IQUA

Irish Quaternary Association
Cumann Ré Cheathartha na h-Éireann

IQUA SPRING MEETING 2022

ABSTRACTS

QUEEN'S UNIVERSITY BELFAST

IQUA Spring Meeting 2022

9.30–10.00 am		Registration
10.00–10.10 am	Graeme Swindles	Welcome address
Session 1: Chair Graeme Swindles		
10.10–10.30	Martin Moucheron	Turning the tide? An archaeological reassessment of Mesolithic Dalkey Island
10.30–10.50	James Perkins, Gill Plunkett and Laura Basell	A multicore palynological investigation of Mesolithic plant and land-use at Derragh Island, Co. Longford
10.50–11.10	Lewis Howell	Linking ecological, environmental and human Holocene change using laminated lake sediments in the Irish Midlands
11.10–11.40		Coffee break and poster session
Session 2: Chair Gill Plunkett		
11:40–12:00	Michelle Curran and Audrey Morley	Enhanced freshwater export to the subpolar North Atlantic: a trigger for abrupt climate change?
12:00–12:20	David O'Leary, Eve Daly and Colin Brown	Digital soil mapping of peatlands using airborne radiometric data and supervised machine learning
12:20–12.40	Michael Dempster	Conservation of Northern Ireland's Quaternary geoheritage – where are we, how did we get here, and where next?
12:40–13:00	Graeme Swindles	Controls on the accumulation rates of European peatlands
13:00–13:15		Discussion and Awards Presentation
13:15–14:30		Lunch
14:30–15:30	Chaired by: Gill Plunkett (President)	IQUA AGM

Posters

Rory Connolly, Martin Moucheron & Carolyn Howle Outlaw: *PRISM: Preservation by Record of Ireland's Shell Middens*

Sarah Ferrandin and Gill Plunkett: *Investigating the Timing and Causes of Nitrogen Cycle Changes in Bronze Age Ireland*

Hazel Mosley and Will Megarry: *Landscapes of Production: Exploring the Palaeoenvironmental Context of Stone Tool Quarrying, Manufacture, Use and Deposition on Neolithic Shetland*

Cormac O'Brien, Sam Kelley, Graeme Warren, Elyeah Schweikert and Alice Doughty: *Examining landscape evolution during the final deglaciation of the Cairngorms, NE Scotland*

Turning the tide? An archaeological reassessment of Mesolithic Dalkey Island

Martin Moucheron

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This contribution introduces an ongoing PhD project aiming to reassess three Mesolithic (c. 8000–4000 BC) shell midden sites on the east coast of Ireland using archival, archaeological, and geoarchaeological methods. The shell middens in Dalkey Island and Sutton, Co. Dublin, and Rockmarshall, Co. Louth, are reference sites for the Irish Mesolithic, yet they have remained unexplored for the past fifty years despite the impact of both coastal erosion and growing urbanisation on the archaeology of the Irish East Coast.

In particular, the development of landscape archaeology, and the increasing precision in data analysis, have imposed change as a key element to understand time and space – the sites in their landscape evolved throughout the Mesolithic, and were different to what they are today. Together with the original excavations' material and archives, the extraordinary technological progress in data acquisition and analysis are being mobilised to assess what archaeological potential has been preserved on our three sites using a combination of archaeological and geoarchaeological methods selected in line with international best practice as a practical contribution to the archaeology of Early Holocene landscapes.

This presentation proposes a particular focus on Dalkey Island, where ongoing damage to archaeological contexts, recorded in the initial phase of this project, has led the National Monuments Service to support a short fieldwork campaign whose first observations offer exciting and challenging perspectives.

A multicore palynological investigation of Mesolithic plant and land-use at Derragh Island, Co. Longford.

James Perkins[1*], Gill Plunkett[1] and Laura Basell[2]

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Archaeobotanical and pollen records from Britain and north-west Europe indicate that Mesolithic people structured woodlands through the intensive use and management of wild plants, and the creation of small-scale clearings. Whether the same is true in Ireland is less clear. Here, despite hints in the archaeobotanical and palynological records that hunter-gatherers actively managed plants and cleared woodland, very little is known about the environmental impacts of these practices. This is due in part to a lack of concerted palynological research into Mesolithic woodland disturbance since the 1980s, and because few detailed palaeoenvironmental investigations have specifically targeted areas with Mesolithic archaeology/archaeobotany.

