IQUA

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Editor: Sarah Murnaghan

1. Introduction

Dear IQUA member,

Welcome to Newsletter no. 47.

Thanks to all who attended the successful Spring Meeting and AGM last April, held in conjunction with the Irish Environmental History Network, Trinity College Dublin. An excellent programme of speakers (see abstracts below under item 4) provided an inspiring and entertaining set of talks on Quaternary research. The student prize went, deservedly, to Adelheid Fankhauser from UCD for her excellent talk on the use of speleothem profiles for understanding climatic variability. Thanks to all the speakers, and organisers of the meeting.

This year we have had several changes to the IQUA committee following the AGM (see item 2). Welcome and best of luck to all those elected to new committee positions. Many thanks are extended to those who stepped down from positions (including Prof Pete Coxon, Dr. Steve McCarron and Dr. Francis Ludlow), for all for their hard work and ensuring the successful running of IQUA over the years.

Also in this newsletter, we get a taste of what's to look forward to on IQUA's schedule for the remainder of 2011. The programme for the annual fieldtrip to Co. Meath (2nd - 4th September 2011) has been confirmed and promises a wide variety of themes to suit all interests (see item 5 for details)! IQUA's Autumn Symposium on 'Quaternary tipping points: exploring the dynamics of human and environmental change' will take place on 2nd December 2011 and is sure to be yet another highlight for all (see item 3 for more information).

Thanks to all who contributed to this edition of the newsletter.

Kind regards,
Sarah Murnaghan (Dept. of Geography, TCD)

2. IQUA Committee (2011/2012)

The IQUA Committee, following the 2011 AGM is as follows:
President: Prof Fraser Mitchell, TCD (elected)
Secretary: Dr. Bettina Stefanini, NUIM (elected)
Treasurer: Gayle McGlynn, TCD (elected)
Postgrad rep: Rory Flood, QUB (elected)
Website manager: Dr. Francis Ludlow, TCD. (continuing)
Publications Secretary: Gayle McGlynn, TCD (elected)
Newsletter editor: Sarah Murnaghan, TCD (continuing)
Ordinary members: Dr. Steve McCarron, NUIM (continuing), Sarah Murnaghan, TCD (continuing), Dr. Steve Davis, UCD (elected), Ellen O'Carroll, TCD (elected), Dr. Graeme Swindles (University of Bradford) (continuing).

3. IQUA Autumn Symposium 2011

IQUA Autumn Symposium 2011:
Quaternary tipping points: exploring the dynamics of human and environmental change.

Venue: Geological Survey of Ireland Lecture Theatre, Ballsbridge, Dublin 4.
Date: Friday 2nd December 2011

This year's IQUA Symposium will explore abrupt environmental change, and possible linkages with societal dynamics during the Quaternary. The Symposium aims to bring together an extensive community of researchers to discuss this theme in the context of Ireland. Keynote talks from Prof. Brian Huntley (Durham University) and Prof. Jed Kaplan (École Polytechnique Fédérale de Lausanne) promise to add to the Symposium's diverse programme of interest to all existing and future IQUA members! Details of the programme will be posted on the IQUA website and via the mailing list. All queries and suggestions should be

directed to Gayle McGlynn (mcglyng@tcd.ie) or Bettina Stefanini (stefanb@tcd.ie).

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4. IQUA Spring Meeting and AGM 2011

The Spring Meeting and AGM, in conjunction with the Irish Environmental History Network (TCD), were held on Saturday 16th April 2011 in IIIS Seminar Room, 6th Floor, Arts Building, TCD. The meeting was very well attended and Prof Fraser Mitchell's insightful keynote talk ('After the storm: exploring ecosystem recovery after disturbance') was very well received. Talks covered a broad variety of topics, from Pleistocene nunataks in northwest Ireland to sedimentation patterns in the Ganges delta! Abstracts of talks are listed under item 6. Congratulations to the winner of the Postgraduate Prize for the best talk, Adelheid Fankhauser (School of Geological Sciences, UCD). The committee would like to extend their appreciation to Dr. Francis Ludlow and the Environmental History Network, TCD, for facilitating and helping with the meeting.

