses from Soils: Effects of Land Use and Management Practice

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With the ratification of the Kyoto protocol it has become important to accurately quantify the carbon sequestration capacity of managed ecosystems in Ireland for both reporting reasons and as a basis for developing carbon-related mitigation strategies. Atmospheric based assessments of net biome productivity (NBP) are often larger than inventory based assessments of NBP, possibly due to unaccounted losses of dissolved carbon (C). As the magnitude of this may vary with vegetation, soil type and land-use we are examining dissolved C losses from three major Irish land use types: arable, grassland and forest. To assess dissolved C, we are sampling the soil solution at two depths using glass suction cups and analysing for both dissolved inorganic and organic C. Fluxes of dissolved C are calculated by multiplying concentrations of leachates with the volume of leached water. Groundwater recharge is estimated by calculating changes in the soil water budget with a simple capacitance model. Concurrent with these measurements N losses are also assessed providing a better understanding of interactions between C and N cycling.

An overview of the Environmental Research Institute at UCC

Paul Bolger

The Environmental Research Institute (ERI) at University College Cork (UCC) formally came into existence in 2000. The mission of the ERI is to foster multidisciplinary environmental-based research within UCC to the highest international standards. The Institute cultivates innovative and sustainable research themes, pools valuable resources and expertise, and ensures the development of an integrated, internationally-competitive research infrastructure informed by cross fertilisation of ideas from up to 15 different departments and 4 different Centres of excellence. The ERI is an inclusive organisation that wishes to build collaborative links in novel ways within UCC and with other Irish institutions.

This presentation will provide an overview of the research being carried out within the ERI in particular looking at research within the five thematic areas (Biodiversity & Ecotoxicology, Environmental Chemistry, Marine and Freshwater, Environmental Microbial Genomics, and Sustainable Energy and Environmental Engineering) and the four centres of excellence (Coastal & Marine Resources Centre, Aquaculture & Fisheries Development Centre, Aquatic Services Unit and Cleaner Production Promotion Unit).

The presentation will be of interest to those researchers who wish to obtain a “helicopter” view of environmental research at UCC and to those who would like to build collaborative links with the Institute and its researchers.

Session 22**Title Conservation/Biodiversity & Agricultural Biota
Part II**

Authors:

Stephen McCormack, Annette Anderson, Helen Sheridan, Gordon Purvis
School of Biological and Environmental Sciences, University College Dublin,
Belfield, Dublin 4.

Title:

Abstract:

Hymenopteran parasitoids are a major component of insect biodiversity. As specialist predators and parasitoids, they are dependent on other arthropods and are potentially useful indicators of the wider biodiversity in agricultural ecosystems. In this study hymenopteran parasitoids were sampled from pastures on 50 farms in southeastern Ireland. Data on farm type, grass sward composition and farm habitats were analysed to investigate factors affecting the diversity of hymenopteran parasitoids. Initial analyses indicate that farms with more intensive grassland management have a less diverse parasitoid fauna, compared with farms with lower management intensity

Investigation of trophic relationships of grassland ants using stable isotopes

Audrey O'Grady, Department of Life Sciences, University of Limerick, Limerick

Olaf Schmidt, UCD School of Biology and Environmental Science, UCD, Belfield, Dublin 4

John Breen, Department of Life Sciences, University of Limerick, Limerick

Ants are keystone species in many ecosystems especially grasslands. Ant workers are dominant predators of other insects and invertebrates and feed the prey mainly to their larvae. Honeydew, from aphids and other homopterans, is very important in the diet of adult worker ants. Some ant species collect seeds as food items (myrmecochory). Hence different ant species in an ecosystem might be expected to have different trophic positions. Differences in the ratios of the stable isotopes of N and C were used to investigate the trophic relationships of eight species of grassland ants. Within a one-month period in July 2005, samples of adult workers and larvae, where available, were collected from ten nests of the following species *Lasius flavus*, *L. niger*, *Formica lemani*, *Leptothorax acervorum*, *Myrmica ruginodis*, *M. scabrinodis*, *M. sabuleti* and *M. schencki* in limestone grassland at Borrhigone, Co Limerick. The stable isotopes of N and C were analysed using Isotope Ratio Mass Spectrometry (EA-IRMS). In all species delta-C was higher in adult workers than in larvae. Except in *Lasius niger*, delta-N levels were higher in larvae than in workers. The results are being used to attempt to interpret the trophic status of workers and larvae, both intra- and inter-specifically, in a grassland food web.

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What are the habitat preferences of Scottish Blackface hill sheep and the implications for blanket bog conservation?

Bryony Williams*⁽¹⁾, Michael Walsh⁽²⁾ & Mike Gormally⁽³⁾

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Blanket bog has been identified as a priority habitat for conservation under Annex I of the EU Habitats Directive. This habitat occurs in the mountainous regions of western Ireland where sheep production is the most widespread agricultural land use and Scottish Blackface the dominant breed. Whilst grazers are an important management tool in ecological conservation, inappropriate grazing management can cause plant community changes, damage to soil structure and soil erosion. Therefore a better understanding of sheep behaviour in an area supporting blanket bog is required for informed decisions about conservation policies, in addition to enabling farmers to utilise the hill resource more sustainably for agricultural production.

The 250ha Teagasc Hill Sheep Farm on Ben Gorm in Co. Mayo forms the study site for this project. Fieldwork was carried out during nine 5-week seasonal sampling periods between February 2004 and April 2006. Data collected from GPS tracking collars, flock observations and focal area sheep observations provide information on sheep ranging behaviour. Habitats occurring on the study site were classified using 'A Guide to Habitats in Ireland' (The Heritage Council, 2000) mapped with the aid of aerial photographs and digitised using ArcGIS. Ewe ranges and core areas, and habitat availability and use were analysed using Ranges7. Compositional analyses of habitat preferences were carried out using Compos Analysis v.6.2+.

Spatial distribution of hill sheep was uneven from preferred areas with high occupation to unoccupied areas. From ten available habitat types, acid grassland was most preferred, blanket bog of low preference and cutover bog most avoided. Management prescriptions to redistribute grazing pressure, such as seasonal grazing, regular shepherding, temporary fencing or the strategic use of supplementary feed blocks, are required to achieve long-term conservation and agricultural objectives.

GEO-ECOLOGICAL STUDIES ON TWO ULTRAMAFIC SITES IN WESTERN IRELAND

Francis Q. Brearley,

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Ultramafic soils are derived from igneous ultramafic rocks and generally have low available plant nutrients, high levels of metals (notably Fe, Mg & Ni) and often poor water holding capacity. Ultramafic soils are found in many sites around the world where they can vary from exceptionally barren to reasonably fertile. Two reasonably fertile ultramafic sites from western Ireland were studied: grassland on Dawros Peninsula, Connemara, Co. Galway and grassy heath near the base of Croagh Patrick, Co. Mayo.

I present data on rock mineralogy and elemental composition, soil nutrient concentrations and water holding capacity. I also present data on a bioassay experiment in which *Lolium perenne* (Poaceae) was grown in soils from the two sites and compared with growth from an extreme ultramafic site in Scotland as well as non-ultramafic growth media.

The Irish ultramafic soils showed many of the chemical characteristics typical of other ultramafic sites including a high Ni content. However, Ca content was reasonably high, as was the water holding capacity, and the high Ca content is likely to have an ameliorating effect on soil toxicities leading to vegetation which is not markedly different from the surrounding non-ultramafic soils.

Plans for future work are noted including an examination of soil microbiology and plant nutrient and metal concentrations.

Title **Animal and Plant Ecology III**

The ecology of Scots pine (*Pinus sylvestris* L.) in Ireland

Roche, J.R.*, Mitchell, F.J.G. & Waldren, S. Department of Botany, School of Natural Sciences, University of Dublin, Trinity College, Dublin 2, Ireland.
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To date, the ecology of *Pinus sylvestris* in Ireland has not been adequately described. Previous research to determine the native status of *P. sylvestris* in Ireland has produced ambiguous results. *P. sylvestris* has consequently been excluded from the National Survey of Native Woodland. Conversely *P. sylvestris* has been included in the Native Woodland Scheme, which is administered by the Forest Service and provides payments for landowners to plant native trees of local provenance, so it is being widely planted in semi-natural habitats in Ireland. However, neither the ecological value of these plantations nor the optimum environmental conditions for *P. sylvestris* planting in Ireland have been determined. Definitive information on the ecology and possible native status of the species is therefore urgently required.

This project aims to provide reliable, consolidated information on the autecology and biodiversity value of *P. sylvestris* in Ireland. The survey involves the recording of vegetation, soil characteristics, structure and regeneration of *P. sylvestris* stands. Mature *P. sylvestris*-dominated stands with a well-developed native ground flora have been selected. These sites are naturalised, planted or of unknown origin. Ten sites throughout the country have been surveyed to date. This research is being supplemented by investigations into the native status of *P. sylvestris* using palynological techniques.

Preliminary data analysis has shown that the environmental variables responsible for most of the variation in *P. sylvestris* vegetation communities are soil pH, soil moisture regime, altitude and slope. *P. sylvestris* has been shown to occupy a wide variety of habitats including raised bog, limestone pavement, granite scree slopes and upland blanket bog.

The output from this research will facilitate site selection and/or species selection during woodland establishment, the identification of seed stands for local provenance sourcing and will inform the conservation management of *P. sylvestris* woodland in the Irish landscape.

POPULATION DYNAMICS AND CONSERVATION OF POND BREEDING AMPHIBIANS: THE EXAMPLE OF NATTERJACK TOADS.

Aubry, A.*¹, Bécart, E.¹, Davenport, J.² and Emmerson, M.¹

¹Department of Zoology, Ecology and Plant Science, University College Cork, Environmental Research Institute, Lee Road, Cork; ²Department of Zoology, Ecology and Plant Science, University College Cork, Distillery Fields, North Mall, Cork. aurelieaubry@yahoo.fr

In Ireland the natterjack toad is restricted in its distribution to twelve sites in Co. Kerry, leaving this species vulnerable to population reduction and extinction. This study (2004-2007) investigates the main environmental factors that can affect the toads breeding activity (number of breeding females) and success (survival of eggs and tadpoles), in order to better assess and improve the conservation status of the species. Our results support the idea that toad populations tend to be larger at sites with the largest amount of available aquatic habitat. A first approach to improve the conservation status of the species is therefore to create more ponds. It is also essential to ensure that the environmental conditions of any new ponds are favourable for toad breeding success. Statistical analyses based on population and environmental data collected in the field over three consecutive years indicate that there are important annual and spatial variations in the toad breeding activity and success. Further analyses suggest that pH and water temperature can in particular explain the variability observed among breeding populations. These environmental variables should thus be considered when implementing conservation programmes for natterjack toads. Based on the findings of the present study, other aspects important for the conservation of pond breeding amphibians are also discussed, in particular the necessity and benefits of maintaining connectivity among populations.

Integrating Harbour Seal Movement data in Web Visualisation tools

Iban Amezttoy

Coastal & Marine Resources Centre, University College Cork.

An exciting study on seals behaviour at sea off southwest Ireland started earlier this year. The project funded by the Marine Institute under the National Development Plan will provide for the first time ever information on the movements and behaviour of seals in Irish waters.

Irish researchers from UCC, working with world leading experts in marine mammal research from the Sea Mammal Research Unit in Scotland are using sophisticated tags to study the seals offshore movements and behaviour. The tags use a novel telemetry system (fast acquisition GPS) together with mobile phone technology to relay the information back to a base phone.

Fine scale information on where the seals have travelled to offshore, along with data on dive depths and duration, will help scientists determine the foraging or feeding behaviour of seals.

One of the objectives is to make available all the information via a website and to display the data using different web-mapping based options.

The display and data integration methods are different depending in which option is chosen. These can be classified into three groups;

- Static Maps.
- Common Geographic Servers (e.g. MapServer, ArcIMS)
- Virtual 3d globes and 2d mapping systems (Google Earth, Google Maps)

The information available via Internet will be accessible to researchers, organizations and the general public interested in seals and Geographic Information Systems, making it possible to raise awareness of harbour seal behaviour in southwest Ireland and providing a medium through which the user can be informed of our research and of any exciting news regarding the project.

Sunday 28 January 2007 Time: 11.30 – 1.30 pm

Session 24

Title Pollution, Phytoremediation and Bioremediation

Investigation of a low cost, biocatalytic material for use in RAPid Oil Spill TrEATment applications, (inland and coastal) to dramatically improve bioremediation efficiencies and protect high risk receptors through pathway activation.

Dr. Michelle Connolly, IT Sligo

For many years petroleum hydrocarbons have entered the environment through natural seepage, accidental spills and inappropriate disposal practices. Increasing environmental legislation has resulted in industrial practices becoming more strictly regulated so reducing the number of accidents occurring. It is impossible to prevent spills in their entirety and so provisions must be made for these eventualities. There are several strategies for oil pollution cleanup and elimination including physical, chemical and biological techniques. This study focuses on the manipulation of biological techniques (biocatalysis and biostimulation), through the addition of a low cost biocatalytic material to enhance the biodegradation of petroleum hydrocarbons in soils and aquatic systems.

THE IMPACT OF PHYTOPLANKTON GROWTH ON THE BIOGEOCHEMICAL CYCLING OF METALS

Áine M. Gormley*, Richard W. Douglas, and Philip Jordan

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Abstract

To quantify the short-term changes in the rate of contaminant uptake and release by the primary producers in freshwater lakes, the distributions of metals between the sediment, the phytoplankton and the dissolved phase have been investigated. Three remote Scottish lakes that have received high, medium or low metal contamination from the atmosphere were selected for investigation. Throughout the growing season phytoplankton specimens were collected, while the behaviour of metals in sediment was investigated with continuous sediment traps and sediment cores. The technique of diffusive gradients in thin film (DGT) was employed to assess the distribution of dissolved metal concentrations. The contents of Al, Cd, Pb, Cu, Zn, Ni, Cr, Fe, Mn and Co within the cells, sediment and DGT were analysed with Inductively Coupled Plasma-Mass Spectrometry (ICP-MS). Using this data, an index of biogeochemical change was developed to calculate if the metals were being cycled at a steady-state despite changes in their pathways. Each region shows a release of metals from the sediment that is followed by an enhanced removal of metals by the phytoplankton. The predominant biological control on the cycling of the metals was apparent in the region of high metal contamination and nutrient status. This suggests that the partitioning of contaminants between phytoplankton and water over short time-scales during the growing season is an equilibrium process. Therefore, models for heavy metals in lake water and sediment can be changed to include this aspect of their behaviour and the new models tested.

A search for the unknown: the use of genetic fingerprinting tools to understand microbial community structure and function.

Pamela Ryan, Emer Colleran.

Environmental Microbiology Research Unit, Department of Microbiology, National University of Ireland, Galway.