One site where peat deposits of Mesolithic age were discovered alongside a contemporary archaeological site with a rich archaeobotanical assemblage is Derragh Island, Co. Longford. To determine whether the site's occupants shaped woodland through the creation of clearances or through their plant-use strategies, three monoliths taken from within a 40 m radius of the archaeology were analysed at multi-decadal (10–30 year) resolution for pollen, charcoal and ^{14}C. This paper presents the results of those investigations and discusses their significance. Despite the archaeobotanical evidence for extensive plant use, the pollen records do not clearly demonstrate signs of vegetation disturbance. The results have significant implications for our ability to infer Mesolithic occupation from pollen records.

Linking ecological, environmental and human Holocene change using laminated lake sediments in the Irish Midlands

Lewis Howell

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Cornaher Lough is a small, freshwater lake located in County Westmeath, Ireland and holds a record of extensive palaeoenvironmental change. Originally investigated by Alyson Heery of Trinity College, Dublin in 1998 the study yielded a unique record of environmental change in response to Holocene climatic change presenting a picture of a diverse landscape undergoing several key transitions from the early Holocene to the present. The occurrence of laminated sections throughout the sequence have sparked new interest in the site. The current investigation focuses on rapid climate events within the Holocene, their impacts on the palaeoenvironment and vegetation of the site with a focus on the human-environment relationship in the area. The study is utilising a range of proxies namely pollen, NPP, geochemistry and magnetic susceptibility data and local archaeology. It is hoped that the laminations present, when analysed for dateable material, will represent several key climate events during the Holocene (e.g. 8.2, 4.2, 2.8 ka events). The Theory of Adaptive change and Ecological Resilience first identified by C.S Holling in the 1970s will be applied to the sequence obtained sitting within a developing niche of Quaternary Science concerned with assessing palaeovegetation and ecological resilience to climatic variability. Specific focus will be given to key archaeological transitions to investigate whether they occur at the same time as key climatic transitions. So far, magnetic susceptibility and stratigraphic information has yielded some interesting results which will lay the foundation for future study. It is also hoped that a similar site in Wales, specifically near the Shropshire hills can be sought to enable a comparative analysis.

Enhanced freshwater export to the subpolar North Atlantic: a trigger for abrupt climate change?

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Recent studies of Marine Isotope Stage (MIS) 11 (424-403 ka), a long and unusually warm Quaternary interglacial, have found that the Atlantic Meridional Overturning Circulation remained strong despite continued background melting of the Greenland Ice Sheet that resulted in a fresh and cold surface ocean in the Nordic Seas. These investigations suggest deep-water formation may not be as susceptible to future melting of the Greenland Ice Sheet as previously thought. Here we test this hypothesis and present a palaeoceanographic investigation of an abrupt climate event recorded in the eastern North Atlantic during peak interglacial conditions, when the Greenland Ice Sheet was smaller than today. Using sediment core DSDP-610B recovered from the Rockall Trough, we reconstruct the evolution of Nordic Seas Deep-Water (NSDW) by means of grain size analysis and endmember modelling. Further, a combination of planktonic foraminiferal assemblage census and Ice-Rafted Debris (IRD) counts enabled a reconstruction of sea surface temperature and the movement of oceanic fronts throughout this event. Our results link a reduction of NSDW with a sudden release of fresh waters from the Nordic Seas to the subpolar North Atlantic. We hypothesise that the ocean-atmosphere climate dynamics linking the Nordic Seas with the subpolar North Atlantic could play a crucial role for the stability of current NSDW formation pathways in the future.

Digital soil mapping of peatlands using airborne radiometric data and supervised machine learning

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Peatlands are important carbon sequestration centres. Through restoration projects they may become carbon neutral or possibly carbon negative. Restoration plans require a knowledge of peatland extent and spatial distribution across large geographic areas.

Current peatland maps are created using combination of optical satellite remote sensing and legacy soil/quaternary maps. Optical remote sensing cannot detect peatlands under landcover such as forest or grassland. Legacy maps are often created from sparse in-situ augur or trial pit data. These types of measurements do not allow for accurate measurement of boundaries.

