



IQUA

Irish Quaternary Association
Cumann Ré Cheathartha na h-Éireann

IQUA Symposium 2019

A Selection of talks from INQUA

Abstract Booklet

Friday 29th November 2019



**INQUA 2019
DUBLIN
IRELAND**

25th - 31st July 2019

ISSN: 0790 410X
ISBN: 978-0-947920-54-8

IQUA Annual Symposium 2019

Schedule

9:30-10:00: Registration

10:00-10:05: Welcome and house-keeping

10:05-10:50: John Lowe and Mike Walker

Reconstructing Quaternary Environments

10:50-11:10: Conor Murphy

Wetter winters and drier summers in the UK explained by data errors and biases

11:10-11:40: Coffee break

11:40-12:00: Catherine Dalton

Lake Sediments & an Irish Palaeoecological Database

12:00-12:20: Jessica Smyth

Intensive dairying in 4th millennium BC Ireland? The Céide Fields complex, Co. Mayo, northwest Ireland

12:20-14:00: Lunch Break

14:00-14:20: Frank McDermott

Speleothems as recorders of centennial- to millennial-scale climate variability

14:20-14:40: Paula Reimer

An overview of the IntCal20 radiocarbon calibration curve

14:40-15:00: Helen Shaw

Beyond the bog: the importance and value of small-scale stratigraphic deposits in the landscape as archives for applied palaeoecology

15:00-15:30: Coffee break

15:30-15:50: Lisa Orme

A 14,200 year sea-surface temperature reconstruction from the western Indian sector of the Southern Ocean

15:50-16:10: Tony Brown

Reconstructing Neolithic to Post-Medieval land-use dynamics and human activity from Lough Catherine, Northern Ireland: a sedaDNA and lipid biomarkers approach

16:10-16:30: Mark Coughlan

Morphology, seismo-stratigraphy and sedimentology of the Wicklow Trough, western Irish Sea: tunnel valley development and contemporary seabed dynamics

The symposium will be followed by the announcement of this year's awards winners

Keynote:

Reconstructing Quaternary Environments

John Lowe¹ and Mike Walker²

¹ *Royal Holloway University of London*

² *University of Wales Trinity Saint David & Aberystwyth University*

At the XX INQUA Congress held in Dublin in July 2019, the textbook *Reconstructing Quaternary Environments* (John Lowe & Mike Walker) received a Special Recognition Award from the INQUA Executive Committee. This included an invitation, along with the other medal winners, to deliver one of the lectures in the series of Lunchtime Talks. The paper presented today is a reprise of that talk, but with some additional material that could not be included in the original lecture because of constraints of time.

We begin by outlining the origins of our own research collaboration at the University of Edinburgh, which involved a combination of palynology and glacial geomorphology of the Lateglacial period, and explain how this interdisciplinary (and subsequently multidisciplinary) approach has informed much of our subsequent research, and indeed has been the leitmotif that runs through all of our books. We acknowledge our debt to our academic mentors and collaborators, in particular Brian Sissons, Russell Coope, and colleagues at the Centre for Ice and Climate in Copenhagen (Sigfus Johnsen, Jorgen-Peder Steffensen and Sune Rasmussen) and note, in particular, the increasing importance of both ice-core and palaeoceanographical research in Quaternary science during the course of our careers, and which is reflected in all three editions of our book.

The multidisciplinary nature of our research has led to our involvement in a number of major international projects, including the North Atlantic Seaboard Programme, INTIMATE (the integration of ice-core, marine and terrestrial records), and collaborations with the Subcommission on Quaternary Stratigraphy to define the Pleistocene-Holocene boundary and to subdivide the Holocene Series/Epoch. All of these initiatives we describe here. We also consider some of the major (and unforeseen) developments in Quaternary science over the thirty years since the publication of the first edition of our book, and note in particular the contribution of tephrochronology as both a correlative and dating tool. Finally, we take a brief forward look into new areas of Quaternary science where we might expect to see significant advances over the coming years.