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Microbial ecology involves the study of microbial interaction and distribution across various ecosystems where microbial transformations are fundamental to the operation of the biosphere. Indeed, microbial ecology arguably represents one of the most important areas of biological research. Particularly, as it was previously understood that microorganisms in the environment was based on only those we could culture in media, which represents between 0.1 and 10% of the total microbial flora in any given environment. However, over the past 25 years there has been a revolution in microbial ecology, catalysed by the use of molecular based methods, which have generated a new insight into the structure and function of microbial communities. The use of these advanced techniques has proven to be invaluable in the study of anaerobic granular sludge, which houses a complex community of microbes responsible for the anaerobic digestion (AD) process. Using the 16S rRNA gene has provided a powerful tool in the determination of microbial populations present in the granular anaerobic sludges commonly used in anaerobic bioreactors. Results gathered through the use of these novel techniques have begun to re-address some of the fundamental AD questions, such as, which microbes are present in a particular granular sludge sample? Where are the different microbial species located in relation to each other and what is their AD function, including the inter- and intra-granular scale? This paper addresses these questions with particular reference to the importance of studying the role of the homoacetogenic bacteria in the AD process. These strictly anaerobic bacteria are known to be present in well functioning anaerobic digesters in high numbers such as 10^5 - 10^7 cfu/ml (Zeikus, 1979) and 10^8 - 10^{11} MPN/ml (Zhang and Noike, 1994), although they should be out-competed by the methanogenic species under the low H_2 partial pressures present in these bioreactor systems. It is the aim of this paper to demonstrate that the use of some of these novel molecular techniques such as TRFLP (terminal-restriction fragment length polymorphism), DNA clone library analysis, DGGE (denaturing gradient gel electrophoresis) and FISH (fluorescence in-situ hybridisation) will increase our understanding of these under researched species.

Evaluating microbial biosensors to detect PCB contamination and degradation in a range of water/soil environments and conditions

Monica Dempsey*

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Polychlorinated Biphenyls (PCBs) were manufactured from 1921 to the 1980s for a range of purposes including transformer oils due to their high stability, low degree of reactivity and inflammability. They are difficult to degrade and therefore, have bioaccumulated in the environment to dangerously high levels. This project will evaluate *Pseudomonas* based biosensors previously constructed by the BMES group at IT Carlow, as well as a novel delivery system for the detection and biodegradation of PCBs and chlorobenzoates (CBAs). This presentation will describe initial biosensor analysis including; detection of the biosensor strains, enumeration of bacteria per alginate bead and bead survival studies.

Further characterisation of BphK, a bacterial GST involved in dechlorination of toxic pollutants.

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A *bphK* gene, found in a central location within the *bph* operon of *Burkholderia* LB400, encodes a protein belonging to a super family of enzymes, the glutathione S-transferases (GSTs). GSTs catalyse the nucleophilic attack of the sulfhydryl group of glutathione (GSH) on the electrophilic centres of a wide variety of xenobiotic and endobiotic compounds, thus rendering them less toxic. Sequence alignment with other PCB degrading bacterial GSTs identified a number of highly conserved residues in the C-terminal region of BphK^{LB400}, thought to be involved in substrate specificity through site-directed mutagenesis. In this study, two BphK^{LB400} mutants, Ala180Pro and Ala180Ser, were examined to establish the role of the highly conserved amino acid, Ala180, on the GST activity of BphK^{LB400}. Compared with wild-type, both Ala180 mutants had altered enzyme activity in cell free extracts towards 1-chloro-2,4-dinitrobenzene [(CDNB), the model substrate for GSTs], chlorobenzoates [(3-CBA and 4-CBA), metabolites of the PCB degradation pathway] and commonly used herbicides, 2,4-dichlorophenoxyacetate (2,4-D) and atrazine. The Ala180Ser mutant had a slight increase in activity towards atrazine and 4-CBA and a slight decrease in activity towards 2,4-D, 3-CBA and CDNB. In contrast, the Ala180Pro mutant had an increase in activity towards all substrates tested. These studies suggests that the highly conserved amino acid, Ala180, may be involved in determining substrate specificity of BphK^{LB400} and that the Ala180Pro mutant could have potential in bioremediation of chlorinated organic compounds, alleviating the effect of these toxic pollutants in the environment. BphK^{LB400} will be further investigated so as to identify additional amino acids playing an important role in determining substrate specificity.

Improved phytoremediation and phytoprotection systems

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There has been an increased concern over heavy metals' pollution in soils mainly due to their persistent in the environment and the fact that they are not biodegradable. In this study, the phytoremediation and phytoprotection abilities of different endophytic and rhizospheric bacteria in protecting plants against toxic effects of As, Cu, Zn, Cr, Te, Hg and Sn were examined. The heavy metal tolerance level of induced and non-induced targeted bacterial strains, VM1450, VM1453, F113rifPCB, TBS10, M55a and M66a was established. VM1450 and VM1453 showed the highest tolerance levels towards Cu (7mM) and As (2.5mM), while M55a and M66a showed the highest resistance towards Cr (5mM). TBS10 displayed extremely high resistance towards Sn (20mM). The microbial phytoprotection ability to improve seed germination capacity of peas, alfalfa and rape seeds in polluted environments was also studied, as was the colonization ability by these strains of this range of environmentally significant plant species.

Session 25**Title Ecotoxicology**

Development of a multiple endpoint bioassay using *Hydra attenuata* to assess the acute (sub)lethal effects of pharmaceuticals in the environment.**Brian Quinn,***Zoology Dept., Trinity College Dublin, Ireland.***Abstract**

Pollution by pharmaceuticals entering the environment has been identified as a major problem, and has developed into a key area of research in the field of environmental toxicology. As yet relatively little research has been undertaken to assess the effect these pollutants have on organisms in the environment. The freshwater Cnidarian *Hydra attenuata* is an important component of freshwater ecosystems and has previously been used in biomonitoring assays. In this study the acute and chronic toxicity potential of 10 pharmaceuticals (cotinine, trimethoprim, carbamazepine, sulfamethoxazole, sulfapyridine, ibuprofen, naproxen, benzafibrate, gemfibrozil, novobiocin and oxytetracycline) found in treated municipal effluent from a treatment works was measured (individually and as a mixture) using a microplate-based assay. The acute lethal toxicity was measured by determining the 96h LC50. Sub-lethal effects included attachment to substrate, bud formation and the development of a feeding test. The feeding test examined the chronic effects on the ability of *H. attenuata* to capture and ingest its prey *Artemia salina* after exposure. Results indicate that the LC50 of pharmaceuticals were considerably above concentrations found in the environment ($>2 \text{ mg L}^{-1}$) and do not present a lethal risk. However a significant decrease in prey ingestion can be seen at lower more environmentally relevant concentrations and may potentially have a chronic effect at the population level. This study demonstrates the suitability of *H. attenuata* for assessing the acute and sub-acute toxicity of pharmaceuticals in the freshwater environment.

**THE EFFECTS OF THE INDUSTRIAL CONTAMINANT
CHROMIUM VI ON THE ENTOMOPATHOGENIC NEMATODE
*STEINERNEMA FELTIAE***

*Stephen Boyle and Thomae Kakouli-Duarte
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Hexavalent chromium (chromium VI) is a known carcinogen and mutagen yet is widely employed in industry. It is often present in soils and groundwaters where there are instances of poor industrial practices.

Nagy *et al.*, (2004), reported that trivalent chromium (chromium III) and chromium VI have long term negative effects on nematode assemblages, especially among predatory and omnivorous nematodes.

The nematode mostly studied at IT Carlow is *Steinernema feltiae* and may be a good candidate as a bioindicator for the presence of chromium contamination in the soil.

We are assessing the effects of chromium VI on levels of physical fitness of *S. feltiae*, and also assessing its influence upon certain targeted 'marker' genes in *S. feltiae*.

We have observed that *S. feltiae*, while susceptible to chromium VI also appears to be resistant to it at higher levels than those reported in other studies utilising nematodes. It appears that high levels of chromium VI present among developing nematodes significantly slows development of this nematode, although they can still produce healthy offspring in concentrations as high as 800ppm Cr VI.

In parallel, the effects of Cr VI in the β -tubulin are also being studied. CR VI influence on DNA variation is examined and subsequent consequences to the amino acid structure of the respective proteins.

We consider this work will aid the understanding of the effects of chromium on soil fauna, as well as being of value in environmental protection policy making.

References

Nagy P, Bakonyi G, Bongers T, Kadar I, Fabian M, Kliss, I. 2004. *Science of the Total Environment* **320**: 131-143.

Assessment of pharmaceutical residue levels in receiving waters at Irish wastewater treatment plants.

Lacey, C.*, Morrissey, A., Tobin, J.
School of Biotechnology, Dublin City University, Dublin 9.

Until recently pharmaceuticals and active ingredients have received little attention as potential environmental pollutants. An increase in the use of such compounds worldwide has resulted in pharmaceuticals and their metabolites being considered as new environmental contaminants.

Pharmaceutical compounds are designed to be lipophilic, to allow for compounds to cross cell membranes, and persistent, for efficient delivery of compounds to the site of treatment and therefore they are highly stable compounds. However, the ongoing presence of these compounds in the environment is not entirely dependent upon their stability. Continual input compensates the rate of removal and transformation allowing for pharmaceuticals to have an exposure similar to persistent pollutants. Also, environmental contamination by pharmaceutical compounds poses a new problem. Other contaminants, such as pesticides and industrial chemicals, have a point source of entry to the environment. Pharmaceutical compounds have the potential to be released into the environment anywhere inhabited or visited by humans.

The presence of pharmaceuticals and their metabolites in the environment is of concern to Ireland as there are in excess of three thousand compounds licensed for use by the Irish medicines board. Compounds such as ibuprofen, mefenamic acid, carbamazepine and diclofenac that are frequently reported at detectable concentrations in effluents and surface water, are among the top one hundred products prescribed in Ireland.

A LC-MS method has been developed for the determination of twenty-two active compounds. At present, three wastewater treatment plants are being sampled to determine the concentration of selected pharmaceuticals in influent and effluent streams.

The H14 Criterion and (Bio)analytical approaches to Ecotoxicological Waste Characterisation

by

Kathleen O'Rourke and Robert Hernan

**Shannon Aquatic Toxicity Laboratory
Enterprise Ireland**

European Council Directive 91/689/EEC on Hazardous Waste defines H-criteria to distinguish between hazardous and non-hazardous waste. H14 substances are defined as: 'substances and preparations which present or may present immediate or delayed risks for one or more sectors of the environment.'

The ecotoxicological hazard posed by H14 substances is evaluated by the response of appropriate organisms when exposed to the substances under controlled laboratory conditions. European workshops and inter-laboratory tests are currently under way with the aim of establishing a standardised suite of tests. This presentation focuses on tests with solid wastes and their eluates, and gives an overview of the ecotoxicity of solid wastes generated in Ireland.

Comparative sensitivity of aquatic organisms to industrial wastewaters

by

Robert Hernan and Kathleen O'Rourke**Shannon Aquatic Toxicity Laboratory
Enterprise Ireland**

Acute aquatic toxicity tests are used in conjunction with chemical analysis in the characterisation of industrial wastewaters. Approximately 275 industries in Ireland are required to carry out acute toxicity tests as part of their IPC licences. Wastewaters generated by these industries are usually complex/non-simple, the majority being from the chemical sector but also from a range of other sectors. When a wastewater is tested for the first time, organisms from four different trophic levels are exposed to the material. Subsequent monitoring uses the two most sensitive species. The suite of species used includes freshwater and marine fish, crustaceans, plants/algae and bacteria. Generally it is found that algae (*Skeletonema costatum* and *Pseudokirchneriella subcapitata*) are the most sensitive and fish (*Scophthalmus maximus* and *Oncorhynchus mykiss*) the least sensitive species. Consequently, further monitoring usually includes an alga with a crustacean or bacterium.

EFFECTS OF IVERMECTIN ON DUNG BEETLE SURVIVAL AND REPRODUCTIVE SUCCESS

***N. O’Hea^{1,2}, J.A. Finn², P.S. Giller¹**

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Ivermectin is a broad spectrum compound used in antiparasitic treatment of livestock. It is predominantly excreted in an unmetabolised form in dung over a period of days and weeks following drug administration. Studies have shown that ivermectin can have lethal and sub-lethal impacts (e.g. delayed larval development, reduced beetle survival etc.) on dung fauna, including dung beetles. This study presents results from an assessment of the lethal and sub-lethal effects of ivermectin residues on two dung beetle species commonly found in Ireland. Bioassays were carried out over two years using dung beetle species *Aphodius ater* and *A. rufipes*. Dung was collected from groups of cattle which had been treated on different days with a subcutaneous dose of ivermectin, so that dung contained varying concentrations of ivermectin. Adult beetles were allowed to feed on dung, and subsequent egg production and larval development within dung were monitored over time. While adult survival is not significantly affected by ivermectin, larval development and survival are negatively affected. Larval development was delayed, and a reduction in larval survival was also observed in dung containing ivermectin. This results in a reduced emergence of second generation beetles which developed in this dung. Results were broadly similar for both species. Reduced survival of beetles has consequences for local and regional dung beetle diversity and population viability, for farmland wildlife that feeds on beetles, and for dung decomposition.

Session 26**Title Agricultural & Land Use (Part II)**

Comparison of soil carbon fluxes from different land use types**Kieran Mc Kevitt*, Kevin Black and Bruce Osborne**

University College Dublin, School of Biology and Environmental Sciences

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Soil represents the largest terrestrial carbon pool, with an estimated global volume of 2000PgC per year. Different land use practises, in conjunction with climatic factors, will influence the extent to which carbon is stored in soils. We are examining two different land use types, a commercial forest plantation of Sitka spruce and cropland devoted to spring barley production that is subjected to either conventional tillage practices or minimum tillage. Temperature and moisture have been found to be major factors in determining the total CO₂ flux lost from soil; moisture also has a role in the transport of carbon dioxide through the soil from sites of production to the surface. Peak carbon dioxide fluxes were recorded in the agricultural site in late June and early July with peak values of 8.13 $\mu\text{mol m}^{-2}\text{s}^{-1}$. This coincided with the highest temperature and lowest moisture levels in the agricultural site. In the forest site the peak values were lower and occurred later in August, with a maximum value of 4.8 $\mu\text{mol m}^{-2}\text{s}^{-1}\text{CO}_2$, nearly half that of the agricultural site. For the agricultural site these changes were correlated with temperature, but at the forest site changes in temperature were rather small, so that soil moisture is of greater importance. At the forest site there was a large input of carbon to the soil in July in the form of litter and this may have given rise to an increase in microbial activity in August. The lower moisture values at this time may also have contributed to the greater CO₂ efflux

Physical and ecological impacts of preferential grazing areas in western hill and mountain peatland

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The project is part of an overall programme to achieve sustainable agri-environmental management of hill and mountain peat land. Peat soils occupy a very high proportion of the western hill/mountain landscape in Ireland. They are especially vulnerable to erosion under inappropriate land use. Grazing systems may impact not only on the density and composition of the vegetation cover but also on a range of micro-topographic features.