The IQUA AGM followed the Spring Meeting and was also well attended. There were several changes made to the including newly elected president, secretary, treasurer, postgraduate representative and ordinary committee members Committee (see item 2 for details). Thanks to all outgoing committee members, and best of luck to those elected to new positions.

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5. IQUA 2011 Annual Fieldtrip to Co. Meath

Bettina Stefanini, Geography Department, NUI Maynooth.

We are looking forward to an exciting programme for the IQUA field meeting, which will take place 2nd to 4th September 2011.

A pre-meeting underground tour of the Tara lead and zinc mines will commence at 13.00 sharp on Friday afternoon. The tour is limited to 16 people. Please let Bettina know as soon as possible if you would like to attend, as there are only a few places left. Directions to the mines can be found on the Tara Mines website (www.boliden.com) under 'Contact us'. The meeting officially gets under way on Friday evening in the seminar room of the Headfort Arms Hotel in Kells at 20.00. Mary Deevy will introduce us to the intriguing findings of the recent excavations along the M3 corridor and Frank Pendergast will talk us through the fascinating spatial layout of the National Monument at Lismullin.

On Saturday morning we will meet in the car park at Loughcrew, Oldcastle at 9.30 am. Robbie Meehan will bring us to the important Ice Age features of this site, while Frank Pendergast will talk about the cairns and introduce us to his research on the archaeoastronomical and spatial significance of Irish passage tombs. Before lunch in Oldcastle we will visit karst crag and tail features at Lough Bann with Robbie Meehan. In the afternoon, we will head to a gravel pit at Dromone with Mike Philcox and Robbie Meehan and from there on to Moynagh Lough (near Nobber) where Rosemary Stewart will speak about her research on the vegetation history of this important historical site.

On Sunday, we will meet at Dowth at 10.00 am where Mark Hennessey will discuss evidence for medieval ridge and furrow ploughing beside the Neolithic monument. The meeting will conclude in Danestown where Emma Arbuthnot will introduce us to a fine example of a ringwork castle and Robbie Meehan will take us to glacial melt water channels and discuss the heavy gley soils of this area.

We will be based in Kells for the two nights. Please arrange your own accommodation. The Headfort Arms Hotel is holding a few rooms for us under mid-week rates. Ask for rooms held for IQUA. The registration fee including a printed field guide is €20/30 for members/non-members, €10/15 for student members/non-members. Transport will be by private car throughout. Please register your interest with Bettina Stefanini (email: stefanb@tcd.ie or phone 087 218 0048) to secure your place on the trip.

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6. IQUA 2011 Spring Meeting Abstracts

Late prehistoric woodland patterns as reflected in the pollen record.
Bettina Stefanini
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Geography Department, NUI Maynooth.

Analysing large datasets often brings unexpected results. In the course of an environmental study for the Discovery Programme covering the period from ca 1500 BC to AD 400, forty Irish pollen sequences are examined. Some of these were originally commissioned within an archaeological framework but most were generated in independent palaeoenvironmental investigations. Analysis of the set confirms widespread mid and late Bronze Age clearance phases. It also singles out a number of sequences from the late Bronze Age, where clearance is more wide-ranging than elsewhere. The semi open landscapes of the early Iron Age almost universally give way to widespread woodland regeneration during a period that Frank Mitchell termed the 'Late Iron Age Lull'. In this talk, the geographies of the exceptions to the regeneration trend are examined from an environmental perspective. Such a perspective sheds light on why particular sites remain un-forested during this period but it fails to account for a cluster of cleared sites along the east coast. Here the reasons for woodland clearance are open to speculation but seem to be rooted in societal causes.

How much is enough! Sampling issues and methodological approaches towards the reconstruction of woodland resource usage from archaeological sites.

Ellen O'Carroll and Fraser Mitchell
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Department of Botany, School of Natural Sciences, Trinity College Dublin.

The National Roads Authority (NRA) awarded funding from its Research Fellowship Programme to the authors to conduct a PhD research project entitled 'Quantifying woodland resource usage in the Irish midlands using archaeological and palaeoecological techniques'. Pollen cores from a lake and a small hollow as well as charcoal and wood samples from 86 archaeological excavations are being used as indicators of woodland resource usage. One of the primary aims of this research is on revising standards and improving practice in charcoal sampling and the identification of charcoal remains from archaeological sites to produce optimal information on woodland resource use. There are two main questions addressed. Are we identifying a representative sample set from archaeological sites and are we identifying enough or over-identifying charcoal fragments from each sample in order to determine wood function, wood use and reconstruction of surrounding woodlands?

