

## NEWS

### Message from the TCBR Director

As 2012 draws to a close, so does the year-long celebration of science in Dublin ([www.dublinscience2012.ie/highlights](http://www.dublinscience2012.ie/highlights)). The TCBR has been a part of this celebration, with public lectures, biodiversity beer mats, and an audio tour among our 2012 outreach achievements. In addition, TCBR postgraduate student, Eileen Diskin, won the "I'm a Scientist Get Me Out of Here!" competition run by Dublin City of Science last month. This was an online event where school students got to meet and interact with scientists, asking them questions and then voting for their favourite scientist. Eileen narrowly beat TCBR PI Andrew Jackson in the "Hydrogen Zone" category. Well done to both of you!

More importantly, 2012 has seen some significant advances in biodiversity research. According to Web of Science, more than 5000 biodiversity related papers have been published from a diverse range of disciplines. These include the cost of achieving 2020 terrestrial biodiversity targets (>\$70 billion dollars a year according to McCarthy *et al.*, *Science* 338, 946-949), the "alarming" effects of climate change on biodiversity (Bellard *et al.*, *Ecology Letters* 15, 365-377), how fungal infections may cause increasing attrition of biodiversity, with implications for ecosystem and human health (Fisher *et al.*, *Nature* 484, 186-194), and how technological innovation can revolutionise how biodiversity is described (Deans *et al.*, *TREE* 27, 78-84). TCBR researchers, despite the many interacting pressures of timing and funding (or rather lack of both!), have also had a successful year. Highlights include papers from PhD student Luke McNally in *Proceedings of the Royal Society of London B*, from Post-doctoral researcher Colby Tanner in *Biology Letters*, and from former-PhD student Eileen Power in *PLoS ONE* (see full list: [www.tcd.ie/tcbr/research/publications.php](http://www.tcd.ie/tcbr/research/publications.php)). In addition, several new PhD students and other researchers have joined the TCBR team and we extend our welcome to them.

Finally, I wish to thank all those involved with the TCBR this year, and I look forward to a productive 2013, when Ireland will take on the EU Presidency, there will be the first meeting of the Intergovernmental Platform on Biodiversity and Ecosystem Services in Bonn, and the School of Natural Sciences will appoint a new Professor of Zoology!

### Dublin Biodiversity Audio Tour Launched

As part of Dublin City of Science 2012, the TCBR put together an audio tour, bringing together stories on 11 sites around the city. The tour comprises a series of free-to-download podcast audio clips ([www.tcd.ie/tcbr/biodiversity-audiotour](http://www.tcd.ie/tcbr/biodiversity-audiotour)) which describe the biodiversity and on-going research at each site, from community gardens and city parks to collections in museums and botanic gardens. The aim of the tour is to raise awareness and understanding of Dublin's biodiversity, to showcase biodiversity research in Dublin and to encourage biodiversity-friendly activities.

The audio tour was launched by TV-presenter, Colin Stafford-Johnson, who specialises in wildlife documentary-making, as cameraman, director and presenter. His work has taken him all over the world, but he is passionate about the wealth of biodiversity here in Ireland. Launching the audio tour, Mr Stafford-Johnson said "even though biodiversity is a difficult word for people to understand, it's important that everyone, not just children, engages with it and appreciates its worth. The audio tour developed by the TCBR is a great way to get the message out there that we need to conserve nature in our own country, even in the city, not just in far flung exotic places".



From left to right: Jane Stout (TCBR Director), Colin Stafford-Johnson, Aoife O'Rourke, Caoimhe Muldoon, Aidan Delaney, Sharon Phelan and Ainhoa González.

Courtesy of Miles Newman.

Caoimhe Muldoon, former PhD in Botany, visited the sites and interviewed representatives to compile the description and biodiversity facts associated with each of these sites. Aoife O'Rourke, postgraduate student in Botany, is the voice

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of the audio clips, which were produced and edited by Sharon Phelan and Aidan Delaney of Trinity's School of Drama, Film and Music. The interactive website was created by Stephen McElhinney from the Trinity Web Office, assisted by Ainhoa González of the TCBR.

Around 60 people attended the launch, including representatives from the Irish Wildlife Trust, National Botanic Gardens, Fisheries Ireland, local consultancies, as well as TCBR staff and postgraduate students.