The objective of this study is to quantify the physical impact of hill sheep at low, medium and high levels of grazing by quantifying changes in micro soil erosion, plant cover and soil nutrient content over time.

Results of the micro-soil erosion, plant cover and soil nutrient analysis will be correlated with relevant farm management systems details and local weather data to identify sustainable agri-environmental management strategies of hill and mountain peat land.

Sites representing three levels grazing intensity (*low, medium, high*) were selected in the Connemara region of Galway and Mayo based on altitude and physiography. Within each site four areas associated with sheep activity namely high and low densities of occupation, sheep 'camps' and movement corridors were chosen. These were identified largely by random selection from existing databases for the *medium* level of grazing and by field examination of topographic transects in the *low* and *high* levels of grazing.

Methods to measure changes in micro-erosion and deformation of soil surface include rainfall detachment trays (constructed), Gerlough troughs, splash cups, micro-topographic pin profilers (designed) and reference marker pins. All the sites have been sampled for soil fertility analysis.

The Colonisation of an Agricultural Drainage Ditch following Mechanical Dredging

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The mechanical dredging of drainage ditches is a regular maintenance technique in intensively managed agricultural landscapes. Such management can cause large amounts of silt to be transported and deposited downstream, but little is known of its direct and indirect effects on the biology and chemistry of these drainage ditches and the overall impact on catchments as a whole. To assess these effects, I studied the temporal changes, over 12 months, of macroinvertebrates, macrophytes, physical habitat and water chemistry in a recently dredged drainage ditch in an intensively managed agricultural catchment, SW Ireland. Preliminary results indicate an increase in species diversity from a low number of initial colonising species to a more diverse community towards the end of the study. Chironomidae and Oligochaeta were the dominant colonising groups in the early stages, while Mollusca and Coleoptera increased in abundance over the study period with increasing habitat complexity. The chemical nature of the ditch showed much temporal variation. Nutrients peaked directly following the disturbance event but then decreased and remained low until the latter half of the study when they increased to a high level. The implications for conservation and the management of agricultural drainage ditches are discussed.

Decision Support System for developing Anaerobic Digestion Technology for treating animal wastes in Ireland

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Ireland has a huge energy potential given by animal wastes. The purpose of this work is to develop a decision support system for helping policy makers in evaluating technical, economic and environmental aspects of anaerobic digestion development strategies. The aim is to employ this technology to get biogas viable for producing electricity, heat or transport systems fuel. The research enfolds the previous issues in two decision-making questions: how much (energy potential analysis) and where (site selection analysis).

The first issue is fulfilled by producing a database of farms (livestock) and abattoirs (slaughtering wastes) throughout Ireland and developing an algorithmic data-model (software package attached) which allows to estimate the biogas potential production in a selected area. The second issue is accomplished by developing a site selection decision model able to identify the best location for anaerobic digestion plants.

The outcome is structured on an interactive (thought as a planning tool) and dynamic (is possible to introduce new variable values) software package which not only is friendly user but also represents a pre-feasibility study for any local area in Ireland and internalises important socio-economic and environmental aspects.

The algorithm-theoretic linked analysis points out some Counties (as Cork for instance, where we are based) as valuable areas where would be profitable to strengthen anaerobic digestion technology development.

Furthermore, as more general aim of this research, it shows a successful way to improve the waste management system by taking advantage of local potential resources and preserving the environment from pollution sources, to increment the rate of endemic renewable energy produced, to achieve a healthier and more profitable management of Irish agriculture and economic practices, and, maybe in a not exhaustive list of benefits, to fulfil international commitments like EU and Kyoto protocol ones.

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By 2009, the Integrated Pollution Prevention and Control (IPPC) Directive will involve the establishment of a European Pollution and transfer register. This will require the European Pollution Emission Register (EPER) to include urban waste water treatment plants [1].

This poster will describe the fundamentals of the urban waste water treatment plant process. It will also highlight the monitoring requirements for the implementation of the European Pollution Emission Register(EPER).

[1] Regulation EC No166/2006 of the European Parliament and the council of 18th January 2006, concerning the establishment of a European Pollution Release and Transfer Register and amending Council Directive 91/689/EEC and 96/61/EEC.

ENRICHMENT RATIOS FOR A RANGE OF IRISH SOILS

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Abstract

Phosphorus (P) is sorbed onto the surface of soil particles and, in an erosion event, these particles may be released to receiving waters, causing eutrophication. The amount of P sorbed onto a particle depends on the surface area of that particle. Small particles have a greater surface area and in a runoff event, may travel great distances, due to their low settling velocity. In this study a modified bottom withdrawal tube (MBWT) was used to determine the settling velocities of soil particles smaller than 150 microns for 6 tillage soils: (i) Ardee, Co. Donegal (ii) Tullow, Co. Carlow (iii) Clohamon, Co. Wexford (iv) Duleek, Co. Meath (v) Fermoy, Co. Cork and (vi) Clonmel, Co. Tipperary. The enrichment ratio, E_R , defined in this study as the ratio of the P concentration of the soil used in the MBWT tests to that of the bulk soil, was determined for each soil. Small soil particles with low settling velocities had a much higher P concentration and E_R than large particles with high settling velocities, and, as a result, are more likely to reach waterways and cause eutrophication there.

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Dredge Material Recovery and Reuse Techniques for Ireland

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Ireland generates approximately 1.2 million wet tonnes of dredge material annually from maintenance projects and averages approximately 0.6 million wet tonnes per annum from capital projects. The material is primarily disposed offshore; beneficial end uses have been limited. A wider range of dredge material management alternatives involving greater beneficial reuse is required for Ireland.

This paper investigates best international practice in dredge material management, particularly in the context of dredge material recovery and reuse. Techniques for dredge material recovery and reuse are reviewed and appropriate technologies for Ireland are identified. Dredge material volumes generated in Ireland over the next decade are estimated and quantified. These estimates include, where appropriate, both maintenance and capital dredging projects. A comparison with historical dredge volume data generated for Ireland is presented. This historical data includes a breakdown both by dredge material size and by method of dredge material disposal or reuse. Future phases of the project will include technical, economic and environmental studies to examine the feasibility of implementing dredge material recovery and reuse technologies at selected sites. Pilot schemes will then be recommended for the most suitable, feasible locations.

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Burning carbs! An alternative treatment strategy for carbohydrate-rich food waste in Ireland: effective treatment and bio energy generation.

In developed countries, the food manufacturing and associated catering industry constitutes one of the largest industrial sectors, and this trend is likely to continue in a more affluent, consumer-driven market. Consequently, disposal of food waste and the recycling of process waste waters is a very real problem in Ireland and on a global scale. Ireland is currently facing a crisis situation in dealing with the ever-increasing quantities of organic waste and in complying with EU legislation requiring immediate implementation of sustainable and effective waste management strategies. Since the majority of food waste is carbohydrate-rich, a simple shift in strategy (away from landfill) with the use of eco-friendly technology could convert this waste to an array of high value end-products.

The focus of research and application of anaerobic digestion technology to date has centred on sewage sludge, animal manures and industrial wastewaters from the food-processing, fermentation and pharmaceutical/ fine-chemical industries. However, in recent years research has also begun to focus on the development of appropriate digester designs for biomethanation of primary biomass sources such as waste food materials from the catering industry. This paper describes the comparative start-ups and results generated to date of 6 up-flow anaerobic sludge bed (UASB) reactors operated at three different temperatures, ambient (18-22°C), mesophilic (37°C) and thermophilic (55°C), while treating a selection of different carbohydrate-rich waste streams.

A Comparative Study of Coastal Atlases As Communication Tools Between the Scientific Community and the General Public

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Information is arguably one of the most powerful assets anybody can have but it can also be irrelevant if it is not destined to the proper audience. A familiar issue facing the scientific community is how best to disseminate interpreted data, after it becomes information, to reach an audience who will deem this information relevant. A coastal atlas is one tool that can relay relevant information to a number of groups with different interests and needs. In recent years, countries such as Australia, Ireland, the United Kingdom and the United States, among others, have launched one or more coastal atlases, each best suited for a particular user group composed of either scientists, policy-makers, educators or students. The purpose of this research is to compare the Australian Natural Resources Atlas (Australia), the Marine Irish Digital Atlas (Ireland), the Coastal and Marine Resource Atlas (United Kingdom) and Oregon Coastal Atlas (United States) in areas of design, technology and content with an aim to formulate recommendations as to how coastal atlas designers can optimize communication with the general public

Brian Barrett, UCC

Abstract—Although soil only contains a small percentage of the total global water budget, soil moisture is of fundamental importance to many agricultural, hydrological, meteorological, biological and biogeochemical processes. Hydrologic processes such as runoff production and evaporation are largely dependent on the temporal and spatial variation of soil moisture.

The purpose of this paper is to address the potential of ENVISAT ASAR (Advanced Synthetic Aperture Radar) data in extracting information on soil moisture over a rural area of pasture land in southern Ireland during a three month period from April to July 2006. The applied technique was based on deriving the relative changes in soil moisture between different ASAR acquisitions rather than the absolute soil moisture values using an existing semi-empirical soil moisture inversion algorithm. Simultaneous with each data acquisition, ground measurements of soil moisture were taken at several locations within the study site. A weak correlation was found between the field measured soil moisture and the image retrieved soil moisture. However, a much stronger relationship was found between the measured and retrieved soil moisture multi-temporal differences, with the HH polarization showing a higher correlation. Multi-temporal soil moisture maps of the study area were then produced to aid visually these changes.

THE USE OF THE 18S rDNA MACROARRAYS TO IDENTIFY INDIVIDUAL SOIL NEMATODE SPECIES

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Nematodes are the most common multi-cellular animals on earth and they are found in almost every environment. In soil, their community structure can be used to assess the environmental health of their habitat. This can allow determination of soil recovery from pollution or other disruptive factors. Nematode community analysis requires robust nematode identification technologies. The 18S rDNA can be used to identify nematodes to species and family, and shows promise as a nematode identification tool that is less labour intensive than the more traditional morphological methods.

In this project, nematode 18S rDNA is amplified using PCR and subsequently labelled with digoxigenin-dUTP (DIG). To date, 18S rDNA has been amplified from *Rhabditoides regina*, *Caenorhabditis elegans*, *C. briggsae*, *Pelodera teres*, *Oschieus dolichuroides* and *Rhabditella axei*. Species-specific oligonucleotides have been designed, and these are bonded to a nylon membrane, thus creating a DNA macroarray. The DIG-labelled PCR products are then hybridised to their respective oligonucleotides on the macroarray, and visualised using an immunoassay colour reaction. A number of DNA macroarrays have been tested that can distinguish individual species using their respective 18S rDNA. To date, *C. briggsae*, *P. teres*, *R. regina* and *O. dolichuroides* have been identified using macroarrays. This project is ongoing, and the results achieved so far indicate towards the suitability and potential of the 18S rDNA as a molecular identification tool for identifying soil nematodes.

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Environ Posters

1. Seaweed Extract Influence on Turfgrass Growth, Nutrition and Stress Tolerance under Foliar Fertilisation

Tim Butler and Alan Hunter

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Although superintendents have been practicing foliar feeding to a degree for years, there has been a dramatic increase in foliar feeding practices in the golfing industry in recent years. Many turfgrass managers feel that they have more control over their grass growth when using foliar fertilisation. Some also may argue that foliar fertilisation may lead to a reduction in nutrient loss through runoff or leaching. Coupled with this, several new products such as biostimulants have been developed to help turfgrass managers to deal with day to day stresses on turfgrass plants. Biostimulants are more environmentally friendly products and aimed at stimulating the biological content of the soil and increasing the stress tolerance levels in turfgrass swards. Common components of biostimulants include seaweed extracts and humic acids. However, there is limited field-based research on the benefits of biostimulant application with foliar fertilisation programmes. The objectives of this research were to determine the influence of applying a commercially available seaweed extract on turfgrass growth and nutrition under a foliar fertilisation programme on a golf green constructed to USGA specifications. A two factor experiment was designed, with nutrient rate and biostimulant being the factors. Treatment plots were fertilized on a monthly basis using a foliar fertilization programme at standard, two-thirds and one-third nutrient rates in the summer of 2005. Liquid seaweed extract (Maxicrop) was applied on a bi-weekly basis at the recommended rate of 2mls per m⁻² to each of the nutrient rates. Controls for each nutrient rate were included. A completely randomised design with three replications was used. Grass dry weight, tissue and soil macro nutrient concentrations and grass colour were measured on three dates. Tissue nitrogen and potassium concentrations were increased on the first measurement date in the seaweed extract treated plots. The biostimulant had no impact on rootzone macronutrient concentrations, however it significantly increased sward colour and reduced leaf proline concentration, which is a measure of stress tolerance compared to the control at the end of the experiment.

2. Bentgrass response to biostimulant and microbial inoculant application on a USGA specification rootzone under reduced nutrient input

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Recent research has shown that microbial populations in newly established turfgrass rootzones are low compared to natural undisturbed soils. Increasing the activity of benign soil microbes-especially in relatively sterile sand-constructed sports pitches, golf greens and tees would be highly desirable since they promote the decomposition and utilisation of dead and decaying leaf material, thus minimising problems of thatch accumulation, and enhancing healthy root growth and development. Soil microbes also interact directly with nutrients, or indirectly through nutrient recycling and the limitation of pathogenic organisms. This study was designed to ascertain the effect of applying a microbial inoculant and seaweed extract (both biostimulant products) on turfgrass growth and nutrition, when applied pre germination to a sand-based rootzone receiving lower than recommended nutrient inputs. Little if any scientific information is available on how biostimulant products influence nutritional aspects of turfgrass management, in particular under reduced fertiliser applications. A glasshouse experiment was designed with five replications to study this topic in detail. The effect of biostimulants on turfgrass growth together with their impact on tissue and soil macro nutrient concentrations was analysed. The results found that the biostimulants significantly increased grass growth. The microbial inoculant appeared to negatively impact upon tissue nitrogen concentrations, whereas the seaweed extract benefits on tissue nitrogen were only found on the last measurement date at two-thirds of the recommended nutrient rate. The biostimulants had no significant effect on tissue phosphorus concentration, although leaf tissue K was significantly increased on two measurement dates with the microbial inoculant treatment.