Two charcoal data sets, ranging in date from the Neolithic to the Post Medieval Periods, are currently under investigation. The first data set includes the analysis of over 500 charcoal samples where a range of charcoal fragment counts (depending on charcoal quantity present in each sample) have been identified for each sample. The second data set includes the analysis/identification of 79 charcoal samples and incorporating the results into a saturation curve programme where saturation points (the point at where all new taxa have been identified within any given sample), mean saturation points and proportion saturation points of taxa are recorded and graphed in order to evaluate woodland resource use and determine best practice and guidelines for future excavations. Initial results from the saturation point profiles for taxa diversity indicate that there is little variance in saturation points between time period, site type and short and long term charcoal deposits. Mean saturation points are also lower than expected for most site types evaluated.

Keynote talk

After the storm: exploring ecosystem recovery after disturbance.

Fraser Mitchell
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Department of Botany, School of Natural Science, Trinity College Dublin.

Prior to the arrival of Europeans, Massachusetts was almost entirely covered by forest. Intensive exploitation was followed by large scale land abandonment. The impact and recovery of this exploitation on the forest ecosystem will be explored through fine spatial resolution pollen analysis. This will be used to investigate how closely the post-disturbance forest resembles the pre-disturbance forest. In 1938 a massive hurricane flattened most of the forest in Massachusetts and adjacent states. The impact to, and recovery of a forest in New Hampshire to this event has been investigated through fine spatial resolution pollen analysis. The impact and recovery of natural disturbance (hurricane) to the forest ecosystem will then be compared to disturbance through human exploitation.

New insights into late Holocene farming in western Ireland with particular reference to the early medieval horizontal watermill at Kilbegly, Co. Roscommon.

Anette Overland
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Department of Botany, NUI Galway

An early medieval horizontal watermill, discovered during archaeological survey preparatory to motorway construction, at the edge of a small mire in Kilbegly Townland, County Roscommon, provided the opportunity for palaeoecological investigations of peat and fossil moss-polster samples. While the data – pollen and macrofossil (moss) identifications and 14C dating – relate mainly to the early medieval period, analyses of a peat core from the mire, and a moss sample that was used as caulk in the trough of a burnt mound (fulacht fiadh), extend the environmental record well into the Bronze Age (c. 1850 cal. BC). Woodland and farming dynamics in the late Holocene are reconstructed on the basis of the investigations at Kilbegly and other sites in the region. An overview of human impact, and the intensity and nature of farming, since the mid Iron Age (c. 350 cal. BC) is presented, based on a review of fossil pollen evidence from key sites.

Climate Change and the Adoption of Agriculture in Co. Mayo.

Steve Davis, Naomi Holmes and Graeme Warren
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UCD School of Archaeology, University College Dublin, Belfield, Dublin 4, Ireland.

This paper presents some results of a recent project examining the relationship between climate change and the adoption of agriculture in North Mayo, famous archaeologically for the Céide Fields system. Our project provided new quantitative palaeoclimate data based on chironimid data from two lake cores from Co. Mayo, in addition to isotopic (C/N) and Itrax core-scanner data. These data allow some critical assessment of existing models of the causational role of climate change in the origins, nature and supposed decline of prehistoric agriculture in the region.

***Arenaria ciliata* on Ben Bulben: a Pleistocene nunatak in northwest Ireland?**

Emma Howard-Williams[1*], Xiaodong Dang[1], Colin Kelleher[2], Pablo Vargas[3], Kevin Walker[4] and Conor Meade[1]
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3. Real Jardín Botánico, CSIC, Madrid;
4. BSBI, Harrogate, Yorkshire.

Did any native Irish plants survive the last glacial maximum in-situ in Ireland? A growing body of zoological evidence suggests Ireland may have been a refugium during the Pleistocene glaciation, and a strong Iberian affinity is evident among much of the island's native flora and fauna. This project is focused on some of the earliest putative postglacial migrants to Britain and Ireland, the arctic-alpine Carnations, in an effort to characterise and date the earliest links between Ireland and Continental Europe.