Wetter winters and drier summers in the UK explained by data errors and biases

Conor Murphy

Maynooth University

Long-term, quality assured records underpin our understanding of climate variability and change. Globally, few such records extend to the 18th Century, particularly for precipitation. The England Wales Precipitation (EWP) series is a notable exception that provides a continuous monthly record from 1766. EWP has found widespread use across diverse fields of research including; trend detection, evaluation of climate model simulations, as a proxy for mid-latitude atmospheric circulation, a predictor in long-term European gridded precipitation datasets, the assessment of drought and extremes, tree-ring reconstructions and as a benchmark for other regional series. A key finding from EWP has been the trends towards wetter winters and drier summers. We statistically reconstruct winter and summer EWP using independent, quality-assured temperature, pressure and circulation indices. Using a sleet and snow series for the UK derived by Prof. Gordon Manley and Prof. Elizabeth Shaw to examine reconstructions, we show that precipitation totals for pre-1870 winters are biased low due to gauge under-catch of snowfall and a higher incidence of snowfall during this period. When these factors are accounted for the trend to wetter winters in EWP is no longer evident. For summer, we find that pre-1820 precipitation totals are too high due to decreasing network density and uncertain data at key stations. A significant trend to drier summers is not robustly present in our reconstructions of the EWP series, with significance depending on start/end year and predictors used in model reconstructions. Our findings challenge current assumptions about historic climate variability and change in north-western Europe. It is also likely that the identified biases in EWP have distorted many other long-term European precipitation series.

Lake Sediments & an Irish Palaeoecological Database

Catherine Dalton

Mary Immaculate College, University of Limerick

Lakes are important components of our landscape and provide a range of important ecosystem services and natural capital. Additionally, lake sediments contain signals of their physical, chemical and biological ontogeny reflecting natural system dynamics as well as anthropogenic activity. A summary of the available lake data is vital to help shape research efforts to determine catchment and lake system contributions to biogeochemical processes, for example, carbon burial. This is particularly important in the context of global climate change. This presentation will summarise the publicly available spatial data on Ireland's lake population. Although small in area, lakes play a critical role in biogeochemical cycling by storing organic carbon produced by the catchment/lake and by releasing CO₂ and CH₄ to the atmosphere. While Ireland has considerable peat and lake rich landscapes, quantitative data on carbon sequestration/burial in lake sediments are largely lacking. A synthesis of the lake sediment geochronologies that have been established for Irish lacustrine systems will be outlined and sediment accumulation rates quantified to-date will be used to establish key patterns and trends in relation to lake type. This in turn will provide invaluable context in terms lake sediment studies and interpretations of Anthropocene change in this north-west Atlantic coastal region.

Intensive dairying in 4th millennium BC Ireland? The Céide Fields complex, Co. Mayo, northwest Ireland

Jessica Smyth

University College Dublin

The Céide complex of drystone co-axial field systems in north Mayo, northwest Ireland, has been extensively mapped and partly excavated over a number of decades and is argued to be the oldest in Europe, emerging in the 4th millennium BC. While recent research has demonstrated dairying is contemporary with the arrival of farming in Ireland, by at least 3800 BC, there is as yet no proven relationship between the sophisticated land management evidenced at Céide and dairying, although soil lipid analyses have indicated arable farming is unlikely. This landscapes/foodscapes relationship will be elucidated through molecular and isotopic analyses of lipid residues preserved in Neolithic pottery sherds recovered from excavations within the field systems, which provide a powerful proxy for animal husbandry and consumption practices. This new evidence will be set alongside detailed analysis of the dating evidence for the Céide Fields complex, demonstrating unequivocally the Neolithic date of the field systems and rebutting recent suggestions of a later, Bronze Age date for the activity.