3. ASSESSING ACCESS TO INFORMATION, PARTICIPATION AND JUSTICE IN ENVIRONMENTAL DECISION-MAKING

This project is an in-depth gap analysis of the legal and in-practice application of the Access Principles, namely: access to information; access to participation; and access to justice on the environment when the other two rights are not upheld, or where acts of individuals or state bodies contravene national environmental law. These principles were first enunciated as Principle 10 of the Rio Declaration in 1992, and then embodied in the Aarhus Convention in 1998. Discovering the reasons for any gaps in provision and the options for closing them will provide the relevant bodies with the basis for rational and focused decision-making in capacity enhancement. The project also provides a focus for dialogue between stakeholders that it is hoped will lead to an effective and widely owned vision of a country where the access principles are woven deeply into all aspects of environmental decision-making. The methodology being used here was developed by the World Resources Institute, Washington, and is called The Access Initiative. It involves the analysis of case studies using indicators to assess the relevant legislation, the effort made to apply it, and the effectiveness of that effort. The indicators are grouped under the headings of: general law, access to information, public participation, access to justice and capacity building.

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4. Levels of Inorganic and Organic Oestrogenic Agents in the Border, Midlands and Western Region of the Shannon Catchment in the Republic of Ireland.

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Keywords: endocrine disrupting chemicals, endocrine disrupting metals, phthalates, alkylphenols

Pre-concentration techniques have become an important feature in trace analysis of oestrogen mimicking chemicals. Our objective was to analyse a variety of environmental matrices with a probability of exposure to hormonally active substances. Diverse extraction methods were employed in the study to both isolate and pre-concentrate targeted analytes using the minimum amount of solvent. For organic endocrine disruptors, a simple, yet extremely sensitive liquid chromatographic method based on ultraviolet detection was developed. In addition, endocrine disrupting metals were determined by voltammetric and atomic spectroscopic procedures. By exploiting enrichment based on extraction limits of detection in the ng/L range were achieved. The prevailing levels found were comparable to previously reported international values. Parallel studies were carried out by other members of the EDC research group to demonstrate both the *in vivo* and *in vitro* effects of these chemicals at the levels detected.

5.

Assessment of arable energy crops as heating fuels

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Abstract

The goal of this project was to evaluate the potential of two arable energy crops (willow chips and chopped miscanthus), three cereal grains (oats, wheat and barley) and pressed rape-seed meal as heating fuels in a commercial wood-chip boiler. Fuel properties relevant to combustion were determined. They included calorific value, ash content, moisture content, bulk density, volatile matter content and stoichiometric air fuel ratio. The fuels were combusted in a rotating-grate boiler with a nominal heat capacity of 100 kW. For this set of experiments, system inputs and outputs such as fuel mass flow rate, heat output and stack emissions were measured.

Willow yielded the highest heat output (80 kW) and fuel efficiency (0.94). There were no problems with clinker formation or stack emissions which were below limits set by *BS EN 303-5:1999*.

Miscanthus gave a much lower heat output (36 kW) and fuel efficiency (0.87). It is felt that these problems arose from the lower energy density of the fuel (1710 vs. 2465 MJ/m³). Stack emissions were below specified limits.

Oats gave the best performance of the cereal grains as a heating fuel. Oats was found to be the easiest to ignite, had the greatest heat output (75 kW) and fuel efficiency (0.93). Wheat and barley had heat outputs of 55 kW and 48 kW with fuel efficiencies of 0.89 and 0.67 respectively. Clinker formation was not a problem with oats, but it was a major concern with wheat and barley. Stack emissions from cereals were below specified limits; however barley exceeded the specified limit for carbon monoxide.

Pressed rape-seed meal was found to be easily ignited, had a heat output of 70 kW with a fuel efficiency of 0.88. Stack emissions were found to be below specified limits, however ash fusion was found to be a major concern due to the high combustion temperature.

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6.

**RISKS FROM THE USE OF CATEGORY 3 ABBATOIR WASTE ON
NON-PASTURE AGRICULTURAL LAND**

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Landspreading is now being considered a viable utilisation route of mammalian meat and bone meal (mMBM) by many European Countries and which is allowed under new European legislation (European Commission regulation No 1774/2002). These changes have meant that Category 3 waste (including mMBM derived from animals slaughtered for human consumption) which has been appropriately heat treated and ground to a specified particle size, can be spread on non-pasture agricultural land. Two separate case studies (study 1 in Great Britain and study 2 in Ireland) on the potential exposure to Bovine Spongiform Encephalopathy (BSE) infectivity following the spreading of Category 3 abattoir waste on non-pasture agricultural land was carried out. Both models use Monte Carlo simulation techniques to account for parameter uncertainty and variability. For Case Study 1, the average BSE infectivity in mMBM spread on non-pasture agricultural land was found to be 1.2×10^{-5} Bovine Oral ID₅₀ per tonne of mMBM. For Case Study 2 the mean level of infectivity in Category 3 produced mMBM was assessed to be 2.36×10^{-5} Bovine oral ID₅₀/tonne of MBM. The spreading of this MBM resulted in infectivity on non-pasture land of 1.62×10^{-8} Bovine Oral ID₅₀/m³. The mean simulated probability of infection per year per bovine animal was 1.11×10^{-9} . The two studies indicate the low risk associated with the re-use of Category 3 abattoir waste as an agricultural fertiliser and signal the option to change national legislation in line with EU TSE legislation without comprising animal or human health.

7.

Abstract – Carlow ENVIRON conference 27-29 January 2007

Productivity of the furoid *Ascophyllum nodosum* and Climate Change - A Preliminary Investigation

Helen McGrath, John Lucas and Dagmar Stengel

The brown seaweed *Ascophyllum nodosum* (Fucales) contributes to the Irish economy by supporting an industry that raised €2 million in 2003. The present study concentrates on the productivity of the furoid *Ascophyllum nodosum* which could be vulnerable to predicted climate change. In particular, increases in atmospheric CO₂ concentrations, UV-B irradiance and temperature are symptoms of climate change, however, the effects of increases in atmospheric CO₂ concentrations have not been studied in combination with other climate change effects in *A. nodosum*. Generally increases in UV-B radiation are expected to be negatively correlated with growth in *Ascophyllum*. Also, increases in temperature can affect the phytogeographic limits of algae, phenology of *A. nodosum* and the enzyme-dependant photosynthetic process. Here different methods that can be employed to access productivity of the algae (infrared gas analysers (IRGA) and pulse amplitude modulated fluorometry (PAM)) are compared. The results of these investigations on the individual and combined effects of climate change on the productivity of *A. nodosum* are required to advise adequate ecological and economical viable management strategies for this species.

8. Using an EF to Operate and Maintain a Sustainable, Self-Regulating and Community -Based Environmental Management Programme

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The research question that will be answered by this project is whether a settlement of c. 1100 residents can be induced to reduce its carbon dioxide emissions through Community Based Sustainable Management? At a time when more and more environmental scientists are talking about Ireland's 3 planet lifestyle it is becoming imperative that people are introduced to the principles of sustainability through the educational system from an early age, and that these principles are regularly reinforced. It is also true that the process of research for improving natural resource management must incorporate participatory and stakeholder-focused approaches, leading to development based on the needs and knowledge of local stakeholders. The "bottom-up" Ecological Footprint (EF) methodology is one of the most comprehensive assessment techniques that can inform the levels of sustainability within communities. This EF needs to be user friendly yet accurate and meaningful. In line with this, a best practice EF method will be developed using the extensive experience of CER and PROSUS. It is hoped, as in previous pilot studies that, regular promotion of the evidence based environmental literacy produced by the EF will enable greening of the host community.

This research proposes a community scale environmental education program. A Green Flag school will be selected as the base for the study by virtue of its: (1) central role in educating the community (2) central position in the physical landscape of the community and (3) experience and greening interest having implemented in-school environmental management systems. Critical and systems thinking together with action, social and experiential learning will be stimulated by the project. It is expected that the selected school in Tipperary will become a focal point where community stakeholders interact and learn together for a sustainable future. This research prescribes a participatory and user-focused approach to (1) developing environmental literacy, (2) environmental problem solving and (3) decision-making. It will inspire community ownership of the EF results and subsequent measures to reduce CO2 emissions. It will also engage community stakeholders and policy makers.

9. Investigation into the Effectiveness of Fumigation as a Treatment Measure to Reduce Pathogenic Microorganisms in Landspread Animal Slurries

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Animal slurries and manures are a valuable source of nutrients, frequently applied to land as a fertiliser. The landspreading of such slurries may release potentially pathogenic microorganisms into the environment, posing a risk to human and animal health. Mitigation of this risk through management and treatment measures is therefore an important consideration. Fumigation is one such treatment option considered. This study investigated the effectiveness of the water-soluble soil fumigant metam-sodium, and its active breakdown product gaseous methylisothiocyanate (MITC), in reducing *Escherichia coli* levels in Irish pig slurries. The efficacy of the compound was determined over time at a range of concentrations in both pure culture, and in pig slurry with different organic matter contents. In pure cultures metam-sodium was found to decrease *E. coli* numbers rapidly at all concentrations, with almost complete cell death observable in the highest concentration of 20 µg/ml within 48hrs. Viable cells were reduced by 53-81 % after 24h at the concentrations tested. In slurry trials the chemical was found to reduce *E. coli* numbers significantly, albeit less consistently than in pure cultures, in all but the lowest concentration of 5µg/ml. Differences between treated and control decreased overtime. Survival of pathogens in slurry increased with organic matter content.

10. Sensors for the detection of hazardous emissions

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This contribution will detail recent developments in sensor technology for the detection of hazardous emissions. The accurate measurement of such emissions is necessary if they are to be controlled to the appropriate regulations; this latter topic is the subject of a related contribution at the colloquium (Hazard emissions monitoring and control).

Firstly, recent developments in gas analysers will be outlined, to measure, for example, reactive and condensable gases such as HCl, NH₃ and formaldehyde [1], [2]. The measurement of emissions of other harmful pollutants (such as NO_x, for example) is also increasingly important; such measurements are required in steam power plants, for example, in which heat is used to create steam, which, in turn, spins a turbine generator that creates electricity. The heat used to convert water to steam most commonly comes from the burning of a carbon based fuel, such as natural gas or oil; emission of pollutants are the inevitable result. NO_x emissions cause a wide variety of health issues, such as respiratory damage from the resulting particles, and environmental problems, such as ground level ozone (smog), acid rain, water quality deterioration and global warming [3]. Sensors to measure NO_x emissions will be treated in detail [3-6].

However, online measurement devices can be costly. An alternative is to use “virtual sensors”, in which variables are estimated based on their correlation with other, more easily measured, quantities [7-8]. The contribution will conclude by considering such sensors.

References:

1. Worthington, B. (2000). “Continuous emissions monitoring technologies advance with regulations”, *Control Engineering, February*.
2. Jessel, W. (2000). “Plan and design the best gas detection”, *InTech, September*.
3. Deininger, D. *et al.* (2004). “Metal oxides at industry cusp”, *InTech, August*.
4. Basta, N. (2004) “Lights up on emissions monitoring”, *Chemical Processing, November*.

5. Scott, J. (2004). "Nitrogen oxides emission control", *Control Engineering*, July.
6. Lang, G.A. (2005). "High temperature oxygen sensors", *Intech*, May.
7. Fortuna, L. *et al.* (2005). "Virtual instruments in refineries: data monitoring for environmental quality", *IEEE Instrumentation and Measurement Magazine*, October, pp. 26-34.
8. Yan, Y. (2005). "Continuous measurement of particulate emissions", *IEEE Instrumentation and Measurement Magazine*, October, pp. 35-39.

11. Hazardous emissions monitoring and control

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There is an increasing awareness in society of the need to protect our fragile environment. Meeting environmental requirements is recognised as one of the six 21st century business drivers for automatic control. Chemical companies, for example, use automatic control to minimise waste production because of increasing prohibitions against discharge and/or disposal of toxic substances. New plants are moving towards a “zero-discharge” concept [1]. In a recent report [2], greater emphasis on automatic control is suggested as a technological response of both the speciality chemicals and pharmaceutical sub-sectors to key business drivers up to 2015.

This contribution will report on recent developments in the monitoring and control of hazardous emissions (such as SO₂ and NO_x, amongst other pollutants). The contribution will firstly introduce the regulatory environment, which is driven by the EU commitment to the Kyoto protocol, the integrated pollution prevention and control licensing requirements of the EPA and, indeed, wider social pressures. Manual sampling to estimate pollutant levels is increasingly costly. Thus, new detectors and sensors have been introduced, which facilitate the development of a continuous emissions monitoring system (CEMS); the wider CEMS technology and typical CEMS computer interfaces will also be reported. Finally, recent developments in prediction emissions monitoring systems (PEMS) will be considered; such systems predict the concentration and emission rate of contaminant(s) based on correlation(s) with other monitored parameters.

References:

9. Edgar, T.F. (2004). “Control and operations: when does controllability equal profitability?”, *Computers and Chemical Engineering*, Vol. 29, pp. 41-49.
10. *Technology Foresight Ireland – Report on the Chemical/Pharmaceutical Panel (1999), Forfas*, <http://www.forfas.ie/icsti/statements/tforesight/chem/sectort.htm>

12. MODELLING OF DRINKING WATER TREATMENT PROCESSES AND THEIR PHASE IMPACT ON LEVELS OF *CRYPTOSPORIDIUM*

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Water quality has become a major environmental and human health issue. Water supplies are frequently being contaminated with waterborne pathogens such as *cryptosporidium*. This fact is highlighted by the increasing number of health warnings being issued by local authorities in Ireland with regard to unsafe drinking water. In 2004 alone, four general outbreaks of *cryptosporidiosis* were reported to the Health Protection Surveillance Centre where the suspected mode of transmission was waterborne. Epidemiological evidence was obtained linking one of these outbreaks directly with tap water consumption. Risk assessment models are required to give an insight into how water sources are contaminated and to assess subsequent levels of human exposure to harmful microbes and pathogens. The objective of this study is to develop a microbiological risk assessment model for *cryptosporidium* in drinking water abstracted from a public water supply. This study focuses on the development of a mathematical model that examines current drinking water treatment processes and their phase impact on levels of waterborne *cryptosporidium* and subsequent human exposure levels. The model focuses on the efficiency of different water treatment processes in reducing oocysts, including an analysis of primary treatment, (screening, pre-chlorination), secondary treatment (coagulation, flocculation, sedimentation and filtration) and tertiary treatment processes (chlorination and fluoridation). The model aims to assess the effect each treatment process can have on water quality in terms of oocyst filtration/inactivation and dilution effects. The proposed model can prove an important tool in assisting risk managers in identifying potential high risk periods for human exposure to *cryptosporidium*.