### European Commissioner for Climate Action Visit to Trinity College

The European Commissioner for Climate Action, Connie Hedegaard delivered a talk on "Climate Action in Europe and Beyond" on Tuesday, 30 October 2012 in the Geography Lecture Theatre, Museum Building, Trinity College Dublin. She came to meet and discuss climate issues with students, primarily under the banner of the Earth and Natural Sciences graduate training programme which is running in collaboration with UCD. The audience included these students and others, who were invited to participate in a Question and Answer session with the Commissioner.



European Commissioner for Climate Action, Connie Hedegaard. Courtesy of Sven Batke.

### Trinity Botanists Discover New Thai Plant Species

Researchers in the Trinity Botany Department's Herbarium, together with Thai collaborators, have just discovered eight species, three subspecies and four varieties of the plant genus *Eriocaulon* from Thailand, all new to Science. Estimates suggest that there are about 13 times more plant species in Thailand than in Ireland. Unlike Ireland, however, it is

impossible to be sure exactly how many plant species there are in Thailand as many have not yet been found.

Unfortunately, though there are many forest reserves in Thailand, plant species are still in danger of extinction before they are discovered and described. This is because the number of plant collectors working in the forests of Thailand is low relative to the size of the flora and because anthropogenic pressure on natural vegetation is high. The Flora of Thailand project aims to describe all plant species growing in Thailand and the work on *Eriocaulon* forms part of this work. The Herbarium of Trinity's Botany Department is one of the lead collaborating institutions participating in this project.



Amornrat (left and pointing), author of the paper, collecting *Eriocaulon* in Thailand. Courtesy of John Parnell.

This study of *Eriocaulon* involved widespread and extensive plant collecting over many years often in poorly explored and remote areas of the country. The DNA of the collected material and their morphology were analysed. This enabled comparison to be made with known existing species of *Eriocaulon* and material that was different could then be recognized as new to Science.

### Biodiversity in Our Lives Feature in Science

The Biodiversity in Our Life beer mats, created by the Biodiversity Forum and designed and illustrated by Aileen Crossley, have featured in the Science magazine's 'Random Sample'.

For the full article, see:

<http://www.sciencemag.org/content/338/6108/727.4>

The aim of the beer mats is to make people aware of how important biodiversity is, and how it is linked to everyday life

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- including the things we would commonly drink in a pub! They have been distributed to 10 local pubs to date, and funding has been secured to print an additional 20,000 beer mats to be distributed to 20 more pubs before Christmas.



Beer mats. Courtesy of the Biodiversity in Our Life team.

Primary School Children Visit the TCBR

Thirty-two second-class primary school children visited Trinity and learned about biodiversity with members of the TCBR in October 2012. Jane Stout talked to the children about plants in the Botany Lecture Theatre and showed them a variety of specimens in the Botany laboratory, and Nicola Marples let them get their hands on some specimens in the Zoology museum. The children were also given a “Biodiversity workbook” which included some facts and figures as well as word games and puzzles. They were particularly excited about seeing the animals in the museum, the venus fly trap plant, the biggest pine cone (Coulter’s pine, discovered by an Irish botanist), and learning that giant sequoias can grow to three times the size of a blue whale! The visit was hailed a great success by the children, teachers and parents and hopefully both inspired the next generation and spread the word about what we do to a wider audience.



School children at the Botany lab. Courtesy of Jane Stout.

RECENT PUBLICATIONS

Journal Articles

Charman DJ, Hohl V, Blundell A, **Mitchell FJG** and Oksanen P (2012). A 1000-year reconstruction of summer precipitation from Ireland: calibration of a peat-based palaeoclimate record. *Quaternary International*, 268: 87-97.

**Coote L**, French LJ, **Moore K**, **Mitchell, FJG** and **Kelly DL** (2012). Can forestry plantations support plant species and communities of semi-natural woodland? *Forest Ecology and Management*, 283: 86-95.

Coxon P, **Mitchell FJG** and **Wyse Jackson P** (2012). Dublin in the Grip of an Ice Age. *Irish Quaternary Association (IQUA)*. Dublin.

**Diekmann K**, **Hodkinson TR** and Barth S (2012). New chloroplast microsatellite markers suitable for assessing genetic diversity of *Lolium perenne* and other related grass species. *Annals of Botany*, 110(6), 1327-1339.