Airborne geophysical datasets offer a means to update national and local scale peatlands maps. Radiometrics, a geophysical method that measures radiation from geological materials, is particularly suited to peatland studies. Modelling of radiometric attenuation indicates that statistical relationships exist between acquired datasets. Peat is a mostly organic material and so is, generally, not a source of radiation. Peat has low bulk density and is usually very porous and saturated. These effects combined means that peatlands can be differentiated from non-peat soils.

This study uses airborne radiometric data combined with machine learning classification to examine the current spatial distribution a peatland database in the west of Ireland. The Quaternary Geology database maps peatland extent where peat thickness is greater than 1m at the surface. The methodology shows that a direct measurement, such as radiometric data, analysed in a supervised machine learning framework, provides increased resolution of peatland extent in this region.

Conservation of Northern Ireland's Quaternary geoheritage – where are we, how did we get here, and where next?

Dr Michael Dempster

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Northern Ireland has a rich and varied Quaternary geoheritage. Landforms and sediments from the last glacial phase of the Late Pleistocene are most prevalent, though the record extends from the last interglacial (MIS 5e) to the Holocene. The glacial record in the region continues to play a crucial role in the development of models of the last British-Irish Ice Sheet, with many sites having international significance. It is the role of the Northern Ireland Environment Agency to legally protect and conserve this important Quaternary heritage, and a programme of statutory protection of these sites as Areas of Special Scientific Interest (ASSIs) has been in place for over twenty years. This talk will look at how conservation of Quaternary sites and features has been approached and achieved in Northern Ireland to date, consider its current status and future needs to ensure its continued protection and recognition as a vital part of the natural heritage of the region.

Controls on the accumulation rates of European peatlands

Graeme T. Swindles[1,2]

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Peat accumulates when there is a positive mass balance between plant productivity inputs and litter/peat decomposition losses. Here we examine the peat accumulation rates from 28 well-dated European peatlands. Peat accumulation rates range between 0.005 and 0.448 cm yr^{-1} (sample mean = 0.140 cm yr^{-1}; inter-site mean = 0.118 cm yr^{-1}). Our work provides important context for the commonplace assertion that peatlands grow vertically at ~1 mm yr^{-1}. We find that summer temperature is the strongest control on the site average and highest recorded accumulation rates across our European sites. Peatland accumulation rates tend to also be higher when water-table (reconstructed from testate amoeba subfossils) is within the 5-10 cm range. When a Gaussian response curve is fitted to the data, the optimal water-table depth for greatest peat accumulation is ~10 cm. Peat accumulation rates appear to be generally lower when water table depths are <0 cm (standing water) or >25 cm, which may relate to a decrease in plant productivity and increased decomposition losses, respectively. These findings corroborate previous experimental studies which examined the relationship between peatland water-table depth, or the thickness of the aerobic surface layer (the 'acrotelm'), and the rate of peat formation. Our work suggests that an average water-table depth of around 10 cm is optimal to enable rapid peat growth and carbon sequestration in the long term, which should inform peatland restoration and rewetting projects.

PRISM: Preservation by Record of Ireland's Shell Middens [poster]

Rory Connolly[1], Martin Moucheron[1*] and Carolyn Howle Outlaw[2]

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Coastal shell middens are an important archaeological resource with the potential to shed light on many aspects of human-coastal interaction over time and contribute with environmental reconstruction. Over 500 sites containing these shell deposits can be found at various locations along the *c.* 7500km of the Irish coastline, dating from *c.* 6000 BC to the modern era. Understanding these sites may assist researchers, policy makers, and community leaders in developing new approaches and building resilience along the coast today. However, these shell middens are rapidly being lost due to both natural — sea-level rise, coastal erosion, increased storm surges, and isostatic shift — and anthropogenic factors — trampling by footfall, removal of shells and other archaeological material, certain agricultural practices, and encroaching development.

PRISM, Preservation by Record of Ireland's Shell Middens, is a citizen science participatory mapping scheme devised to assist volunteers in recording midden sites and the effects of erosional factors in their own communities. An interactive website has been developed to include digital mapping tools and information for assisting such recording. The project aims to foster pride in local coastal heritage for the volunteer citizens along with creating a more complete record of shell middens within their cultural and geological context. This poster will show the website and how to interact with it to continue to spread PRISM throughout the research community and the interested public.