13. EVALUATION OF CURRENT APPROACHES TO MODELLING MICROBIAL CONTAMINATION OF WATERSHEDS

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The availability of safe drinking water is a critical factor for survival for all human beings. As a result, the emergence of waterborne pathogens, such as *Cryptosporidium* and *Escherichia coli*, has become of increasing regulatory concern. This has highlighted the need to enhance strategies that minimise human exposure to pathogens in drinking water supplies. Simulation models can play an important role in the assessment and management of natural water systems. An assessment of current modelling methodologies, data requirements and software as applied to microbial risk assessment of water quality in agricultural watersheds is required to evaluate current state of the art. Models were evaluated and assessed based on a number of set criteria including: type of model (qualitative or quantitative); treatment of input variables (stochastic or deterministic); use of input data (vector or raster); ability to incorporate meteorological, geological, hydrological and management factors; output facilities (GIS compatibility, graphical outputs, numerical outputs). Thirteen existing modelling approaches were evaluated. No model suited all of the evaluation criteria. Bacterial loading, incorporating pathogen sources, transport and behaviour in water (e.g. growth and decay) are represented in general forms in several models. However, pathogen predictions have proved variable and no model was capable of accounting for all geological and hydrological factors in addition to modelling the physical transport of bacteria in surface run-off. Qualitative model approaches can provide an effective means of assessing the risk of exposure to waterborne pathogens with minimum resources and limited data. This can then be used to determine the need for a full quantitative risk assessment and the availability of data for use in such an assessment. The various qualitative and quantitative approaches for modelling watershed contamination by waterborne pathogens are evaluated and discussed in the context of suitability to Irish data and conditions.

14. New Generation Contact Economiser Systems for Flue Gas Energy Recovery Addressing the Environmental Impact of Industrial Boilers.

Anne Laffan, Prof. Toshko Zhelev

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Industrial boilers are wide spread energy generating systems used mainly for steam generation. They are a practical and efficient way for flexible and controllable transportation of heat through industrial sites. The problem is that most the boilers in operation in Ireland today are quite old and inefficient and contribute negatively to the environment. Tougher environmental legislation, rising fuel and energy costs and the pending introduction of carbon taxation will all impact on doing business in Ireland. Firms that can successfully improve their operating conditions will enjoy competitive advantage.

The focus of this research is the optimal design and efficient operation of flue gas energy recovery systems, with the primary priority to increase and maximise industrial boilers efficiency. This research aims to develop a methodology for the evaluation of industrial boilers identifying possible scope for additional energy recovery, boiler efficiency improvement, giving recommendations on how to achieve this improvement. This project aims to design a contact economiser system for efficient flue gas energy recovery using packed bed column design. This project also aims to identify additional environmental benefit from the contact economiser system such as NO_x generation minimisation and particulate scrubbing through the filtration of the flue gases and controlled humidification of the combustion air. Upon the successful completion of this project it is expected that a methodology will be in place to identify possible energy recovery from industrial boilers with proposals on how to efficiently recover that energy and possible applications of the recovered energy.

15. DEVELOPMENT OF A RISK ASSESSMENT FRAMEWORK MODEL FOR EVALUATING HUMAN EXPOSURE TO NANOPARTICLES THROUGH ENVIRONMENTAL PATHWAYS

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Nanotechnology is a revolutionary new technology which allows the manipulation of materials at a scale comparable to the size of a single molecule (i.e. < 100 nm). At this scale the characteristics of a material may be drastically different to those of the same material at millimetre or even micrometer scale. This has led to research into, and even the current application of, this technology in many commercial sectors, with many applications in environmental remediation and energy generation. Over one billion euros has been used in nanotechnology research and development in Europe in 2004. It is expected the global R&D sector will be worth over 20 billion euros by 2008. With this new technology comes concern about human exposure to, and increased toxicity of, these nanoparticles. Despite the massive investment, the area of nanotechnology risk assessment has been a neglected one, even though many international reports and investigations highlight the importance and urgency of a risk assessment framework for nanoparticles in order to protect environmental and human health. In this study, a risk assessment framework is developed within which risks from nanoparticles through environmental pathways can be evaluated. The framework pulls together all current research on nanoparticle uses, likely exposure routes and toxicity. The analysis looks at the production and uses of nanomaterials in the environmental context while identifying sources of nanomaterials and particles that maybe of environmental and, consequently, public health concern. The framework approach can provide qualitative estimates of risks from nanomaterials in the absence of extensive quantitative data while also forming a sound basis from which future research can be directed in order to secure relevant quantitative data. The impact of physical and chemical properties of the nanoparticles and different exposure routes (oral, dermal and inhalation) on levels of human exposure to nanoparticles are discussed.

16. Using paleolimnological techniques to analyse past and present ecological status of lakes in Ireland: pigments and pollen.

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Paleolimnology, the scientific study of lake histories, provide a useful means of describing and examining changes in the biological and chemical statuses of a lake over time. Lake sediments, which are obtained using sediment corers, are an important source of palaeolimnological information: they often contain fossil records of aquatic organisms such as algae and macrophytes and provide a means of extending information on lake and catchment dynamics from instrumental and survey records back into deep historical and pre-historical time.

This poster refers to preliminary results from research that forms part of the EPA-funded ILLUMINATE project. The research referred to will eventually use algae pigments, pollen and macrofossils – in combination with other proxies of lake water and catchment conditions and analyses of radioactive isotopes - to reconstruct ecological dynamics in contrasting catchments in Ireland. The focus of attention are changes over the last ca. 200 years or so. In this poster, lakes in two catchments are referred to: the Burrishoole catchment, County Mayo, and the Lough Leane catchment, County Kerry. Lakes in the Burrishoole catchment have experienced disturbance as a result of catchment erosion linked to a forestation, while Lough Leane has experienced eutrophication in the recent past. Lakes in both catchments are likely to show climate change impacts over time.

Paleolimnological data can be calibrated through reference to over-lapping (in time) instrumental and documentary evidence. Together the two datasets – palaeolimnological and instrumental/ documentary - provide a means of verifying the output of ecological response models that are also being developed for the study sites through ILLUMINATE. These models, once constructed and verified, will have the potential to make predictions of responses to drivers of aquatic changes in the future. These models are likely to prove of value during the current implementation phase of the Water Framework Directive.

17.

Diatoms and Cladocera: indicators of ecological and palaeoecological conditions in two west of Ireland lakes

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Lakes are important components of inland surface water and they play significant roles in freshwater ecosystem and biodiversity. (European Council, 2000). In Ireland lake eutrophication has been identified as the most common water quality problem and as the principal pressure since 1970. The main sources of nutrient enrichment to Irish lakes are diffuse agricultural activities and discharges of domestic and industrial wastes. Intensive farming and nutrient transport from grasslands are responsible for the decreasing of lakes water quality in Ireland.

Paleolimnology is the study of lake sediments to reconstruct the history of lake environments, catchment development and climate change. The remains of diatoms and cladocerans deposited in the sediment can be analysed to display these changes. Diatoms (microscopic unicellular algae characterised by their siliceous cell walls) and cladocerans (small, transparent and discus-shaped water flea) have been extensively used to assess changes that result from lake eutrophication, acidification and climatic change. In paleolimnological methods both proxies have been recognised and applied as vigorous tools in tracking the history of water quality because they are some of the most important organisms in lake sediments in terms of abundance, diversity and indicator sensitivity.

This poster presents preliminary results to-date. The work is a part of the ILLUMINATE ref. no. 2005-W-MS-40 project funded by the Environmental Protection Agency. The aim of this study is to use paleolimnological methods to reconstruct past conditions in lakes from two catchments in the west of Ireland. Lakes in the Leane Catchment, County Kerry and the Burrishoole Catchment, County Mayo are at risk from nutrient enrichment, organic loading, point and diffuse sources pollutants and land-use changes.

The reconstruction over the past 100-200 years will be validated using measured ecological data and compared to hindcast model simulations. This study will aid the implementation of the WFD (Water Framework Directive) in Ireland.

18. The Insurance Hypothesis: Grassland based experimental test of its assumptions, conceptual basis and implications.

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Abstract

A central theory of ecology postulates that more diverse ecosystems are more stable, and hence predictable, in the face of environmental change. Within the framework constructed around the relationship between biodiversity and ecosystem functioning, this hypothesis of increased resistance and resilience has received renewed interest. Adapting experimental and modelling concepts recently developed to address some of the issues surrounding research into biodiversity and ecosystem functioning, this study aims to quantify the presence of Insurance effects in mixed grassland systems by applying environmental perturbation treatments and measuring the resilience of productivity. A second facet of the Insurance hypothesis involves the resistance of a system to invasive species. This will be addressed by analysing the dynamics of community composition. The results are expected to give further evidence of the benefits of using mixtures in managed grassland but also to provide some quantitative evaluation of a central ecological theory.

19. A preliminary study into the effects of nutrients and salinity on biomarkers in the brown seaweed *Ascophyllum nodosum* (Fucales)

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The increasing anthropogenic effect on our marine environment has highlighted the need to monitor and study the various habitats that exist here. Eutrophication is an ever increasing problem in Ireland especially in estuary and shallow marine environments. This demonstrates the importance to quantify and assess water quality and its effect on plant physiology along our coastline.

Ascophyllum nodosum is a slow-growing furoid that dominates the mid-tidal zone of North Atlantic coastal regions. This environment is characterised by a range of ecological variables. In certain areas freshwater input (coinciding/ along) with periodic tidal cycles create variable salinity regimes. The aims of this study are to identify and characterise the seasonal effects of nutrients NO_3^- , NH_4^+ , NO_2 , PO_4 and salinity on the physiological biomarkers of *Ascophyllum nodosum* from four different sites around Galway Bay. Sites are characterised based on salinity gradients high-low, freshwater influence and nutrient input.

Nutrient contents, phenols and pigments (chlorophyll *a*, chlorophyll *c*, fucoxanthin and β -carotene) were analysed in actively growing tips of *Ascophyllum nodosum* and related to salinity and nutrient concentrations of water samples collected from four sites. In addition, plant tips cultured in different known salinities and nutrient concentrations were also analysed and compared.

20. Biodiversity Politics – policy, planning and public understanding

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The past 50 years have seen dramatic losses in biodiversity and associated ecosystem services despite increased environmental policy at global, EU and National scales. Biodiversity policy has moved from protectionist conservation to a framework with sustainable development at its core, calling for broad spectrum public support and involvement. As part of the EPA-funded Biochange initiative, this poster describes the 'Biodiversity politics' project and details the findings of preliminary research. The project will examine the highly political activity of biodiversity planning which involves a wide variety of actors operating at a range of scales. It will engage these key actors and publics (including children) in discussions. To provide information on issues of power, politics and participation in biodiversity planning with the ultimate aim of generating recommendations for mechanisms to promote positive biodiversity management. In particular this poster details preliminary research that has generated a reference manual for policy makers outlining potential approaches to improve public understanding of biodiversity. The reference manual provides policy makers with an introduction to biodiversity and describes the need for greater public participation in biodiversity planning. It also presents a typology of participation and case studies of participation processes that have been developed in a wide range of geographical contexts and relate to a variety of different habitats, species and populations. A number of illustrative case studies are presented.

21. Energy Efficiency Improvement of Wastewater Treatment Processes Using Process Integration Techniques

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It is expected that very many intensive energy-users will find the near future challenging in meeting their energy demand.

As the pressure to cover costs and ensure economical operation grows on municipal wastewater treatment plants which are one of the largest energy users of County Councils, their operational optimization is gaining more and more importance.

However the ultimate goal of wastewater treatment is the compliance with discharge standards for the protection of the environment, other principal concerns of wastewater treatment plants are capacity to meet customers need and reliability of operation. Also from an economic point of view wastewater treatments plants should be operating at the lowest cost possible, including cost of construction, operation and retrofitting. Energy falls into the category of cost of operation and this research addresses the issue of how to improve the energy efficiency of wastewater treatment processes.

The energy efficiency of wastewater treatment plants must be integrated into plant design and operation when moving towards a more sustainable urban wastewater management.

The integration of energy concerns helps to achieve a better and more cost effective wastewater treatment processes which goal is in line what the EU and Ireland set as targets in the Green Paper for energy efficiency.

Energy savings can come from two areas: either by using less energy or by recovering and reusing as much energy as possible.

In this research the focus is on energy recovery and reuse. The methodology used is the Process Integration methods, namely Pinch Principle. It was developed in the late 1970s originally to help the design of heat exchange networks, but has moved to a larger scale of applications since. Two modifications of Pinch Analysis are to be utilised: Thermal Pinch – tuned for semi-batch processes and Oxygen Pinch – directly focused on energy for aeration and agitation.

The methodology is applied to the case study of this research project which is the Killarney Municipal Wastewater Treatment Plant.

22. ON THE TRAIL OF WATER POLLUTION – USING BACTERIA TO TRACK THE SOURCE OF FAECAL CONTAMINATION

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Monitoring methods used to detect faecal contamination of water have traditionally been based on the cultivation and enumeration of faecal indicator bacteria (i.e. faecal coliforms, *E. coli* and faecal enterococci). However, these methods provide us with no information on the source of faecal contamination, which is vital for the effective targeting of water source protection and pollution prevention. This has led to the development of various faecal source identification methods.

This research is focused on a method that involves the *Bacteroides-Prevotella* group. These bacteria are found only in the GI tract of warm-blooded animals, and are present in high numbers in human and animal faecal material. Most importantly, they display a high level of host specificity, i.e. some species are exclusively of human origin and some are exclusively of animal origin. Therefore, their specific identification in water can be used to distinguish between human and animal sources of faecal contamination. Since culture-based methods for the identification of members of the *Bacteroides-Prevotella* group are complicated by the requirement for strict anaerobic growth conditions, molecular methods, such as the polymerase chain reaction (PCR), provide a viable alternative for tracking the origin of faecal contamination in water.

In this study a number of ruminant-specific genetic markers were identified in faecal samples by amplifying 16s ribosomal DNA fragments from members of the *Bacteroides-Prevotella* group and by subsequently performing terminal restriction fragment length polymorphism analysis (TRFLP) on this DNA. By correlating these genetic markers with sequence data obtained from clone library analysis two ruminant-specific PCR primers were designed. These PCR primers were tested on ruminant, human, avian, canine, equine and porcine faecal samples. Both sets of primers are exhibiting good specificity and sensitivity which indicate that they show potential for use as a molecular method of faecal source identification in water.

23. DISPOSAL OPTIONS FOR ALUM SLUDGES FOCUSING ON COMPOSTING THE SLUDGES AND LANDSPREADING THE COMPOST

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Alum sludges are water treatment sludges classified under the European Waste Catalogue as wastes from preparation of water intended for human consumption or water for industrial use. During the water treatment process, potable water is produced by the removal of impurities from raw water. The residue is the water treatment sludges. Coagulant sludges are the most common of water treatment sludges. The most widely used coagulants are simple polymeric salts of aluminium and iron. The quantity of alum sludge produced in Ireland is less than 5% of the overall quantity of non-hazardous sludges produced. This percentage of alum sludge seems small but yet it poses a growing problem for disposal. This study examines the disposal options available for alum sludges and the viability of these options. Currently, the main disposal option for alum sludges is landfill. The diversion of these would contribute towards national targets of reducing quantities of waste landfilled. In Ireland the landspreading of alum sludges is only considered to be a viable option if a beneficial result to the soil can be shown. The study also looks into the composting of alum based water treatment sludges and shows that the resultant product is a mature, stabilised compost. Finally, this study looks at the land application of the compost through grass produce on trial plots and includes results showing an increase in vegetation on the plots, and benefits to the soil which include an increase in organic matter.