Nielsen A, **Dauber J**, Kunin WE, Lamborn E, Jauker B, Moora M, Potts SG, Reitan T, Roberts S, Söber V, Settele J, Steffan-Dewenter I, **Stout JC**, Tscheulin T, Vaitis M, Vivarelli D, Biesmeijer JC and Petanidou T (In press) Pollinator community responses to the spatial population structure of wild plants: A pan-European approach. *Basic and Applied Ecology*.

O’Connor NE and **Donohue I** (in press). Environmental context determines the multi-trophic effects of consumer species loss. *Global Change Biology*.

O’Connor NE, Emmerson MC, Crowe TP and **Donohue I**. (in press). Distinguishing between direct and indirect effects of predators in complex ecosystems. *Journal of Animal Ecology*.

Ollerton J, Watts S, Connerty S, Lock J, Parker L, Wilson I, Schueller S, Nattero J, Cocucci AA, Izhaki I, Geerts S, Pauw A and **Stout JC** (2012). Pollination ecology of the invasive tree tobacco *Nicotiana glauca*: comparisons across native and non-native ranges. *Journal of Pollination Ecology*, 9: 85-95. Open access:

[http://www.pollinationecology.org/index.php?journal=jpe&page=article&op=view&path\[\]=189&path\[\]=56](http://www.pollinationecology.org/index.php?journal=jpe&page=article&op=view&path[]=189&path[]=56)

Trias-Blasi A, **Parnell JA** and **Hodkinson,TR** (2012). Multi-gene Region Phylogenetic Analysis of the Grape Family (Vitaceae). *Systematic Botany*, 37(4), 941-950.

## MSc BIODIVERSITY and CONSERVATION RESEARCH

The 14 students of the 2011-2012 MSc in Biodiversity and Conservation class have recently graduated, 8 of them with a distinction. Well done to everyone!! Find below a short summary of the two best MSc dissertations.

### Current Status, Distribution and Impacts of Non-native Plants in Irish Coastal Dunes by Seán Kelly

This MSc dissertation study, supervised by Dr Daniel Kelly, looked at the impacts of non-native plant species in Irish coastal dune habitats. It assessed their current status and distribution on North Bull Island and Malahide Island (Co. Dublin) and examined their effects on the native dune vegetation at each site. It also attempted to identify landscape features which may influence the distribution of non-native species within this habitat type. The study focused on non-natives that were abundant and/or widely distributed within their habitat, including *Hippophae rhamnoides* and *Acer pseudoplatanus* (invasive at both sites) and *Clematis vitalba* (invasive at Malahide Island only). Comparisons between plots in which such invasive species were present and control plots which contained native dune vegetation only, showed that each of the invasives caused significant reductions in species richness and diversity values. Furthermore, the presence and continued spread of these invasive species could significantly alter the species composition of the native dune flora. This could ultimately represent a successional shift from open dune grassland to a scrub or woodland type community, with the subsequent loss of many rare and endangered dune species.



Dense *Hippophae* scrub at Malahide. Courtesy of Seán Kelly.

In order to determine factors that potentially influence the distribution of non-native species within each site, distances from their mapped positions to distinctive landscape features were measured and compared with distances from randomly placed reference points using GIS. This analysis showed that the spatial positions of non-native species were positively correlated with the boundaries of golf courses, highlighting their role as significant propagule sources. This was also the case for tracks and pathways, indicating the potential

effect of human presence and disturbance in facilitating the spread and establishment of non-native species.

### *Clematis vitalba*: Breeding System and Baker's Law by Conor Redmond

This MSc dissertation, supervised by Dr Jane Stout and Dr Steve Waldren, looked at alien plants species which become invasive. A large proportion of the Irish flora is comprised of alien plant species, which can greatly affect the ecology and genetic diversity of native species, the composition of biological communities, and ecosystem processes. One such species is *Clematis vitalba*, a popular horticultural choice, considered as naturalised but potentially invasive in Ireland.



Hoverfly flying away, *C. vitalba*. Courtesy of Conor Redmond.