The Ben Bulben mountain range in County Sligo has been suggested as an Irish refugium, which is home to the distjunctly distributed arctic-alpine *Arenaria ciliata*, where its closest sister populations occur in the Jura, 1350km away. A. ciliata however is part of a taxonomically difficult group of species (*A.ciliata A.moehringiodes, A.gothica, A.pseudofrigida* and *A. norvegica*). This project will elucidate biogeographic relationships between members of the *Arenaria ciliata* L. complex in Ireland, Iberia and central Europe in an effort to determine putative postglacial migration routes to Ireland or investigate the possibility of In Situ survival. Detailed biogeographic analysis of this complex is being carried out using DNA sequences from different gene regions and AFLP analysis to address the following questions:
-What is the phylogeographic affinity between *A.ciliata* and A.norvegica in Spain, Ireland and the Alps?
-Does the *A. ciliata* population on Ben Bulben carry a nunatak/ refugial genetic signature

Of key importance in the postglacial history of the Irish flora, these species have not as yet been studied in any phylogenetic analysis, and there exists a considerable knowledge gap in relation to systematic affinities between taxa and estimates of divergence times based on discrete DNA sequence data.

Testing the utility of a geochemical approach to sea-level reconstruction in western Ireland.

Kieran Craven and Robin Edwards
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Department of Geology, School of Natural Sciences, Trinity College Dublin

Saltmarshes are intimately linked to tidal levels and so the identification and dating of these environments preserved within coastal sedimentary sequences is an important tool to reconstruct past changes in relative sea-level (RSL). While the western coastline of Ireland is typified by high-

energy environments that are not conducive to the application of sediment-based RSL reconstruction, the Shannon Estuary contain suites of intercalated organic and clastic sediments that should record changes in RSL. However, the absence of microfossils from these sediments have hampered the establishment of accurate sea level index points (SLIPs) from the outer estuary that could be used to accurately model RSL changes over time. In recent years, there has been renewed interest in the potential use of composite records developed from elemental (organic carbon, total nitrogen) and isotopic ($\delta^{13}C$ and $\delta^{15}N$) data for RSL reconstruction independent of microfossils.

A novel geochemical approach to sea-level change, based on saltmarsh $\delta^{13}C$ and C/N gradients, is currently being tested within the Shannon Estuary to identify changing intertidal and terrestrial environments. Preliminary results obtained using this new methodology on sediment cores taken from 3 locations in the estuary show changing isotope and elemental ratios across the lithographical boundaries at the bases of peats, representing changing environments of deposition. These results could indicate a transition from intertidal to terrestrial environments that would allow new SLIPs to be established in this region, though interpretations are not definitive. This casts doubt on the new technique, though ad hoc solutions may exist.

Recent sedimentation processes, patterns and chronology of the west Bengal Sundarbans.

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School of Geography, Archaeology and Palaeoecology (GAP), Queen's University Belfast

The primary aims of this project are to examine the sedimentation processes and sources of sediment in the Sundarbans mangrove forests of India from the late Holocene (ca. 1,000 years) to present. The Sundarbans are one of the largest mangrove forests in the world encompassing a transnational area of approximately 1 million ha in India and Bangladesh. In tropical coastal systems, both sea-grass meadows and mangrove forests are widespread components in the stabilisation of dynamic coastlines and are highly beneficial in developing productive ecosystems. Mangrove forests are important sinks for the accumulation of marine and terrestrial derived sediment loads, due to the physical trapping effect of a complex network of aboveground root and shoot systems. The Sundarbans are known to be relatively recent development in the Holocene, and the extent of its coverage has changed considerably when the Ganges-Brahmaputra river system changed course ca. 7,000 BP. The erosional effects of waves and storm surge waters on muddy wetland environments are limited only by; sediment cohesion, grass-canopy baffling, and plant-root binding. The ability of forests to persist in the face of rising sea level depends on their capacity either to migrate inland or to maintain positive surface elevation change equivalent to or exceeding the rates of sea-level rise. Fieldwork has been carried with three cores obtained from the Sundarbans, ranging in depth from 6.5m to 4.5 respectively. This project will employ the use of geochemical techniques (e.g. XRD, XRF and AAS). Stable isotope ($\delta^{13}C$) and elemental ratios analysis (organic C/N) will also be used as both provenance indicators of sedimentation in the Sundarban and potential tracers of extreme storm events. Preliminary analysis of sediment indicates stratified sequences with bands of intermittent organic and inorganic layers. Furthermore, sedimentary deposits appear to differentiate between inhabited and uninhabited islands.