24. The Urban Waste Water Treatment Plant and the European Pollution Emission Register (EPER)

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By 2009, the Integrated Pollution Prevention and Control (IPPC) Directive will involve the establishment of a European pollution and transfer register. This will require the European Pollution Emission Register (EPER) to include urban waste water treatment plants [1].

This poster will describe the fundamentals of the urban waste water treatment plant process. It will also highlight the monitoring requirements for the implementation of the European Pollution Emission Register (EPER).

[1] Regulation EC No 166/2006 of the European Parliament and the Council of 18th January 2006, concerning the establishment of a European Pollution Release and Transfer Register and amending Council Directive 91/689/EEC and 96/61/EEC.

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The Energy efficiency improvement of anaerobic processes in Wastewater Treatment Plant by process integration techniques

Abstract.

In the decade of fast growing Irish economy and due to incoming immigrants enlarging Irish society the problem of the amount of waste produced and its treatment energy requirements force researchers to look for new opportunities of energy conservation.

The subject of the research is “The Energy efficiency improvement of wastewater treatment processes by process integration techniques” and is an attempt to create a model of integrated wastewater treatment processes to achieve lower energy consumption and energy recovery from waste treated on site. The project will be based on both the analysis of the existed literature examples of modern Wastewater Treatment Plants and on an Irish WWTP case study as a source of data provided to validate a general energy model. It envisages the utilisation of Pinch principal analysis for targeting and guided changes allowing maximum heat recovery. The required results of the project are to create a methodology for an analysis and evaluation of existing facilities, indicate scopes for energy efficiency improvements and design guidelines for the energy efficiency improvements in Wastewater Treatment Plant.

26. Effects of stocking rate and grazing season length on nitrate leaching from a free draining soil type

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There is increasing pressure on Irish agriculture to reduce the quantity of nitrate leaching from farming systems. The EU Nitrate Directive (91/676/EC) and the Water Framework Directive both require sustainable cost effective measures to protect, prevent and reduce water pollution from agricultural sources, with focus being on both point and non-point sources. To address the issue of non-point source of nitrogen loss from dairy production systems, two experiments are being undertaken at the Teagasc Dairy Production Research Centre, Moorepark, Fermoy, Co. Cork. Experiment 1 is to quantitatively examining the relationship between stocking rate, N fertiliser rate and nitrate leaching, while experiment 2 is examining the relationship between grazing season length and nitrate leaching. Both experiments have 9 treatments. Experiment 1 has 3 stocking rates x 3 N fertiliser levels, and experiment 2 has 3 spring turnout dates x 3 autumn housing dates. There are five dairy cows per treatment; cows are balanced across treatments. Nitrate leaching is being determined using 32 ceramic cups installed 1 m below ground level in each treatment. The leachate volume, nitrate, ammonium and total nitrogen concentrations are being recorded on a fortnightly basis. The experimental design was based on the hypothesis that there will be less leaching from lower stocking rates and N fertiliser input; and from later spring turnout and early autumn housing. The project will also provide data for modelling of N losses from dairy production systems.

27. STABILITY OF GRAIN YIELD AND QUALITY OF SPRING BARLEY
(*HORDEUM SATIVUM* L.) CULTIVAR MIXTURES AND MONOCULTURES
OVER DIFFERENT SITES IN IRELAND

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To date, in Ireland and indeed worldwide, most cereals are produced using single cultivar stands (monocultures). Even though cultivars are rigorously selected for optimal performance in a given region, fluctuations in yield between sites and years is one of the major problems in cereal cultivation. It has been suggested that growing cultivar mixtures might be a way to reduce these fluctuations. In mixtures, cultivars may compensate for yield loss caused by suboptimal performance of an affected component of the mixture.

To test if cultivar mixtures produce more stable yield than cultivar monocultures, an experiment has been carried out at four sites with different soil types in Ireland. At each site, 4 cultivars of spring barley (*Hordeum sativum* L.) were sown in monocultures and in mixtures with different initial proportions of each cultivar in early April 2006. Results and methods to analyze stability over sites will be presented. Results indicated that mixtures of cultivars did not perform better than monocultures, nor was their yield generally more stable over sites.

28. Name: Eoin O'Callaghan College: University College Cork**The diversity of aquatic macroinvertebrates in calcareous fen wetlands
within an agricultural landscape****ABSTRACT**

Fens are minerotrophic, groundwater-fed, peat-forming wetlands that harbour a rich diversity of plant and animal species. As for many other natural habitats, the extent and biological integrity of fens has declined in Ireland as a result of land drainage and reclamation, eutrophication and urban development. We need to understand how the remaining fen wetlands are impacted by factors such as the continuing high inputs of agriculturally-derived plant nutrients in order to develop effective management strategies for these threatened habitats. The aims of this study are (i) to describe the macroinvertebrate communities of remnant fen wetlands (ii) to quantify the impacts of nutrient enrichment on biodiversity and ecological processes and (iii) to identify potential diversity and habitat quality indicator taxa.

29. OVERVIEW OF THE NATIONAL SOURCE PROTECTION PILOT PROJECT AT CHURCHILL & ORAM, CO. MONAGHAN, IRELAND.

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The Group Water Sector have experienced an increase in the cost of the provision of their drinking water in recent years, mainly due to deteriorating raw water quality and associated treatment difficulties. As a direct result of this, the National Source Protection Pilot Project based at Milltown Lake catchment, Churchill & Oram commenced in September 2005, led by DkIT, to attempt to develop a strategy for monitoring Group Water Scheme sources and their catchments through community involvement.

Continuous monitoring of the catchment is underway and includes microbiological, macrophyte, macroinvertebrate and diatom collection and analysis across 33 individual sites. Nutrient loadings are being recorded and paleolimnology studies are ongoing. All data collected to date has placed the lake firmly in the eutrophic category.

As *E. coli* readings throughout the catchment have had an “unacceptably high” status in approximately 50% of sites sampled, septic tank surveys are also being conducted to assess the status of all septic tanks and to assess the suitability of these waste systems to the physical characteristics of the soils in the area.

In addition, in an attempt to monitor nutrient inputs from diffuse agricultural sources, soil sampling is being conducted from which appropriate nutrient management plans will be devised. Furthermore, farmyard inspection surveys are being conducted to ensure appropriate and adequate measures are in place to deal with storage and control of farmyard wastes and associated dirty water.

Finally, a combination of all these factors will allow the project to create a full GIS map representing the source protection area including all potential contamination sites. All threats will then be ranked according to their degree of risk in impairing vulnerable water sources. From this, a source protection plan will be implemented in the area, which will involve a combination of protection, rehabilitation and sustainable remedial measures which will eventually be rolled out across the Group Water Sector.

30. A Comparative Study on Legislation, Guidelines and Best Practice Approaches for SMC Management

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With an estimated sixteen million tonnes of spent mushroom compost (SMC) produced annually worldwide, it is inevitable that the appropriate legislations and polices should be in endorsed to deal with the apposite management of this sizeable quantity of SMC effectively. The United States, Netherlands, Canada, the United Kingdom and Ireland were selected for evaluation of the legislations and best practice approaches regarding SMC management at local and national levels within these countries. The United States and Canada have comprehensive best practice management plans for the mushroom community, issuing extensive information from the appropriate storage and treatment of SMC to the available markets present. The major environmental hazards associated with SMC are its appropriate storage, particularly when land spreading is not permitted, determining a suitable application rate in light of stringent nutrient management plans and finding a proper and environmentally friendly end use or market. Best management practice plans should be developed in the Netherlands, the UK and Ireland comparable to those regulated in the US, taking into account limitations that may occur at a local level, such as the volume of SMC produced in certain areas of the countries, the proximity of mushroom farms to other agricultural outlets, local weather patterns and variability in soil nutrient content. Therefore one set of guidelines may not be adequate for each country, and therefore guidelines should possibly be rationalised and implemented at a provincial level. Furthermore, ecotoxicity data on pesticides and disinfectants should be considered in the management and planning decisions made regarding the application of pesticides and future utilisation of SMC.

31. A COMPARISON OF A MULTI-CHANNEL FLOW CYTOMETRY SYSTEM WITH EXISTING TECHNIQUES AND ITS SUITABILITY FOR THE DETECTION OF WATER-BORNE MICROORGANISMS

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The monitoring of microorganisms in our aquatic systems is becoming increasingly important in recent years, due to the enormous quantity of waste produced each year through both industrial and domestic avenues. The overall aim of this project is to increase the efficiency in detecting toxic algal events or the presence of dangerous strains of *Escherichia coli* in Irish marine and freshwater environments. To this end, the Tyndall Institute, U.C.C is designing a micro fluidic-based flow cytometry system, which will incorporate cell pre-treatment, immuno-fluorescent tagging and the subsequent counting of the cells by flow cytometry. The main objectives of the project are the development of a pre-treatment system for the bacterial cells which can operate at ambient temperatures, the development of a specific immuno-fluorescent tag capable of detecting one particular cell among tens of thousands and a comparison of the micro fluidic flow cytometer with existing techniques. Initially the focus is on the detection of harmful *E. coli* strains due to the availability of commercial immunoassay kits for system comparison and the availability of environmental samples containing detectable levels of these bacteria. Growth curves of the *E. coli* lab strains being utilised have been constructed to allow enumeration of the bacteria prior to flow cytometric analysis. A study has been carried out on a number of sites using the Delagua Coliform Detection Kit, this uses selective media and membrane filtration to enumerate faecal coliform bacteria in environmental samples. This method of enumeration will later be compared to the flow cytometry technique.

32. FEEDING ECOLOGY OF THE CHOUGH IN IRELAND

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The Red-billed Chough, *Pyrhcorax pyrrhcorax*, has undergone European-wide declines over the past two centuries. The species is listed as a top priority (Annex 1) species on the EU Birds Directive. Changes in agricultural practices and land-management systems are suspected to be the main reasons for the decline of the Chough across Britain and Ireland. Foraging Red-billed Choughs are being studied across their range in Counties Waterford, Cork and Kerry in order to assess feeding rates in various habitats throughout the year. Surface and soil invertebrates are sampled at feeding sights with a view to calibrating Chough energy-intake. Faecal analysis is being carried out, to establish the overall diet of the Chough in Ireland, and to determine the relative abundance and seasonality of different prey species in the diet. Other habitat-related enquiries include a GIS study into the relationship between habitat availability and Chough distribution, an investigation into rates of prey-depletion in heavily utilised feeding-areas, a study of animal-pesticide usage, and an analysis of stable isotope ratios from bird tissues to determine habitat usage. Chough population dynamics are monitored in selected areas by regular roost counts. Population dispersal is assessed through the ringing of chicks and through genetic analysis of blood samples. From preliminary analysis, no significant relationships have been found between foraging behaviours and habitat type. Faecal analysis show a diet similar to that known for British Choughs, but with fewer prey-species recorded to date. No re-sightings have been recorded for the 11 chicks ringed during the 2006 breeding season.

33. Past, present & future conditions in Lough Mask, a marl lake, integrating palaeolimnological investigations & existing data in a dynamic modelling framework.

Described as the ‘jewel in the crown’ of the western lakes, Lough Mask, a marl lake, is renowned for its retention of a large population of natural wild brown trout and arctic charr. However, long-term water quality datasets have raised concern about the future of this important fishery resource, with indications of increased nutrient input to the lake resulting in a reclassification of the lake’s status from oligotrophic to mesotrophic (EPA 2003).

Current knowledge of marl lakes in Ireland, in terms of their ecology, palaeolimnology and sensitivity to environmental change, is lacking. In particular, no palaeolimnological investigations have been carried out on L. Mask to date. Studies of a nearby marl lake, Lough Carra, have led to concern about the sensitivity of these calcareous lakes, specifically their resistance to eutrophication (Hobbs et al., 2005). A so-called ‘critical threshold’ for nutrient concentration has been proposed for such lakes (Scheffer et al., 2001) below which conditions remain unchanged, e.g. a charophyte-dominated vegetation, clear water system, but beyond which a dramatic ‘flip’ to an alternative turbid, phytoplankton-dominated state can occur. In addition, simple reduction of nutrient concentrations below this ‘critical threshold’ does not restore the lake to its original conditions. Evidence of increased nutrient status in L. Mask presents a worrying trend for the approach of such a catastrophic shift.

This poster presents preliminary results from research forming part of the EPA-funded ILLUMINATE project. The research aims to investigate L. Mask using a combination of palaeolimnological techniques and computer modelling. The former will involve the determination of sediment chronologies (using radiometric ^{210}Pb dating), a multiproxy palaeolimnological approach to establish reference conditions and recent lake and catchment changes over the last c. 200 years and the verification of reliable palaeolimnological indicators for marl lakes. In particular, charophyte remains will be analysed in an attempt to decipher the recent history of L. Mask. Modelling will involve the coupling of a dynamic catchment model to an ecological pressure-response model combining a range of historical information: climate, nutrient loading, historical census data, inflow/outflow, landuse, etc. This will be used to hindcast past events, which will be validated using the palaeolimnological results and historical datasets, thus enabling reasonable forecasting of possible future scenarios for different catchment conditions. This will ultimately inform the lake management bodies and aid in the implementation of appropriate measures required to meet the objectives of the WFD.

34. Pollution as a driver of biodiversity change - impacts, indicators and long-term monitoring

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The Habitats Directive (92/43/EEC; HD) and the Water Framework Directive (2000/60/EC; WFD) both require consideration of the impacts of pollutants on elements of biodiversity and the development of cost-effective tools to measure those impacts. A network of 13 intertidal sites has been established on the west coast of Ireland, to serve as a focus for strategic research to test the effects of nutrient enrichment and develop biomonitors. Community of molluscs, invertebrates and macroalgae in the lower rocky intertidal have been sampled at the sites. A range of physicochemical parameters was measured in order to characterize levels of eutrophication on the shores. The biological community structure was compared among sites and related to environmental variables using multivariate and univariate ecological analyses. Preliminary findings will be presented. Additional biota and habitats will be sampled in related projects at the same sites, together with potentially applicable biomonitoring measures, such as scope for growth in mussels. The overall objective is to develop a comprehensive data set that will allow us to identify ground-truth and cost-effective tools for long-term monitoring of marine environmental quality. Findings will also be integrated with work in freshwater and terrestrial habitats as part of the EPA funded Biochange project (www.biochange.ie).