Given that alien species which become invasive are one of the main drivers behind the global loss of biodiversity, there is a clear need to better understand the invasion process, particularly reproduction in novel environments. The reproductive biology of an alien species affects its ability to become naturalised and invasive in its non-native range. My project examined the phenology and breeding system of *C. vitalba* in the Burren, Co. Clare, an area of great floristic diversity and value. I tested the applicability of Baker's Law, that uniparental reproduction is associated with colonising plants as it provides a means for establishing a new population following a single long distance dispersal event. Indeed, pollination experiments confirmed that *C. vitalba* is capable of uniparental reproduction via geitonogamy and autonomous selfing. Also, pollinator observations revealed *C. vitalba* is visited by at least 10 native pollinator taxa, with hoverflies dominating visitation rates. *C. vitalba* has a number of traits commonly found in invasive plants, including phenological characteristics such as profuse flowering, ability to self-fertilise, generalised pollination system and readily dispersed seeds. Given that *C. vitalba* can have detrimental impacts on native communities, as seen in New Zealand, arguably this species warrants particular attention in Ireland.

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**Rwanda: Land of a Thousand Hills (and a Few Hundred Gorillas...)** by Andrew L.R. Jackson

For the past few years TCD has been running field trips to Rwanda as part of the one-year MSc Environment and Development and the two-year MSc Development Practice. Together with Prof. David Taylor (recently departed for the National University of Singapore), I've helped to run two of the Environment and Development trips, and I've hence had the chance to witness the country's extraordinary biodiversity first hand, as well as the many environmental and development challenges facing Rwanda.

Our field trips – typically run in the spring – included visits to all three of Rwanda's national parks: first, to communities adjacent to the Volcanoes National Park in the North of the country, which hosts Rwanda's mountain gorillas (*Gorilla beringei beringei*), made famous by Dian Fossey's 'Gorillas in the Mist'. While the entire mountain gorilla population has been the subject of conventional conservation measures such as ranger patrols, the habituated gorillas (i.e. those visited regularly by tourists and researchers) have benefited from what has been termed "extreme conservation" (Robbins et al, 2011) - that is, continuous monitoring and in-situ veterinary care. As a result, the Virunga gorilla population has grown steadily from a low of 250 in 1981 to its current population of c.400 individuals.



Volcanoes National Park. Courtesy of Andrew L.R. Jackson.

The area around the Volcanoes National Park has the highest human population density in Rwanda, and Rwanda as a whole has the highest population density in continental sub-Saharan Africa. The densely-populated communities around the National Park - up to 820 people per km<sup>2</sup> around the Virunga Massif as a whole (Robbins et al, 2011) - face numerous issues in view of their proximity to the protected area; e.g. people

can no longer access the park legally for resources such as water and firewood, and animals range in and out of the park, eating and trampling crops grown in surrounding fields (TCD's Shane McGuinness, a graduate of the M.Sc. biodiversity and conservation programme, is doing his PhD research on this subject).



Communities at the Volcanoes National Park.  
Courtesy of Andrew L.R. Jackson.

Gorilla tourism is a major contributor to the Rwandan economy. Until recently, it cost US\$500 per foreign national to visit the gorillas; this figure recently rose to US\$750, and there is talk of another increase to US\$1,000. Despite the high cost, there is nevertheless a high demand for permits to visit the gorillas, raising the spectre of conflicts between tourism/revenue generation and research/conservation goals. The extent to which adjacent communities will benefit in the longer term from some sort of trickle-down effect remains to be seen, though good work has been done in a town called Bisate by the Karisoke Research Centre, founded by Dian Fossey. How the relationship between the park and local communities will change as the human population grows also remains an open question.

Moving on from Volcanoes National Park, our field trips took in Nyungwe Forest National Park and surrounding communities in the south-west of the country. With thirteen species of primates (including chimpanzees), Nyungwe is said, by area, to have the highest primate diversity anywhere in the world. And covering some 970 km<sup>2</sup>, Nyungwe is also said to be the largest block of montane forest in Central or East Africa. During this year's field trip we attended presentations by researchers from the University of East Anglia's ReDirect project (<http://www.redirectrwanda.com/>), which is examining the potential for payments for environmental services to achieve conservation and development objectives.