Speleothems as recorders of centennial- to millennial-scale climate variability

Frank McDermott

University College Dublin

Caves are unique environments that offer physical protection for speleothems and other climate-sensitive archives, particularly during glacials when surficial deposits may be removed or reworked by erosion. Speleothems (calcitic or aragonitic stalagmites, stalactites and flowstones) are ideal materials for U-series dating, permitting the construction of exquisitely detailed chronologies for depositional phases, well beyond the c. 50ka limit of radiocarbon dating. Crucially, speleothem deposition requires that liquid water is available to percolate downwards through soils and bedrocks, and so during glacials, intervals of speleothem deposition indicate episodic absences of permanently frozen ground and the availability of biogenic CO₂. Results of 1-D thermal modelling of heat conduction through soils and bedrock will be presented, along with a discussion of new and published U-series dates from selected European caves, with specific examples from Ireland, the Alps and Georgia to constrain the duration of the onset of climate amelioration during the Dansgaard-Oeschger (DO events). Previously published U-series dates from Crag Cave, SW Ireland (Fankhauser et al., 2016), augmented by additional dates for key speleothems from this site provide evidence for short-lived climate-driven centennial to millennial scale episodes of deposition. These occur during Marine Isotope Stage 5 (MIS-5) through to the Last Glacial Maximum (LGM), into the Late Glacial. New U-series dates will also be presented for stalagmites collected from Solkota Cave in western Georgia during 2016. Stalagmite SKK 16-3 from Solkota Cave exhibits intense but short-lived depositional phases that are contemporaneous with DO events in the Greenland ice cores. In detail, SKK 16-3 shows rapid but intermittent growth around 84 ka, coinciding with climatic amelioration during Marine Isotope Stage (MIS) 5a, and specifically during the short-lived Greenland Interstadial 21.1e (GI-21.1e). Following a long-lived hiatus, a short interval of deposition resumed at 57 ka, coinciding with a warm interval in MIS3, Interstadial GI 16.1, indicating a strong climatic control. Coeval episodes of speleothem deposition are seen at Crag Cave and in the published results from caves in the European Alps. Finally, the new results permit snapshot comparisons of elevation-corrected Last Glacial speleothem longitudinal $\delta^{18}\text{O}$ gradients during selected DO events across Europe, from the Irish Atlantic margin in the west to the Black Sea in the east, with those of the Holocene.

Fankhauser, A., McDermott, F. and Fleitmann, D. (2016) *Episodic speleothem deposition tracks the terrestrial impact of millennial-scale last glacial climate variability in SW Ireland*. *Quat. Sci. Rev.* 152, 104-117.

An overview of the IntCal20 radiocarbon calibration curve

Paula Reimer

Queen's University Belfast

The IntCal20 radiocarbon calibration curve has been constructed from carefully screened ^{14}C and calendar age data using a newly developed Bayesian framework. New data include ^{14}C measurements of the U-Th dated Hulu cave speleothem back to 54ka cal BP, late glacial tree-rings from New Zealand and Europe, and thousands of decadal and single year tree-rings from around the world. It also includes the extension and revision of the Lake Suigetsu varve counts. In addition, floating series of glacial age tree-rings have been wiggle-matched to the ^{14}C calibration data. A GCM ocean model has been used to estimate marine reservoir age changes over time. The new curve compares well to other independently dated records such as wood buried by the Campanian Ignimbrite. IntCal20 provides more robust atmospheric ^{14}C values and uncertainties than IntCal13 particularly for calendar ages older than 12ka cal BP.

