IQUA Autumn Symposium 2023

1st December 2023

Programme and Abstracts

Society House, 63 Merrion Square, Dublin
The Royal Society of Antiquaries of Ireland

IQUA Autumn Symposium 2023

9:30 Registration opens

10:00 **Welcome address**

Session 1: Humans and marginal landscapes (Chair: Graeme Swindles)

10:20 **Kangkang Li**, X. Qin, G. Plunkett
Environmental aspects of the decline of the ancient Silk Road

10:35 **Jasper Knight**
Episodic lateglacial and Holocene meander migration patterns of the Blue Nile River, South Sudan, and their implications

10:50 **Gill Plunkett**
No Man's Land? Can we identify territorial boundaries through pollen analysis?

11:05 ***Tea/coffee***

11:35 **Keynote: Eugene Costello**
Learning from the past? Adapting land use and shaping habitats in uplands since medieval times

12:15 **Carla Ferreira,** G. Plunkett, L. Fontes
Socio-political contexts as drivers of upland cultural land-use change and impacts on landscape over the last millennium. The Cabreira Mountain, northwest Portugal.

12:30 S. Kelley, **Graeme Warren**, M. Butler, A. Doughty, M. Moucheron, N. Lifton
Life on the margin, early people and glacier environments of the Cairngorm

12:45 ***Lunch***

Session 2: Processes in marginal environments (Chair: Nick Scroxton)

14:00 **Dave O'leary**, J. Connolly, L. Gilet, P. Tuphy, J. Hodgson, E. Daly
Identifying the Transition Zone between Peat and Non-Peat Soils Using Airborne Radiometric Data

14:15 **Peter Glanville**
River Channel and Floodplains as marginal environments in the Irish landscape: The importance of Physical Processes and Nature Based Solutions in the restoration of our rivers biodiversity

14:30 **David A. Hatton**, H.M. Roe, R.T. Patterson, P.R. Leavitt, E.T. McCann, D.R. McMullin, E.G. Reinhardt, N.A. Nasser
Exploring the drivers of toxic lake cyanobacterial bloom events using conventional and novel proxies from sedimentary cores

14:45 **Catherine Dalton**
Blind Loughs: a preliminary cartographic and toponymic examination

15:00 ***Tea/coffee***

Session 3: Ice sheets and their margins (Chair: Adrienne Foreman)

15:30 **Pete D. Akers**, B.G. Kopec, E.S. Klein, J.M. Welker
Water isotopes across a periglacial Greenland landscape: lessons for paleoclimate reconstruction in Ireland and afar

15:45 **Matthew Hunt**, A. Newton, B. Rea, A. Jennings
Holocene Oceanographic Change in Northwest Greenland

16:00 A. Clark, **Sam Roberson**, B. Davies, S. Blockley, A. Palmer, M. Damaschke
New investigations into the deglaciation of northeast Ireland: initial results from high-resolution geomorphological mapping

16:15 **IQUA Prize-giving**

16:20 **Concluding remarks**

Environmental aspects of the decline of the ancient Silk Road

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The ancient Silk Road was of great significance for connections between China and Europe since the second century BCE, facilitating far-reaching, transcontinental exchanges of activities in trade and culture. The UNESCO Silk Roads network is a noteworthy example of current international collaborations on world heritage. Major sections of the Silk Road in northwest China crossed inhospitable areas, including the extremely arid Tarim Basin and the high Inner Asian Mountain Corridor, which are characterised by a complex desert-oasis-alpine-steppe landscape. Since the early 16th century, however, the Silk Road declined substantially, especially the desert routes. Hypotheses regarding the decline of the routeway have tended to take a socioeconomic perspective, considering, for example, the impacts of warfare or the flourishing of the Maritime Silk Road. This paper aims to introduce in brief the ancient Silk Road network and to examine the roles of climatic and environmental factors in its decline.

Episodic lateglacial and Holocene meander migration patterns of the Blue Nile River, South Sudan, and their implications

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The Blue Nile River in South Sudan flows northwards across a broad alluvial floodplain from precipitation sources in the Ethiopian Highlands, joining the White Nile River at Khartoum. Here, fluvial sediments have accumulated within a subsiding tectonic basin through the Quaternary. Previous studies in this region have shown significant variations in rainfall and river discharge of the Blue Nile through the lateglacial and Holocene. Other studies have also mapped overview of present and abandoned river channel systems. However, the relative chronology and dynamics of meander migration, and the implications of shifting meanders for patterns of human occupation, have not been investigated. This study maps in detail the spatial patterns of palaeomeanders and cutoffs along a river reach ~100 km in length in the middle Blue Nile, using remote sensing imagery. The relative timing of abandonment of palaeomeanders and river system dynamics was evaluated based on cross-cutting channel relationships. This also includes reconstructing the directions and rates of meander migration based on patterns of internal scroll bars, and changes in sinuosity. Results show that there is significant spatial and temporal variability in meander patterns, driven by sediment supply and climate. The presence of water is also critical for human activity in this semiarid region: progressive river channel migration influences the development or abandonment of settlements, thus the dated archaeological evidence of floodplain occupation can be used to inform on river system dynamics. This innovative multidisciplinary approach can provide insight into physical and human systems in sensitive semiarid environments during the lateglacial and Holocene.