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Akagera National Park in Eastern Rwanda was our final stop. With expanses of savannah and a huge network of papyrus swamps and freshwater lakes, Akagera is a bit different in character to the hilly or mountainous landscape which dominates much of the rest of Rwanda. Much of Akagera was reallocated as farmland to accommodate refugees returning to Rwanda following the 1994 genocide, reducing the park size from more than 2,500km<sup>2</sup> (nearly 10% of the surface area of Rwanda) to its current extent of 1,122km<sup>2</sup>. Since 2010, the park has been managed jointly by the Netherlands-based African Parks ('A business approach to conservation') and the Rwandan government.

A major project is currently underway to fence 120km of the Western boundary of Akagera, to reduce the potential for human-wildlife conflicts. Amongst the animals found in the park are elephants (reintroduced), black rhino (introduced in the 50s), giraffe (introduced in the 80s), jaguar and hyena. Once the Western fence is completed, the park plans to reintroduce lion, and to introduce black rhino for a second time. Owing to its diverse habitats, Akagera is also an important ornithological and botanical site. On this year's trip, we benefited from the knowledge and expertise of Eugene Mutangana, Chief Park Warden at Akagera and a 2011/12 MSc Environment and Development course student.

While the Environment and Development course has unfortunately been suspended owing to the absence of key staff, one would hope the course and its field trip will be revived in the future, giving TCD students once more this unique learning opportunity. In the meantime, possibilities for research abound in Rwanda can continue; Eugene, Chief Park Warden at Akagera, has expressed a particular interest in hosting MSc/PhD research projects from TCD, for example, from the Biodiversity and Conservation class. Please contact me if you would like to make contact with Eugene or with individuals at the other parks mentioned in this article.

\* Robbins, MM et al (2011) Extreme conservation leads to recovery of the Virunga mountain gorillas. PLoS ONE 6(6): e19788. doi:10.1371/journal.pone.0019788.

### Glacial Relict Fauna - Ecology and Future Prospects

by Marcin Penk

Glacial relict species are the remnants of a past colder climate, which now typically have circumpolar distribution, but managed to survive within the temperate zone in suitable refugia. Owing to cool Atlantic summers, Ireland is within the

Southern marginal zone for many relict species such as the Arctic char (*Salvelinus alpinus*), the pollan (*Coregonus autumnalis*), or the freshwater opossum shrimp (*Mysis salemaai*). I'm studying the ecology of the latter species, with a particular focus on threats to its survival.



*Mysis salemaai*. Courtesy of Marcin Penk.

*Mysis salemaai* is the only native freshwater member of its taxonomic order in Ireland and as such is an important component of our biodiversity. It is also an important element of food webs, providing food for many fish species including the protected pollan and the critically endangered eel. *Mysis salemaai* may occur in high abundance accounting for a significant part of the energy transfer in a lake. The species remains in the dark layers by day and migrates up at night, redistributing nutrients between the lake bed and open water adding to its significance in the ecosystem. Even though the species is only known from 12 lakes in Ireland, they include most of the largest ones, such as Neagh, Corrib, Derg and Erne, and cumulatively they account for over half of Ireland's lake surface area. Therefore, the ecology of most of Ireland's surface waters is influenced by this mysid. However, given its nocturnal activity, the distribution, ecology and importance of this mysid to ecosystem functioning are largely unknown.

Similarly to other glacial relict fauna, the opossum shrimp are cold-liking and favour oxygen-rich conditions typically associated with arctic waters. Many Irish lakes are relatively cold with only ephemeral stratification in summer and therefore a low risk of oxygen depletion, and they have been providing adequate conditions for *Mysis salemaai* and other freshwater relicts. However, the changing environment is calling into question their future prospects. For instance, excess nutrients can lead to de-oxygenation events in summer and many Irish catchments receive heavy nutrient loads from agricultural run-off and insufficiently treated wastewater discharges.

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Increasing summer temperatures predicted by the climate change scenarios are another threat, and may have a direct negative impact on the survival of the cold-liking glacial relicts, but they can also magnify de-oxygenation episodes. Adding to the physico-chemical threats, the recently introduced invasive mysid *Hemimysis anomala* appears to be a more potent competitor than the native *Mysis salemaai*, and may have a negative impact through food depletion. Impacts of the above threats are being assessed as a part of a project co-funded by IRCSET and EcoServe Ltd. with contribution from TCD Association and Trust, and TCD Zoology RDC.