Beyond the bog: the importance and value of small-scale stratigraphic deposits in the landscape as archives for applied palaeoecology

Helen Shaw

Maynooth University

A growing desire for both high-nature value farming and rewilding as conservation strategies has highlighted a pressing need to understand long-term dynamic change in natural and semi-natural vegetation systems. Palaeoecology can, and does, contribute much to our understanding of ecological dynamics in these systems. Modern palaeoecology is increasingly focussed on linking with ecosystem models at regional and global scales, and scaling up collated datasets from lake and bog archives. However much information of application to nature conservation requires scaling down. There are still surprising gaps in our knowledge-base: areas where paleoecology is either missing, or at too coarse a temporal or spatial resolution to provide useful data for modern application. In order to develop understandings of local-scale ecological dynamics and their drivers new local-scale palaeoecological histories, from mosaics of small sites, in landscapes of interest are required. Scaling down and collecting new data can also assist in filling in the considerable spatial gaps in the current set of regional-scale palaeoecological models.

Whereas large areas of peat, or lake systems, are increasingly recognised, as carbon stores and for biodiversity value, with ecosystem service valuation driving protection, preservation and conservation of the geoheritage archive within them; in contrast, local-scale palaeoecological archives are seldom considered and are potentially being lost. Much ecologically relevant palaeoecology relies on samples from small peat hollows, ponds etc. within cultural and woodland landscapes. These deposits are often disturbed or drained with little thought for the historical and palaeoenvironmental records that they contain.

This paper will present and explore examples of local-scale palaeoecological research especially in the context of social-ecological systems in traditional agricultural and wooded landscapes. Examples from personal research in Ribblesdale, north Yorkshire, Scotland and the English Lake district will be presented, as well as some review of other studies. Via these examples, the paper aims to highlight the value of a range of non-standard palaeoecological sites within the landscape, and to urge consideration of a wider range of sites as contributing to a valuable palaeoecological geoheritage.

A 14,200 year sea-surface temperature reconstruction from the western Indian sector of the Southern Ocean

Lisa Orme

Maynooth University

The temperature of the Southern Ocean is dependent on factors including the temperature of the atmosphere and upwelling water, shifts in the position of the Antarctic Circumpolar Current and the southern westerly winds, and the amount of heat transported northwards by the Atlantic Meridional Overturning Circulation (AMOC). Over recent decades, a slowdown of the AMOC has led to heat accumulating in the subsurface of the Southern Ocean, while surface waters poleward of 50°S have cooled, particularly in the Pacific sector (Armour et al., 2016; Jones et al., 2016). Given the scarcity and short length of Southern Ocean temperature records (Jones et al., 2016) palaeoclimate reconstructions can be used to investigate if the observed patterns are outside the range of natural variability and how temperature has varied in response to past changes in the climate system.

We present a diatom-based sea-surface temperature reconstruction from core KH-10-7 COR1GC, sampled from the western Indian sector of the Southern Ocean (54°16.04'S, 39°45.98'W), which was produced using the Modern Analogue Technique. The record spans from 14.2 to 1.0 ka BP (calibrated kiloyears before present) and has an average resolution of 60 years, allowing an improved understanding of the millennial-centennial variability since the deglacial. The record shows that temperatures varied in parallel with atmospheric temperatures over Antarctica, supporting synchronous changes in ocean and atmospheric temperatures across the southern high latitudes. Temperatures were low during the Antarctic Cold Reversal and gradually increased during the Younger Dryas (13-11.8 ka BP) to reach higher and stable values during the early Holocene (11.8-8.7 ka BP). Subsequently, cooler and variable conditions prevailed. The results support that during the Younger Dryas a slowdown in the AMOC along with rising atmospheric CO₂ levels caused the inferred warming of the Southern Ocean. A cool interval at 8.2 ka BP may be a southern hemisphere response to the '8.2 event' seen in records primarily in the northern hemisphere.