No Man's Land? Can we identify territorial boundaries through pollen analysis?

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Pollen analysis is a well-established method for reconstructing past human activities, and has played a major role in helping to contextualise aspects of the archaeological record. Alternating phases of woodland clearance and regeneration through prehistory and the medieval period point to changing levels of human impact on the environment, much like changing concentrations of radiocarbon-dated archaeological sites reflect periods of greater or lesser human visibility in the past. While it is tempting to correlate such fluctuations with changing population levels, variations in settlement or subsistence patterns could arguably influence the imprint of past societies in the archaeological and palaeoenvironmental records. For instance, with the emergence of complex societies, shifts to a more nucleated settlement pattern could lead to a less extensive archaeological record and woodland regeneration in areas between competing territories, resulting in a net reduction in the visibility of the society of that time. This paper considers the extent to which pollen records can be used to infer the emergence of centralised settlement and the creation of neutral zones between territories, drawing on examples from Late Prehistoric and Early Medieval Ireland.

Learning from the past? Adapting land use and shaping habitats in uplands since medieval times

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This lecture considers why the study of marginal environments in the past offers lessons for us today, particularly in terms of farming and conservation. In the first place, it outlines some of the landscape knowledge and skill that past upland communities had, including how they may have used certain land-use strategies to adapt to climate change. The paper then discusses habitat change and loss over time in uplands and its relevance to present debates about the management of uplands.

Socio-political contexts as drivers of upland cultural land-use change and impacts on landscape over the last millennium. The Cabreira Mountain, northwest Portugal.

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Mountain landscapes are under threat from climate change, degrading ecosystems and rural exodus, despite a long history of human settlement and exploitation. The present study aims to reconstruct human activity in the Cabreira Mountain, in northwestern Portugal, by investigating the degree to which human interaction with the mountain environment has contributed to shifting landscapes and ecosystem demise throughout the last millennium. This study offers a long-term perspective on the evolution of cultural land-use in the context of ongoing social and economic change through the examination of three paleoenvironmental sequences interpreted in the light of available archaeological, historical, and documentary records. Social-political factors and population pressure were fundamental in the utilisation of upland spaces and in defining the economic structure of the uplands. We conclude that long-term occupation of the uplands was sustained by low-intensity land-use throughout the Medieval to post-Medieval periods, and that the present landscape has assumed a very different character following depopulation of the mountain areas and a shift towards commercial forestry.

Life on the margin, early people and glacier environments of the Cairngorm

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The Late Glacial and early Holocene climate in Brittan was defined by abrupt climate events, such as the Younger Dryas. These variations in climate occurred in tandem dramatic landscape changes driven by the recession of local ice masses. Late Upper Palaeolithic and Mesolithic hunter-gatherers in Northern Britain lived through this period of climatic turmoil, making use of resources available in a rapidly changing environment. Today, upland landscapes continue to be dynamic, with a host of anthropogenic factors, such as reforestation/rewilding, tourism, as well as human-induced climate change driving landscape evolution. Accelerated landscape and environmental change have direct effects on natural and cultural heritage found in upland areas, resulting in poorly understood consequences. This lack of understanding stems from a gap in knowledge regarding the location and extent of heritage in highland areas, specifically that linked to Mesolithic people. The Looking Up project utilizes glacial geology, Quaternary geochronology, and archaeology to generate predictive models of cultural heritage linked to Late Glacial and early Holocene hunter-gatherer use of the Cairngorm region, the highest upland area in Brittan and Ireland. Our models, which assess the potential of cultural heritage across a highland landscape, are driven by new deglacial chronologies and glacier modelling as well as existing archaeologic and geomorphic datasets. The predictive models are intended as a tool for land managers facing decisions centred on the management of highland landscapes. Here, we show the value of interdisciplinary work in seeking solutions regarding the exploration and preservation of cultural heritage in the Cairngorm.

Identifying the Transition Zone between Peat and Non-Peat Soils Using Airborne Radiometric Data

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Peatlands play a vital role in carbon storage and climate regulation. However, human activities have exacerbated the fragility of these ecosystems. All landscapes have a physical margin where change between environmental states takes places. However, these margins are rarely well-defined boundaries. Accurate delineation of peat to mineral soil transition zone is critical for assessing land use and planning effective conservation and carbon loss mitigation strategies. This abstract presents a novel approach for defining the transition zone between peat and mineral soils.