Speleothem versus ice core ages for the Greenland interstadials. Does the latest NGRIP chronology still exhibit time lags?

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Climate variability during the last glacial is exquisitely recorded by the Greenland ice cores, but in Ireland only few climate records of Midlandian age are known because of extensive glacial reworking during the Last Glacial Maximum (LGM). Cave deposits such as speleothems are relatively protected during glaciation. The air temperature of shallow caves is similar to the mean annual air temperature at the surface. Speleothem deposition requires the presence of liquid water thus cave air temperature above 0ºC. While speleothem deposition was abundant in Crag cave during the Holocene, periods of ice free conditions in the last glacial can also be identified. Preliminary U-Th ages from two independent speleothems indicate episodic deposition between 44.0 and 23.5 ka BP.

In particular, periods of deposition, interrupted by visible hiatuses, have been identified at 44.0 ±0.6; 41.95 ±0.04; 38.0 ±0.1; 34.6 ±0.2; 32.7 ±0.05; 27.9 ±0.04 and 23.5 ±0.06 ka BP. These periods in Marine Isotope Stages (MIS) 2 and 3 shows an overall synchronicity with the Dansgaard-Oeschger (DO) events recorded in Greenland. But, whereas these interstadials are coeval in speleothem records from Crag Cave, Sofular Cave (Turkey) and Hulu Cave (China), DO events 3, 4, 5, 7, 10 and 11 appears to be offset towards younger ages in the Greenland ice core NGRIP (GICC05 chronology). Heinrich events 2, 3 and 4 are clearly marked by non-depositional episodes in the Crag speleothems. Measured $\delta^{18}O$ in the investigated speleothems are approximately 2‰ heavier than in Holocene reference material, attributed predominantly to changes in the $\delta^{18}O$ of the Atlantic surface waters. Measured $\delta^{13}C$ are as low as c. -9‰, implying the presence of vegetation and soil microbial activity in the warm intervals of MIS 2 and 3. Some episodes of non-deposition are preceded by gradual increases in $\delta^{13}C$, indicating slow deterioration of climatic conditions over timescales of centuries, whereas others are more likely to reflect local hydrological effects only.

Update on the ongoing research of submerged coastal features on the northern coast of Ireland.

Benjamin Thebaudeau
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Department of Geology, School of Natural Sciences, Trinity College Dublin.

The potential for recognition of submerged coastal landscapes is tested on the recent seabed mapping survey (JIBS) in the north of Ireland through a 4-year PhD project at TCD. This multi-disciplinary approach aims at recognising ancient coastlines corresponding to lowstands of the relative sea-level (RSL) in the Quaternary, and particularly in the last 20000 years since the last glacial maximum (LGM). Indeed, the latest GRM are still displaying some discrepancies with geological data and further testing of the most robust features of the model, like the eastward gradual uplift of Ireland, is required.
This talk will present the state of the project so far. The first work undertaken was an inventory of the shore-platforms present, hard rock erosional features, which are in numbers on the study area coastal seabed. After the recording the morphological parameters of all the shore-platforms identifiable on the sea bed (about 500 features for the study area) and plotting them on a database, a first analysis of the hypsometric curves will be presented, displaying unexpected results. The next step of the research, the comparison of the coastal profiles with profiles created from an erosional model, will be introduced. Finally, the plan for the coming years will be mentioned, with a look at sub-bottom profiles to assess the presence of more erosional features under sediment cover as well as identify any soft sediment accretional features still present.

7. Recent PhD completions

Planktonic foraminiferal response to the Last Glacial Termination and their application to Holocene biostratigraphy in the western Mediterranean Sea

Teresa Broggy
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Department of Geography, Mary Immaculate College, University of Limerick, South Circular Road, Limerick.

This research presents the planktonic foraminiferal assemblage variation of four western Mediterranean Sea cores since the Last Glacial Termination.