Investigating the timing and causes of nitrogen cycle changes in Bronze Age Ireland [poster]

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Archaeological and palaeoenvironmental evidence suggests that the Irish Bronze Age was a time of substantial, recurrent societal and environmental changes that would have affected human life on many levels. Against a backdrop of fluctuating climate, repeated phases of land clearance and abandonment changed the nature of the Irish landscape. Previous research on herbivore bone collagen $\delta^{15}N$ has suggested that an intensification in farming and deforestation activities triggered a shift in nitrogen trophic levels at a broad regional scale. Such an intensification is generally supported by palynological and archaeological evidence, but anthropogenic impacts were not sustained. Might then the nitrogen shift be explained by other factors? Nitrogen stable isotopes are often very hard to interpret as they mirror a complex synergy of causes, including climate. The Irish Bronze Age is marked by a number of climate transitions, including a possibly significant drought event around 900 BCE.

This paper outlines a research project that aims to effectively distinguish between climate and land-use changes during the Irish Bronze Age. The study will apply a multi-proxy approach combining the use of pollen, testate amoebae, carbon, and nitrogen stable isotope analyses to examine the occurrence of the nitrogen shift in sedimentary records and compare its timing with climate and land-use changes. The work targets paired sites of ombrotrophic peat bogs and lake sediments from areas with known Bronze Age settlement: ombrotrophic peat bogs get all their nutrients from the atmosphere which is why their $\delta^{15}N$ values are only affected by climate change, unlike lake sediments which also reflect land-use changes. Herbivore bone collagen reflects years of dietary intake, therefore providing a greater spatio-temporal perspective.

Landscapes of production: exploring the palaeoenvironmental context of stone tool quarrying, manufacture, use and deposition on Neolithic Shetland [poster]

Hazel Mosley[1*] and Will Megarry[1]

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Palynological analysis shows considerable variation in openness, inferred vegetation and landscape history across Shetland during the middle Holocene, likely influenced both by topography and anthropogenic factors.

During the last decade, new radiocarbon dates and reanalysis of Shetland sites long suspected to be Neolithic, such as Ness of Gruting and the stone buildings at Scord of Brouster, has suggested an early Bronze Age chronology, challenging previously held beliefs about settlement and landuse during the Neolithic and creating a gap in our understanding of this important period. More recently, radiocarbon dates from felsite stone tool quarries in North Roe and a cache of polished axes and knives at Modesty in West Mainland have indicated extensive quarrying and distribution networks in the early to middle Neolithic. Polished felsite axes and knives are found across the archipelago, suggesting widespread settlement activity.

A review of the palaeoenvironmental and archaeological data has shown north-west Mainland has a wealth of Neolithic archaeology and limited palaeoecological coverage, something this project seeks to redress. This poster will summarise existing mid-Holocene palaeoenvironmental studies, which are mostly focussed on south and west Mainland. It will then outline the project aims to for new palaeoenvironmental investigations targeting areas associated with felsite production and use in north-west Mainland, and new analysis of the palaeoenvironmental sequence and chronology at Scord of Brouster. The project will use geospatial analysis and visualisation, integrating new and existing pollen data to explore vegetation cover across Neolithic Shetland.

Examining landscape evolution during the final deglaciation of the Cairngorms, NE Scotland [poster]

Cormac O'Brien[1], Sam Kelley[1], Graeme Warren[1], Elyeah Schweikert[2] and Alice Doughty[2]

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In Scotland, the influence of deglaciation on Late Glacial–Early Holocene hunter-gatherer activity in mountain landscapes remains unclear. We will contribute to the debate by constraining the timing of the final deglaciation of the Cairngorms to characterise the evolution of the Late Glacial landscape. To constrain the timing of deglaciation, we have collected bedrock and boulder samples for ^{10}Be and ^{14}C cosmogenic isotope exposure dating. Our new chronology, along with recalibrated exposure ages, will constrain our computational models of ice mass evolution. To provide a further constraint on the models, we have compiled published data on the locations of long-lasting modern snow patches in the Cairngorms, as an analogue for where Late Glacial/Early Holocene snow and ice may have accumulated. We find that snow tends to last the longest on slopes with a NE aspect, and that years with no surviving snow have become more frequent since records began. This research is part of a larger project which seeks to characterise the Late Glacial and Early Holocene landscape of the Cairngorms, which were home to hunter gatherers in the Holocene and near areas of hunter-gatherer settlement in the Late Glacial, using field observations, cosmogenic exposure dating, and computational glacier modelling.