35. ASSESSING THE CONSERVATION STATUS OF TURLOUGHES

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Turloughs are classified as Groundwater Dependent Terrestrial Ecosystems and are described as topographic depressions in karst which are intermittently inundated on an annual basis, mainly from groundwater, which lack a surface outflow and have a substrate and/or ecological communities characteristic of wetlands. Turlough conservation is driven by the objectives of the EU Habitats Directive (92/43/EEC) and Water Framework Directive (2000/60/EC) which emphasise the need for a scientifically based system for assessing the conservation status of turloughs. This multidisciplinary project aims to describe and classify the vegetation, algal and aquatic invertebrate communities, in conjunction with hydrological, hydrochemical and pedological assessments across a representative range of Irish turloughs. Twenty turloughs were selected for study from an area spanning Co. Clare, Co. Galway, Co. Mayo and Co. Roscommon, lying within the Shannon and Western River Basin Districts. Turlough vegetation description initially requires an assessment of the relationship between semi-quantitative vegetation data and previously described plant communities. Geo-referenced vegetation mapping and transect surveys will allow integration of vegetation data with relevant hydrological and topographical parameters. Algal and aquatic invertebrates respond to nutrient loads and their relationships with corresponding hydrochemical data in addition to local- and catchment-scale pressures will assess the effectiveness of monitoring aquatic biota for turlough trophic status assessment. Dynamic turlough hydrology dictates that hydrological indicators are based on water level, which is recorded using sensors near the lowest points in each turlough. It is proposed to test the relationships between the hydrological signature for each turlough and aspects of the biological communities indicative of trophic status and to define how such relationships may be used as predictors and indicators of expected turlough trophic status or declines in turlough habitat quality.

36. THE IMPACT OF PAST LAND USE ON SEMI-NATURAL WOODLAND

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Present-day woodland may be descended either from old-growth natural forests or from abandoned agricultural land that has subsequently reverted to woodland. Ancient woodlands tend to have relatively undisturbed soils and their soil and vegetation structure can take several centuries to mature. Recent woodlands, however, often differ in both their vegetation composition and soil structure from old-growth forests. These variations may be linked to long-term changes in nutrient cycling and structural soil properties, and may be irreversible on a historical time scale.

The Gearagh is a mixed deciduous woodland in the floodplain of the River Lee in Co. Cork. It is one of the last semi-natural forested floodplains in Europe and a considerable block remains largely undisturbed. However, parts of the Gearagh were developed for agriculture (grazing of cattle) in the past but were eventually abandoned and have regrown as woodland. In addition, all but 200 hectares was felled and flooded by the ESB in the 1950s during the construction of the River Lee hydroelectric scheme. Observations suggest that there are marked gradients in soil invertebrates, soil organic matter and aboveground vegetation in the woodland. The aim of this project is to investigate the soil and vegetation dynamics of these undisturbed and secondary woodland sites. This involves recording and determining the complete links between the soil properties, vegetation structure, soil invertebrate and microbial communities. The results of this study may have important implications for future forest conservation and restoration.

37. Carol Meaghar

By 2009, the Integrated Pollution Prevention and Control (IPPC) Directive will involve the establishment of a European Pollution and transfer register. This will require the European Pollution Emission Register (EPER) to include urban waste water treatment plants [1].

This poster will describe the fundamentals of the urban waste water treatment plant process. It will also highlight the monitoring requirements for the implementation of the European Pollution Emission Register(EPER).

[1] Regulation EC No166/2006 of the European Parliament and the council of 18th January 2006, concerning the establishment of a European Pollution Release and Transfer Register and amending Council Directive 91/689/EEC and 96/61/EEC.

38. Effect of the environment on phenol content of *Ascophyllum nodosum* and its impact on their metal binding properties: first results from a transplant experiment in Galway Bay

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Brown seaweeds, present in high biomass on temperate rocky shores, bind metals with high affinities and are commonly used in biomonitoring studies. Phenols, which can make up to 20% of algal (dry) biomass, are the major cellular component responsible for brown algal metal-binding, besides polysaccharides such as alginates and fucoidan. These phenols are secondary metabolites and stress compounds: they protect thalli against, for example, grazers, pathogens and harmful UV-radiation. They also play a role in the cell wall formation in first stages of zygote development. Phenol contents have been reported to fluctuate considerably according to ambient environmental factors such as seawater salinity and nutrient concentrations. An ability to quantify reliably environmental effects on the production of phenols that bind divalent metals, and therefore contribute to seasonal and local variation in algal metal concentrations, would significantly improve the application of seaweeds as biomonitors. Here we report first results of a transplant experiment between two sites in Galway Bay. The aim of this experiment was to assess the capacity of transplants to acclimate to their new environmental conditions and to align their phenol content to the local plants. The first site, Kinvarra, is located in the south-east coast of the Bay and is characterised by high nutrient levels and a low salinity at low tide due to extensive groundwater input. The second site is located in Connemara, with normal seawater salinity and very low nutrient levels. Plants of *Ascophyllum nodosum* (knotted wrack) commonly observed on sheltered western shores, were transplanted between the two sites. Previous studies suggested a large difference in phenol level between the two sites, with the higher level (11.5% dry weight) in Connemara plants and the lower level (3.2% d.w.) in Kinvarra plants. Phenol levels in apical parts were determined every 15 days: in transplants from one site to the other, transplants within the same site and control plants.

39. The Dangers of Dust: results of Indoor Dust sampling utilising IOM sampling unit

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Human beings spend most of their lifetime in indoor environments. Studies have shown that personal exposure to micron-sized particulate matter (PM) is related to these environments. Human activity re-suspends particulate contaminants from indoor catchment's surfaces. Aerosol/Dust concentrations from re-suspension are generally much lower than those from direct release of dust/aerosol; but due to the persistence of the contaminants in indoor environments and continuous human activity, long-term exposure to the re-suspended contaminants can cause considerable human health problems.

The aim of the study was the investigation of dust concentrations using ambient air monitoring (Institute of Occupational Medicine IOM Sampling unit) via gravimetric analysis/investigation of the dust particles within different indoor environments.

Dust standards employed:

For an 8Hr Time weighted average (TWA) - 5.0 mg/m³ Respirable dust Permissible Exposure Limit (PEL).

Different sites were measured, in order to provide a variation in the dust concentration results.

Findings indicate all sites exceeded the permissible exposure limits and that PPE was rarely employed during any of the activities. The data will show that employing an oral mask can radically reduce respirable dust concentrations.

Keywords; Dust, Particulate Matter (PM), Institute of Occupational Medicine IOM sampling unit, Time Weighted Average,

40. Bernadette Kearney

The use of biostimulants such as seaweed extracts and microbial inoculants, which either feed indigenous microbial populations or add micro-organisms to existing rootzones, is becoming increasingly popular with turfgrass managers, particularly on relatively sterile newly constructed sand based rootzones. The objectives of this research were to study the effect of applying a commercially available seaweed extract and a commercially available microbial inoculant on turfgrass growth, microbial activity, and overall plant stress tolerance levels which are of critical importance in turfgrass management. A two factor experiment (nutrient rate and biostimulant type) was initiated in a glasshouse experiment. Rose pots measuring 15cm x 18cm (3L) were filled with a rootzone mixture to United States Golf Association specifications. The pots were divided into ten separate treatments. Five treatments received two-thirds and five treatments received one-third of a recommended nutrient package. Separate treatments of bentonite clay carrier at 12.5 gm.m^{-2} , seaweed extract at 50 gm.m^{-2} and microbial inoculant (bacteria and fungi) at 25 gm.m^{-2} were applied to both nutrient rates. An additional treatment containing a mixture of the seaweed extract and microbial inoculant was applied to each nutrient rate. Control treatments were used which only received two-thirds and one-third nutrient rates. Grass fresh weight growth was measured on a monthly basis for four months. Soil fungal and microbial activity, arbuscular mycorrhizal activity, grass colour, leaf proline concentration, rooting mass and the normalized difference vegetation index were measured during the experiment. The application of the seaweed extract/microbial inoculant, and the microbial inoculant treatments increased grass growth. The biostimulant treatments, in particular the seaweed extract/microbial inoculant combination significantly increased soil fungal activity and soil microbial activity. Application of the biostimulant treatments significantly reduced leaf proline concentration, and significantly increased rooting mass, grass colour and the normalized difference vegetation index. Interactions between the treatment factors were found for numerous measurements including grass colour, and leaf proline concentration. The results suggest biostimulant applications may be very useful to turfgrass managers who are renovating or building sand based golf greens.

41. MICROBIOLOGY OF BIO-ENERGY CROPS: PATHOGEN FATE AND BIOREMEDIATION ENHANCEMENT

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The use of local energy crop plantations for the disposal of suitable municipal and food industry wastes could benefit local authorities and local waste-generating industries as well as farmers and energy users. Yet the commercial uptake to date has been slow, possibly due to the fact that for regulatory agencies assurance is needed that the effluents are applied such that they do not lead to pollution of the air or water or create any health hazards. Therefore more information is needed on the fate and potential hazard of pathogens following application. Competition among microorganisms in the rhizosphere and predation are mechanisms thought to be involved in the removal of pathogens following application of effluent. However, some pathogens have been shown to colonise plants in laboratory conditions.

As part of this study limed sludge from a municipal wastewater treatment plant was applied onto a plot of *Miscanthus*. After a period of 5 weeks, soil samples from the rhizosphere were taken from the treated plot and a control plot. Soil samples were analysed for the presence of recent and remote indicators of faecal contamination.

Preliminary studies showed that the indicators of recent faecal contamination were absent from the soil and rhizosphere of the treated site although the presence of spore forming indicators were detected. Future work will examine possible contamination of the groundwater following application of Sewage sludge and the presence of indicators in the crop plant

Acknowledgement

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42. Ants as keystone species in Irish grasslands: species mosaic, conservation status and trophic relationships

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In recent decades the importance of soil biota has been recognized increasingly. As ecosystem engineers ants have important direct and indirect relationships to other soil and non-soil biota. However most studies were carried out in other countries. The Cré Beo project, funded by the EPA, will provide data for the occurrence and the diversity of keystone biota in soil, including ants. It is intended to identify ant rich sites and sites with rare ant species in Ireland and provide criteria for their rapid evaluation for conservation. Trophic relationships of ants in the grassland ecosystems will be investigated using stable isotopes. Earthworms are also keystone soil biota and the relationship between ant and earthworm species diversity will also be examined. This poster provides an introduction to this project.

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43. THE EFFECT OF INSTREAM MACROPHYTE COVER ON SALMONID DISTRIBUTION AND BEHAVIOUR

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Riverine salmonid populations are affected by a number of different factors, including instream physical and chemical habitat, inter- and intra- specific competition and the nature of riparian vegetation. While it is known that dense riparian canopy can reduce the growth and abundance of epilithic algae, higher plants and their invertebrate consumers in a stream, little is known about the complex interactions between riparian shade, instream plants such as *Ranunculus*, and salmonid ecology. Instream macrophytes can have many impacts on river systems. Whilst dense growths can result in low night-time oxygen concentrations and lead to excessive siltation of gravel substrata (both effects deleterious to salmonids), they also provide important substrate for some species of aquatic invertebrates and also act as 'cover' for juvenile fish against terrestrial and instream predators. Many studies have shown a positive correlation between stream habitat complexity and salmonid density, a result of the strong territorial behaviour of juvenile salmonids. The role of instream macrophytes in a given system is thus likely to be a major factor in the biology of salmonids, potentially determining their recruitment success, growth rate and population densities. Recent observations on salmonid densities in Munster streams have shown that dense riparian shade both reduces the abundance of *Ranunculus* and correspondingly the densities of young-of-year trout and salmon which were strongly associated with the trailing fronds of the macrophyte. We propose to investigate the impact of *Ranunculus* densities within a stretch on the foraging, movement and territorial behaviour of brown trout and salmon on the River Owenkeagh in Co. Cork, and also how macrophyte use by juveniles might change with stream size. The importance of macrophyte beds as a potential winter refuge for young-of-year salmonids will also be investigated.

44. A transcriptional regulator in *Pseudomonas aeruginosa* PAO1, differentially induced by plant root exudates, controls the expression of a metallopeptidase involved in dipeptide metabolism.

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Abstract:

The identification of genes and promoter regions in bacterial strains which are induced in the rhizosphere is paramount in the development of novel plant growth promoting strains and strains which could play a role in biocontrol. The dipeptide transport machinery has to date been implicated in the transport of amino-levulinic acid (ALA), a component of plant root exudates. Investigation of the dipeptide transport machinery in *P. aeruginosa* indicated the presence of an extended transport operon which included two additional dipeptide binding proteins, a putative metallopeptidase and a putative transcriptional regulator. This putative transcriptional regulator (*pdpR*) was found to be centrally located in this extended dipeptide transport operon. Analysis of the promoter activity of a novel transcriptional regulator, *pdpR* on the plant root was carried out. This showed expression of the regulator was specific to the Roberta root with little or no induction on the Celt root. Further information regarding the spatial activity of the regulator showed expression was focused at the root tips. Gnotobiotic plant-trial analysis has shown that a mutation in this regulator, however, didn’t affect its ability to colonise in the rhizosphere. Proteomic analysis of this regulator has identified putative targets. Proteins shown to be up-regulated in the mutant strain included DnaK and PA4498 (MdpA), a putative metallopeptidase. Functional genomic analysis of this regulator has shown it regulates dipeptide metabolism, *via* the transcriptional regulation of its target *PA4498*.

45. Functional Genomic Approaches to Elucidate Novel Transcriptional Regulators with a Role in *Pseudomonas*-Plant Interactions

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There is increasing pressure to reduce the widespread use of chemical inputs in agriculture due to growing concerns for environmental protection and human health. Many naturally occurring microorganisms can stimulate plant growth and are antagonistic to plant pathogens. Members of the *Pseudomonas* genus are of particular interest due to the ability of certain strains to colonise the rhizosphere at a high density and to produce biologically active secondary metabolites. Molecular signalling between microbes and their eukaryotic hosts can influence both beneficial and pathogenic interactions in the rhizosphere, however, little is known about the influence of plant-derived signals on bacterial gene expression and function.

To address this, a transcriptome profiling study was conducted to investigate the effects of two varieties of sugarbeet root exudate on global gene expression in *Pseudomonas aeruginosa* (1). Field-based studies have shown that these two varieties select for genetically and phenotypically distinct resident culturable fluorescent pseudomonad populations in the rhizosphere. This study identified subsets of genes that were similarly and differentially regulated in response to the exudates. We hypothesise that genes with similar alterations in expression in response to both root exudates may function in colonisation and competitive ability of *Pseudomonas* in the rhizosphere, while those with differentially altered expression may play a role in plant variety-specific function.

The genes being investigated encode probable transcriptional regulators whose expression is differentially regulated in response to the exudates. These genes have been analysed for roles in rhizosphere colonisation and a number of rhizosphere-associated phenotypes. This has identified a gene which plays an important role in competitive colonisation of both varieties of *Beta vulgaris*, and a gene which influences the degree of host specificity during competitive colonisation. Proteomic analysis has identified a number of targets regulated by these genes. Molecular analysis of the regulatory pathways is being carried out to determine the role of transcriptional regulators in plant-microbe interactions.