## Further reading:

Penk MR (2011). A review of the current distribution of the freshwater opossum shrimp *Mysis salemaai* Audzinyte and Väinölä, 2005 in Ireland. *Biology and Environment: Proceedings of the Royal Irish Academy*, 111(B), 107-115.



Lough Allen. Courtesy of Marcin Penk.

### How do Water Level Fluctuations Alter the Structure and Multi-functionality of Lake Ecosystems? by Lindsay Hislop

Under the supervision of Dr Ian Donohue in the TCD School of Natural Sciences, I'm exploring the effects of water level fluctuations on the structure and functioning of near-shore biotic communities as part of my PhD. Abstractions (withdrawals) of freshwater from lakes in order to support a rapidly growing population is quickly becoming a major stress on lake biodiversity. Not only has anthropogenic water abstraction altered the magnitude of water level fluctuations in lakes, but it has also contributed to major changes in seasonality and frequency of fluctuations. Such water level fluctuations disproportionately affect the littoral (near-shore) zones, the sites of the majority of lake biodiversity due to desiccation, or indirectly as a result of resource scarcity or competition for habitat. Anthropogenic abstraction, however, is not the only pressure faced by lakes. With changes in precipitation patterns and temperature regimes, climate

change is predicted to exacerbate existing water level fluctuation in lakes. According to climate models, the combined anthropogenic abstraction and climate change pressures will have significant implications for both the associated aquatic and terrestrial habitats, and the ecosystem services provided by these habitats.



Lindsay Hislop exploring lake water level fluctuations.

Although the pressure on lakes due to anthropogenic abstraction and climate change is becoming increasingly clear, there are startlingly few studies investigating the effects of water level fluctuation on lake ecological structure and functioning. My project aims to address this knowledge gap by determining what parameters of water level fluctuations have the greatest impact on lake littoral communities, examining the effect of water level fluctuations in conjunction with additional pressures, such as nutrient addition and increased water temperatures as predicted by climate models. I'm currently involved in monthly sampling of five lakes with varying fluctuation regimes in addition to conducting controlled mesocosm experiments. The results of these investigations are expected to shed light on both the present and near-future pressures faced by these essential freshwater habitats.

### Behavioural and Evolutionary Ecology

by Seán Kelly

July and August of this year saw members of the Behavioural and Evolutionary Ecology research group embark on another field season studying the birds of tropical south-east Sulawesi, Indonesia. Principal investigators Dr Nicola Marples and Dr Dave Kelly were joined this year by PhD student Seán Kelly, as well as a number of undergraduates from various disciplines within the university. This year's expedition, carried out in collaboration with Operation Wallacea, consisted of two

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teams: the mist netting team, led by Dr Marples and Dr Kelly, and the behavioural team led by Seán Kelly.

The netting team trapped birds using mist nets at various locations on Buton island, mainland South-East Sulawesi and Wangi-Wangi island (of the Wakatobi archipelago). While small passerines such as white-eyes, sunbirds and flowerpeckers were the target species, individuals from a total of 35 species were caught. The season proved to be a great success with over 300 birds trapped and processed. Data on plumage, morphology, age, sex and breeding condition were collected from each bird, which was colour-ringed and released unharmed. A small number of body feathers were also plucked from each bird for later genetic and stable isotope analyses.



A male Grey-sided Flowerpecker *Dicaeum celebicum* mist netted on Buton Island. Courtesy of Seán Kelly.

The behavioural team spent the season on various islands of the Wakatobi archipelago collecting detailed behavioural ecology data on the white-eye, sunbird and flowerpecker species present. This included information on their diets, competitors, preferred habitats, social habits, courtship and breeding, as well as their foraging and flocking behaviours. Data collection took place in the early morning and evening, walking 1 km transects through scrub, farmland or forest edge habitats. This resulted in some fantastic insights into the behaviour and ecology of these poorly studied species.



A male Olive-backed Sunbird *Cinnyris jugularis* foraging, Wangi-Wangi Island. Courtesy of Seán Kelly.

From analysis of the plumage, morphometric and genetic data we have found a number of significant differences between bird populations on the Wakatobi archipelago and mainland Sulawesi, as well as between populations within the Wakatobi. It is hoped that the behavioural data gathered this season will help us to understand the selective pressures driving this divergence, giving us further insight into the evolution of this region's fascinating avifauna.