The Holocene epoch represents the current interglacial since the Last Glacial Termination ~11,600 cal. years ago. Extensive palaeoenvironmental research has verified the ability of planktonic foraminiferal abundances to record climatic and environmental variations. This research utilises planktonic foraminiferal abundance and morphological asymmetry to establish new biostratigraphic applications and to reconstruct Holocene palaeoenvironmental conditions.

A detailed investigation into the Holocene coiling variation of *Globorotalia truncatulinoides* is presented to establish its potential as a biostratigraphic marker. In addition, faunal abundance variations established the identification of four biozones for the previously undefined areas of the Gulf of Lion and the Balearic Basin, each associated with distinct environmental and hydrological conditions. Sea Surface Temperatures (SSTs) were reconstructed for each core via faunal assemblage variations using Artificial Neural Network (ANN) software, based on the calibration dataset of Hayes et al. (2005). A high-resolution palaeoenvironmental reconstruction was established for the core M40/4 82-2 SL in the Gulf

of Lion, identifying 3 phases of climatic variability and 4 significant cooling events.

The chronology of this research is validated by ^{14}C-AMS dating and oxygen isotope analyses. Findings suggest that *G. truncatulinoides* has significant potential as a biostratigraphic marker in the western Mediterranean Sea, while biozonation may have greater applicability on a local rather than a basin wide scale in the Mediterranean sea.

8. Notices

***IQUA/Queen's University Belfast Radiocarbon Award ***

Congratulations to the winners of the first round of the IQUA/Queen's University postgraduate radiocarbon grant (Kieran Craven, TCD, and Beatrice Ghilardi, NUIG). The second round of awards will be open for applications until 30th October 2011. For more details, contact Bettina Stefanini (stefanb@tcd.ie).

International Quaternary Association (INQUA) committee electee

IQUA has nominated Dr. Julius Lejju, Mbarara University of Science & Technology, Mbarara-Uganda (former PhD student at Department of Geography, TCD) as incoming Secretary of INQUA.

Dublin, City of Science 2012

Dublin has been chosen to host Europe's largest science conference, Euroscience Open Forum (ESOF), 2012. To celebrate this prestigious, international event a programme of science-related events and activities will take place in Dublin from 11-15th July 2012, and throughout Ireland during 2012. IQUA have submitted a proposal for a Glacial tour of the Dublin and the Wicklow mountains to be to be included in the programme of events.

9. Forthcoming workshops, seminars & conferences

***Bids for International Quaternary Association (INQUA) Congress 2015 ***

Quaternary community representatives from both Spain and Japan are presenting bids to host the next (XIX) INQUA Congress (2015) at INQUA 2011 in Bern (20-27th July). Full copies of the bids are posted on the web (http://www.inqua.org/documents/icb2011.html). The alternate bids will be discussed and voted upon at a meeting on Saturday July 23rd by attending National Delegates. You are invited to make your opinions known about a preference for either bid to stephen.mccarron@nuim.ie before July 23rd 2011.

Symposium: Stable Isotope Analysis and Modelling in Freshwater Ecosystems

Venue: Queen's University Belfast.
Date: Wednesday, 14th September 2011.

Evelyn Keaveney & Paula Reimer, Queen's University Belfast

This is the first official call for abstracts (for both oral and poster presentations) for a symposium on 'Stable Isotope Analysis and Modelling in Freshwater Ecosystems'. The symposium aims to highlight recent research in freshwater ecology using stable isotopes, and will provide an international forum to present and discuss research results. Speakers confirmed include Dr. Mark Trimmer (Queen Mary University of London). A practical workshop on 'Stable Isotope Analysis in R' (SIAR), a stable isotopes modelling package for R, a statistical software language and environment, will be led by the authors of SIAR, Dr. Andrew Jackson (Trinity College Dublin) and Dr. Andrew Parnell (University College Dublin). Participants will be given the opportunity to run the package using their own data. To register for the symposium, please email siamodellingqub@gmail.com.