1. Mark, G. L., *et al.*, (2005) Proc Natl Acad Sci USA 102:17454-17459

46. Investigation of the role of a novel regulator in bacterial competition in the rhizosphere during plant-microbe interactions

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Conventional agriculture relies on a high input of chemicals such as pesticides and fertilisers to produce consistent high crop yields. There is increasing pressure to reduce the use of these inputs due to growing concerns for environmental protection and human health. Plant roots are the site of attack for a number of bacterial pathogens. There are many naturally occurring microorganisms that are antagonistic to plant pathogens and have the potential to provide an alternative to chemical pesticides. These microorganisms can stimulate plant growth and have the ability to promote plant health and development. Molecular signalling between microbes and their eukaryotic hosts plays a fundamental role in the establishment of beneficial interactions and in pathogenesis. It is generally accepted that plant-derived extracellular signals can influence the behaviour of bacteria in the rhizosphere however, little is known about the effects of these signals on the patterns of bacterial gene expression.

The strategy adopted was to investigate the role of root exudates from two plant varieties (*Beta vulgaris* Celt (BVC) and Roberta (BVR)) on the transcriptome of *P.aeruginosa* PA01 using Affymetrix™ Genechips® (1). Field-based studies have shown that these two sugarbeet varieties select for genetically and phenotypically distinct resident culturable pseudomonad populations in the rhizosphere. Genes with altered expression in response to the plant root exudates were characterised as being similarly regulated or differentially regulated.

A subset of differentially altered genes was selected for further study. These include a novel gene encoding a probable ECF sigma factor. Functional genomic analysis was completed using a wild-type strain and a strain containing an insertional mutation in the gene of interest. Disruption of this gene reduced the ability of the mutant to compete with the wild-type in the rhizosphere of BVC and BVR, grown in a gnotobiotic plant trial. Proteomic analysis is currently being carried out to identify targets regulated by this sigma factor.

1. Mark, G. L., *et al.*, (2005) Proc Natl Acad Sci USA 102:17454-17459

47. Effects of invasive species on biodiversity and the interaction with climate change

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ABSTRACT

The major elements of global environmental (climate change, increasing nitrogen deposition and land use change) are likely to favour the spread and range extension of alien invaders, enhancing their impacts on ecosystems. Whilst previous evidence has shown that invasive plant species can alter ecosystem functioning and biodiversity, there is little direct experimental evidence on exactly how this will be affected by projected changes in climate; most information has been based on model predictions. Climate manipulations to assess the performance of two invasive plant species, one alien (Japanese Knotweed) and one native (bracken), as well as their effect on native biodiversity will be tested using field-based simulations. Due to logistical problems and economic costs the installation and operation of facilities for imposing climate change scenarios in remote locations is difficult. For these experiments changes in climate will be induced using specially constructed passive polythene tents in which a number of environmental factors will be regularly monitored. The tents are comprised of a galvanized-steel frame (2m x 2m x 1,4m high) covered by a UV-permeable polythene film. Twelve of these tents are being set up on six species rich grasslands in the Burren, Co. Clare, three of comprising plants of the alien invader and three of the native invader. Additional treatments, using water and nutrient applications will, together with temperature and carbon dioxide measurements, provide a basis for predicting community response to climate change.

48. Physical and ecological impacts of preferential grazing areas in western hill and mountain peatland

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The project is part of an overall programme to achieve sustainable agri-environmental management of hill and mountain peat land. Peat soils occupy a very high proportion of the western hill/mountain landscape in Ireland. They are especially vulnerable to erosion under inappropriate land use. Grazing systems may impact not only on the density and composition of the vegetation cover but also on a range of micro-topographic features.

The objective of this study is to quantify the physical impact of hill sheep at low, medium and high levels of grazing by quantifying changes in micro soil erosion, plant cover and soil nutrient content over time.

Results of the micro-soil erosion, plant cover and soil nutrient analysis will be correlated with relevant farm management systems details and local weather data to identify sustainable agri-environmental management strategies of hill and mountain peat land.

Sites representing three levels grazing intensity (*low, medium, high*) were selected in the Connemara region of Galway and Mayo based on altitude and physiography. Within each site four areas associated with sheep activity namely high and low densities of occupation, sheep 'camps' and movement corridors were chosen. These were identified largely by random selection from existing databases for the *medium* level of grazing and by field examination of topographic transects in the *low* and *high* levels of grazing.

Methods to measure changes in micro-erosion and deformation of soil surface include rainfall detachment trays (constructed), Gerlough troughs, splash cups, micro-topographic pin profilers (designed) and reference marker pins. All the sites have been sampled for soil fertility analysis.

49. Environmental Issues Relating to the Large-scale Production of Plasmid DNA for Gene Therapy.
Finola Cliffe

The concept of gene therapy involves the transfer of genetic material into a human cell, tissue or organ with the objective of either curing a disease or decreasing the progression of the disease [1]. To attain clinical benefit, delivery systems are required that are capable of gene transfer directly into the target cells or surrounding areas. Both viral and non-viral delivery systems have been developed to deliver the therapeutic genes effectively. Due to the toxicity and immunogenicity of viral vectors, non-viral vectors such as plasmid DNA (pDNA) have become steadily more attractive. At present, the number of gene therapy clinical trials using pDNA based delivery vectors rests at 206, representing approx. 17% of the 1192 ongoing gene therapy trials [2]. The advancement of large-scale pDNA manufacturing processes must therefore accompany the escalating number of gene therapy applications.

The possible risks connected with the waste streams from these large-scale processes have to be taken into account, particularly issues associated with the DNA content of these wastes. This research aims to investigate the appropriate management methods to reduce or eliminate persistent plasmid DNA present in the waste streams as well as determining the environmental impacts of such large-scale production. Further work in this project will concentrate on optimisation of process design for the minimization of environmental impact.

References:

- [1] Prescott, L. M., Harley, J. P., and Klein, D. A., (2002) *Microbiology*, 5th ed., Boston: McGraw Hill.
- [2] Gene Therapy Clinical Trials Worldwide, *Journal of Gene Medicine* (2006), Available: <http://www.wiley.co.uk/genmed/clinical/> [accessed 31 Oct 2006].

50. MODELLING PAST AND FUTURE ECOLOGICAL IMPACTS IN IRISH LAKES.

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Management of Irish surface waters has up to now relied primarily on routine assessment of water quality. However, the implementation of the Water Framework Directive requires that cognisance be taken of past reference conditions and that such conditions in surface waters be restored by 2015. Modelling can aid in the realisation of these goals by quantifying past ecological responses and by providing a tool to explore future management options. In the ILLUMINATE project a catchment model linked to an ecological pressure-response model will be applied for the first time in an Irish context. The sites at which the models will be applied are the L. Leane catchment in Co. Kerry and the L. Feeagh and L. Mask catchments in Co. Mayo. The General Watershed Loading Functions model (GWLF), which has been validated for the Leane and Feeagh sites in a previous project, is being used to simulate catchment loads of sediment, nutrients and dissolved organic carbon (DOC). The combined physical-biological model 'DYRESM-CAEDYM' is being used to model in-lake biological processes. DYRESM (DYNAMIC REServoir Simulation Model) is a one-dimensional hydrodynamics model that predicts the vertical distribution of temperature, salinity and density in lakes and reservoirs. It is dynamically coupled to CAEDYM (Computational Aquatic Ecosystem DYNAMICS Model), a widely used biological response model that simulates primary production, secondary production, nutrient and metal cycling as well as oxygen dynamics and the movement of sediment. The combined models will be used to hindcast important ecological pressures and to forecast these pressures under different scenarios of land use, population change and climate change. Model hindcast simulations will be verified using historical records and paleolimnological data for the sites. This poster presents results on the validation of the three models under present day conditions.

51. Substrate specificity of a bacterial GST, BphK^{LB400}: Potential for bioremediation

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The *bphK* gene located in the *bph* operon of *Burkholderia* LB400 encodes a protein, BphK^{LB400}, with significant sequence similarity to glutathione-S-transferases (GSTs), a group of enzymes involved in the detoxification of many endobiotic and xenobiotic substances. Comparison of the amino acid sequence of BphK^{LB400} with GSTs from other bacteria that degrade polychlorinated biphenyls identified a number of highly conserved amino acids in the C-terminal region of the protein that may be associated with substrate specificity. In this study, a highly conserved amino acids in the C-terminal region of BphK^{LB400} was selected for mutation and further analysis in an effort to learn more about the substrate specificity of BphK^{LB400} (wt and mutant) so as to determine it's potential in bioremediation. BphK^{LB400} (wildtype and mutant) was over-expressed in *E. coli* where the *bphK* gene (wildtype and mutant) is under the expression of a *lac* promoter and is induced by IPTG. Mutating the conserved amino acid at position 180 (Ala180Pro) of BphK^{LB400} was shown to result in an increase in GST activity of bacterial cell extracts towards a number of chlorinated organic substrates tested including 1-chloro-2,4-dinitrobenzene, 4-chlorobenzoate, 3-chlorobenzoate, and the commonly used herbicides and pesticides, 2,4-dichlorophenoxyacetate, atrazine, pentanochlor and chlormequat chloride. BphK^{LB400} [wildtype and mutant (Ala180Pro)] was further purified using affinity chromatography and used in enzyme kinetic studies to determine various enzyme parameters including V_{max} and K_M . These data suggest that specific BphK^{LB400} mutants such as Ala180Pro identified as having increased activity towards environmental pollutants could have potential in bioremediation.

52. Spatial variation in the hyporheic invertebrates inhabiting the freshwater-terrestrial ecotone

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Abstract

The hyporheic zone of a river refers to the extensive floodplain aquifer, which is hydrologically connected to the open-channel and the true groundwater. Recent research suggests that it supports a unique fauna that is subject to a variable inundation regime as a result of frequent flooding. The aim of this study was to determine the spatial variability in the distribution and abundance of hyporheic invertebrates and to establish if any predictive relationships exist between this assemblage and hydrochemical parameters. The freshwater-terrestrial ecotone of the River Liffey was sampled in October 2006 with the use of a Bou Rouché suction sampler. A total of 48 quantitative samples were taken in a 4 by 4 grid at three sites approximately 20m apart. Each grid consisted of 4 bands starting from the water column and extending across the ecotone at 2m intervals. Although a high variability was observed among all the chemical parameters examined, significant patterns across the ecotone were detected: Conductivity and alkalinity showed an increase with increasing distance from the open channel, which was accounted for by an increase in potassium, magnesium and calcium amongst others. Other ions such as chloride showed a reverse to this trend. Total carbon increased from the channel into the ecotone. This increase was due to the presence of inorganic carbon rather than organic carbon, which showed a significant decrease. The biological data showed a decrease in diversity with respect to taxa richness and abundance with increasing distance from the water column. The freshwater-ecotone was primarily dominated by the presence of crustaceans and oligochaetes. Preliminary results suggest that the river channel is not a major source of organisms for the hyporheic habitat within the ecotone. The patterns in the invertebrate communities in relation to the environmental variables were analysed using multivariate analyses and are discussed in this paper.

53. Life history and ecology of *Perla bipunctata* (Plecoptera: Perlidae) in Ireland

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Abstract

The stonefly species in Ireland constitute a large component of the benthic invertebrate fauna of freshwater habitats. Although an important part of rapid water quality assessments, stoneflies and their ecology remain poorly studied. *Perla bipunctata* Pictet is the most common perlid species occurring in large productive rivers in Ireland, which are usually dominated by large substrates and fast currents. Although a common component of freshwater biological studies, the life history of this predatory stonefly has not been accurately determined. This study focuses on the life history and provides additional ecological information. Standard kick samples were taken at monthly intervals over a 1-year period in the River Liffey (3rd Order) to determine the life history of the immature stages of *P. bipunctata*. In addition, twelve surber samples were taken in each month to determine the instream distribution, density and biomass of the nymphs. A further 60 surbers were collected in October 2006, to determine the substrate associations in relation to various physical parameters. Samples were taken at 2m-intervals across the river at a total of 6 transects over a 50m stretch. *Perla bipunctata* has a semi-voltine life cycle taking at least two years to complete the immature stages, with an adult emergence period during May and June. A greater number of smaller instars were collected from smaller streams (1st order) in November indicating that development may be delayed for a further 1-year period. Spatial variability in correlations between dry and wet weights with interocular width was determined in rivers differing in order and catchment geologies. Substrate associations in relation to flow, depth and instream position were analysed using multivariate statistics.

54.

VALINE DEHYDROGENASE-TYPE ACTIVITY FROM R. ERYTHROPOLIS: STRUCTURAL COMPARISON WITH OTHER AMINO ACID DEHYDROGENASESL. Jennings¹, *B. Kearney², D. Dowling³, P. Mulcahy⁴¹⁻⁴Department of Science & Health, Institute of Technology, Kilkenny Road, Carlow. ¹linda.jennings@itcarlow.ie, ²kearney.b@itcarlow.ie,³david.dowling@itcarlow.ie, ⁴mulcahy@itcarlow.ie

To provide the basis for elucidation of the catalytic mechanism of NAD⁺-dependent valine dehydrogenase (ValDH, EC 1.4.1.8), whilst also providing a platform for protein engineering studies focussed on the generation of new biocatalysts for the chiral synthesis of novel amino acids, the structural gene (*vdh*) coding for a putative NAD⁺-ValDH activity from the environmentally relevant *Rhodococcus erythropolis* ITCB was cloned and sequenced. The 371 amino acid sequence showed 50-53% identity with those of ValDH from *Streptomyces sp.*, 45-47% identity with those of leucine dehydrogenase (LeuDH, EC 1.4.1.9) from *Bacillus sp.*, 42-44% identity with those of phenylalanine dehydrogenase (PheDH, EC 1.4.1.20) from *Bacillus sp.*, and much lower identities (27%) with NAD⁺-dependent glutamate dehydrogenase (GDH, EC 1.4.1.2) from various microbial sources. A multiple sequence alignment of representative proteins from all four enzyme groups identified fully conserved amino acid residues important in the design of the active site; Lys-88, which recognises the 1-carboxyl group of the amino acid substrate; Asp-135, which is believed to be involved in proton transfer to and from the amino acid substrate; and Lys-100 which is thought to enhance the nucleophilicity of an essential water molecule. Other highly conserved residues were found to include Arg-64, Asp-251, Asp-302 and Glu-316, which are probably involved in substrate recognition and binding. A comparison of the sequences for LeuDH, PheDH and ValDH revealed that while Cys-256 in the *R. erythropolis* enzyme was highly conserved and may therefore be essential for catalytic activity, a second cysteine residue (Cys-29 in *S. albus* ValDH) thought to be essential for catalysis was not. The 3D structure of the putative ValDH was constructed by molecular modelling using a representative structure of LeuDH from *B. sphaericus*. This will be used to establish active site structure models for ValDH whereby several amino acids are implicated in the recognition of the specific substrate side-chain. This research should help provide insights into amino acid substitutions required to transform the ValDH into a biocatalyst with broader or narrower specific substrate ranges.