A Lemon-bellied White-eye *Zosterops chloris* with nesting material in its bill, Tomia Island. Courtesy of Seán Kelly.

Behavioural and Evolutionary Ecology group webpage: <http://www.tcd.ie/Zoology/research/research/behaviour/index.php>

### Biomass and Carbon Sequestration

by Jesko Zimmermann

In recent years the use of biomass for energy production has become an increasingly important measure for mitigating global change. While national and EU legislation strongly advocate the further development of the bioenergy sector, the scientific debate has been inconclusive. There is particular concern that land-use change to bioenergy production can lead to CO<sub>2</sub> emissions. These emissions result from the loss of vegetation and the soil disturbance when ploughing natural ecosystems and pastures as a preparation for planting bioenergy crops. A possible solution is to use perennial energy crops such as willow or *Miscanthus*. Recent research on experimental fields has shown a high soil carbon sequestration potential across Europe; however, it can be expected that sequestration rates will differ on commercial plantations.

During my PhD, under the supervision of Prof. Michael B. Jones, I worked on assessing soil carbon sequestration under



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commercial *Miscanthus* plantations. An initial survey was conducted on commercial *Miscanthus* sites during their establishment phase (2 to 3 years old) in south-east Ireland, measuring the stable <sup>13</sup>C isotope to assess the *Miscanthus*-derived carbon stocks. As expected the amount of *Miscanthus*-derived carbon in these young plantations was low, the annual sequestration rates, however, were similar to values measured in experimental crops.



*Miscanthus* plantation. Courtesy of Jens Dauber.

To analyse the fate of newly sequestered carbon a soil fractionation experiment was performed. The fraction with which the soil organic carbon is associated has a significant impact on decomposability and turn-over time. The results showed the freshly sequestered carbon is mainly found as particulate organic matter, and therefore is in a labile state with short turn-over times. The comparison with adjacent control sites representing the former land-use showed no significant differences in soil organic carbon stocks or distribution of soil fractions, indicating that the introduction of this bioenergy crop into agricultural landscapes does not lead to significant reductions in existing soil stocks.

In conclusion, the analyses show significant carbon sequestration in young commercial *Miscanthus* sites. However, as the majority of that *Miscanthus*-derived carbon is still in a labile state, the *Miscanthus* should be grown on a longer time-scale to ensure benefits. Additionally it was shown, that the introduction of *Miscanthus* to grasslands does not lead to a significant loss of already existing soil organic carbon, and that one time ploughing events associated with *Miscanthus* introduction do not lead to a significant disturbance of soil aggregation.



*Miscanthus* plantation. Courtesy of Susannah Cass.

FEATURED PUBLICATION

**Can forestry plantations support plant species and communities of semi-natural woodland?**

by Coote L, French LJ, Moore K, Mitchell, FJG and Kelly DL. Published in *Forest Ecology and Management*, 283: 86-95 (2012).

The potential contribution of plantation forests to the conservation of woodland plant diversity needs to be assessed in order for commitments to Sustainable Forest Management (SFM) to be fulfilled. To this end, the plant communities of mature Sitka spruce, Norway spruce, Japanese larch and ash plantations were compared with those of semi-natural oak and ash woodlands at 75 sites across the island of Ireland. A number of different plant communities were recognized in plantations, with only one resembling either of the semi-natural woodland types studied. The exception was a community of ash plantations on base-rich soils, on or adjacent to historic woodland, which was similar to the semi-natural ash woodland community. Despite supporting a plant community similar to semi-natural ash woodlands, the ash plantations supported significantly fewer woodland species. While none of the other plantation communities strongly resembled either the semi-natural oak or ash communities, they had the potential to support high numbers of woodland species. A range of forestry (forest type, canopy cover, grazing), geographic (elevation, historic woodland) and edaphic variables (soil pH, drainage) were found to be important in determining the types of plant communities and numbers of woodland species supported. While geographic and edaphic factors are either impossible or difficult to control, considerable scope exists for enhancing the plant diversity of plantation forests through changes in forest planning and management.

REQUESTS

Please send in information concerning current research, calls, news, publications and wildlife photos from field trips for inclusion in our next quarterly newsletter.

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