Abstract submission deadline: 1st August 2011.
Registration deadline: 5th September 2011.
Registration cost: £10 sterling (includes lunch, tea/coffee).
Further details: www.qub.ac.uk/schools/gap/ or http://tinyurl.com/siamodellingqub

QRA Postgraduate Symposium

Venue: Geography Department, Durham University
Dates: 30th August - 1st September 2011

The QRA Postgraduate Symposium provides a great opportunity for postgraduates to present their research and meet others in the field of Quaternary science in a relaxed and friendly environment, and combines fieldtrips, formal presentations and social events without being too expensive.

Further details: www.dur.ac.uk/qrapg2011/

10. Recent Publications

Benetti, S., Dunlop, P. and O Cofaigh, C. (2010). Glacial and glacially-related features on the continental margin of northwest Ireland mapped from marine geophysical data. *Journal of Maps* **2010**, 14-29.

Dunlop, P., Shannon, R., McCabe, M., Quinn, R. and Doyle, E. (2010). Marine geophysical evidence for ice sheet extension and recession on the Malin Shelf: New evidence for the western limits of the British Irish Ice Sheet. *Marine Geology* **276**, 86-99.

Moore, R., Cooper, A., Dunlop, P. and Jackson, D. (2011). Geology and Geomorphology. In: *Lough Swilly: a living landscape*. Four Courts Press, Dublin, 17-34.

Ó Cofaigh, C., Dunlop, P. and Benetti, S. (In press). Marine geophysical evidence for Late Pleistocene ice sheet extent and recession off northwest Ireland. *Quaternary Science Reviews*
DOI: 10.1016/j.quascirev.2010.02.005

Sacchetti, F., Benetti, S., Georgiopoulou, A., Dunlop, P. and Quinn, R. (2011). Geomorphology of the Irish Rockall Trough, North Atlantic Ocean, mapped from multibeam bathymetric and backscatter data. *Journal of Maps* **2011**, 60-81.

Spagnolo, M., Clark, C.D., Hughs, A.L.C, Dunlop, P. and Stokes, C.R. (2010). The planar shape of drumlins. *Sedimentary Geology* **232**, 119-129.

Spagnolo, M., Clark, C.D, Hughs, A.L.C and Dunlop, P. (2011). The topography of drumlins; assessing their long profile shape. *Earth Surface Processes and Landforms* **36**, 790-804.

11. General Membership Items

Please let your students/colleagues know about IQUA and encourage them to join.

Join/Renew IQUA membership online via PayPal

We encourage all our members to update their annual subscription for 2011.

IQUA now offers a fast, safe, online payment system already familiar to many (**PayPal**) for joining IQUA or renewing your membership (!), and for purchasing past field guides (where available). The annual membership cost is: €15 waged; €10 students/unwaged.

PayPal allows you to pay securely with your credit/debit card via the IQUA website:

http://www.iqua.ie/Member/Mem_Hme.htm

Simply click on the relevant "Pay Now" button and follow the on-screen instructions. Upon completing the process, you will receive a confirmation receipt from PayPal, and shortly thereafter confirmation from the Treasurer of your membership status.

For the convenience of members, we are also offering a three-year membership option with automatic billing. PayPal will automatically debit your credit/debit card each year for the relevant amount (either €15 or €10). This happens each year on the date you initially join/renew. To try this option, click on the relevant "Subscribe" button. You can cancel the automatic billing any time before the three-year period is up by contacting the Treasurer.

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If you do not have access to our online PayPal system, which is our preferred method of dues collection, please cut out and complete the following form and send it with the relevant annual subscription (€15 waged; €10 students and unwaged) to the IQUA Treasurer at the address below.

Cheques should be made payable to IQUA. It is suggested that, for their convenience, members may wish to pay two or three years' subscription in a single transaction.

IQUA membership form

Name: ……

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Telephone: ……

E-Mail: ……

Amount paid: ……

If you have any queries about IQUA membership, please contact the Treasurer.

Gayle McGlynn, IQUA Treasurer

Email: mcglyng@tcd.ie

Address: Department of Geography, Museum Building, Trinity College Dublin.

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IQUA e-mail listerver:
https://listserv.heanet.ie/iqua-l.html

If you are not receiving IQUA listserv emails, please sign up to the list at the location above. A request for subscription to the IQUA-L list goes initially to the list moderator first for cross-referencing with the current membership list.

B. Stefanini, IQUA-L Moderator

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