Reconstructing Neolithic to Post-Medieval land-use dynamics and human activity from Lough Catherine, Northern Ireland: a sedaDNA and lipid biomarkers approach

Tony Brown

University of Southampton

A molecular approach to lake sediments used for artificial islands (crannogs) is here used to reconstruct the environmental record from a natural island in Lough Catherine Northern Ireland. The island, named 'Island McHugh, was excavated in the 1940s-1950s and again in the 1970s. It has yielded artefacts from most periods including; Neolithic worked flint, a Bronze Age sword, worked wood, and charcoal, an early medieval crannog, and lastly a post-Medieval castle. The excavations by in the 1940s revealed a complex stratigraphy which has been re-evaluated as part of the Celtic Crannogs Project. A core from just off the island has revealed a complex stratigraphy extending back to the early Neolithic. Extracellular sedaDNA from the site shows three principal phases of human activity including both domesticates and synanthropes. In the first phase provisionally dated to the Iron Age open ground and grazing taxa increase with a small increase in arable indicators. There is also the appearance of cattle, pigs and sheep. In the second phase more securely dated to the early Medieval period there is a larger increase in both grazing and arable indicator taxa and a very strong increase in domesticated animals. In the Post-Medieval period horse is present and there is a comprehensive reflection of 18th century landscaping. The later two periods (Early Medieval and Post-medieval) are well represented in the excavations but the earlier phase (Iron Age) is not, so we are undertaking a further review of the existing excavation data as well as proposing re-excavation of some, somewhat enigmatic, features. The lipid biomarker evidence is also strong with high faecal stanols from the Iron Age to the Medieval levels. A clear peak at c. 600 BC enables the identification of the source as almost certainly of human origin. The faecal stanols record is shown to mirror the animal sedaDNA results. This study illustrates the ability of sedaDNA to identify both the impact of human activity on local ecology, but also the causes - from the presence of cultivars to domesticates such as cattle, pig and sheep. The presence of horse only in the Post-Medieval levels suggests stabling of horses at the castle on the island. Taken with the direct evidence of human habitation from the faecal stanols we can see how these techniques could be used to provide an archaeological record of sites that had never been excavated.

Morphology, seismo-stratigraphy and sedimentology of the Wicklow Trough, western Irish Sea: tunnel valley development and contemporary seabed dynamics

Mark Coughlan

University College Dublin

Wicklow Trough is one of several deeps in the Irish Sea. The morphology and sub-seabed stratigraphy of the deep is described from ship based multibeam echosounder data and 60 km of sparker seismic profiles across and along the deep. The deep is asymmetrical and closed to the north by sediment waves and an adjacent bank. The floor of the deep reveals a variety of sediment wave types, ridges and four over-deepened sections. Groundtruthed by five vibrocores, the sub-seabed reveals sediment wave drifts, glaciofluvial and glaciomarine fills overlying a rock basement. The Trough fill sediments are predominantly heterogeneous glacial outwash sediments with indications of slumping on the flanks. Strong contemporary currents create sand and gravel dominated sediments at the seabed with mobile sediment generating sediment waves migrating between 7 and 43 m a⁻¹. A bedload parting zone is inferred in the Trough. Eroded seabed and scour pits are also apparent. Collectively, the evidence suggests that the Wicklow Trough is a tunnel valley formed under the last Irish Sea Ice Stream by a composite of time transgressive glacial processes, with pressurised meltwater acting as the dominant agent during gradual or slow ice sheet retreat. Its location may be fault controlled.



Details of IQUA membership are available at www.iqua.ie

Details of IQUA Field Guides (many of which are now available for purchase as PDFs) and INQUA excursions Field Guides are also available at www.iqua.ie

14
CHRONO



Queen's University Belfast
**AMS Radiocarbon
Dating**

...over 45 years
of experience...

- ✓ **results:** - typically less than 10 weeks
- fast track available
- accurate and precise*
- $\delta^{13}\text{C}$ included (& $\delta^{15}\text{N}$ for bones)
- ✓ **small sample size**
- ✓ **full sample pretreatment (all types)**
- ✓ **expert sampling & calibration advice**
- ✓ **10% student discount**

* Check our website for VIRI results

Contact us for current price and turnaround:
www.chrono.qub.ac.uk chrono@qub.ac.uk

+44 (0)28 9097 3104