Airborne radiometric data, which measures natural environmental radiation, has been shown to differentiate between peat and mineral soils due to high attenuation of gamma rays in peat. This is a result of the high-water content in peat soils. Additionally, as airborne radiometric data is acquired in a spatially consistent manner, it has the potential to identify areas of transition between these soil types.

An updated machine learning methodology, which allows for the extraction of a confidence value, once data are classified as either peat or mineral soil, is presented. The effectiveness of this classification confidence in identifying transition zones is shown at several field sites across the midlands of Ireland, which are located at verified transition zones i.e., around industrial peat extraction land.

The results provide valuable insight for informed land use decisions and mitigation measures in transition zones. Understanding the location of these peat to mineral soil transitions is paramount when considering the impact on climate change mitigation strategies such as potential impact of rewetting of peat soils.

River Channel and Floodplains as marginal environments in the Irish landscape: The importance of Physical Processes and Nature Based Solutions in the restoration of our rivers biodiversity.

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Rivers, including river channels and floodplains, have been a central aspect of the Irish landscape for human activities in terms of society and economic activity. However, in the past c. 150 years changes in economic activity and the implementation of policy measures have meant that our river channels and floodplains have become a marginal environment in the landscape, somewhat forgotten and 'unloved'.

Government policy measures around our rivers has resulted in the decoupling of river channels from their floodplains to manage the flooding of lands. The control of flooding through intervention measures has resulted in floodplains and associated wetlands becoming a marginal environment.

In order to address biodiversity loss and with the implementation of the new EU Nature Law we need to look carefully at the ecological services that our rivers provide to us as a society. The benefits provided by a functioning river and floodplain system are multi-faceted and include increased biodiversity, climate resilience, flood mitigation and water resilience, all of which provide significant societal benefits.

The Citizens Assembly report on biodiversity loss (March, 2023) made 159 recommendations, 14 of which relate to freshwater environments (rivers and lakes); the government has undertaken a commitment to implement all of the recommendations in the report. Nature Based Solutions offers us a holistic ecosystem-based approach to implementing the report's recommendations and in particular restoring the natural physical processes of our marginalised river channels and floodplains.

Exploring the drivers of toxic lake cyanobacterial bloom events using conventional and novel proxies from sedimentary cores.

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Harmful cyanobacterial blooms (CyanoHABs) in freshwater systems have garnered increased public and scientific interest due to the potentially devastating impacts of their toxic secondary metabolites on biota. This has created significant impetus to elucidate the drivers of CyanoHAB occurrence, and to better understand the resilience of lakes to these toxic bloom events.

Dated sediment cores (^{210}Pb, ^{137}Cs, ^{14}C) from shallow lake sites in New Brunswick, Canada, a maritime region which has seen an increased frequency of lake CyanoHABs in the last decade, have been examined to explore relationships between past toxic bloom events and their controls. Multi-proxy sediment analyses (grain-size, Itrax-XRF; stable isotopes: δ^{13}C; δ^{15}N) were employed to explore the mechanistic links between the drivers of lake change (i.e. climatological stressors and catchment related disturbances) and past episodes of CyanoHAB development. Cyanobacterial responses were investigated using taxonomically specific sedimentary pigments: aphanizophyll (N^2-fixing), echinenone (total cyanobacteria), canthaxanthin (nostocales) and myxoxanthophyll (colonial). Microcystin congeners LA, LR, [Dha^7] LR and RR, cyanobacteria-specific toxic metabolites that preserve in sediments, were quantified using liquid-chromatography tandem mass spectrometry.

Preliminary results show that lake productivity, cyanobacterial pigments and cyanobacteria specific toxins have increased significantly in recent decades across the three lakes studied. Further work is being undertaken to try to elucidate the mechanisms underpinning the drivers of CyanoHAB occurrence in these lakes.

These initial results demonstrate the utility of applying a palaeolimnological approach to reconstructing CyanoHAB events, providing an opportunity to significantly extend the inferences which can be made from water quality monitoring data alone. This may provide invaluable insights into how lakes might respond to future stressors.

Blind Loughs: a preliminary cartographic and toponymic examination

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An interesting feature in the landscape depicted on OS maps are 'Blind Loughs' which are found in many counties throughout Ireland. Extinct and extant blind loughs are evident. This talk will examine these cartographic legacies and consider the toponomy of these remnant landscape features. Their role is especially important in the current context of rewetting landscapes and the imperative to enhance carbon sinks.

Water isotopes across a periglacial Greenland landscape: lessons for paleoclimate reconstruction in Ireland and afar

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Periglacial landscapes in Greenland occupy the marginal transition from the extreme environment of the Greenland ice sheet and the relatively hospitable environment of the oceanic coast. Every summer, the ice-free tundra fringing the ice sheet briefly comes alive as lakes, streams, and the uppermost soil thaw, but rapidly changing Arctic climate is disrupting these surface water systems. To improve our interpretation of stable water isotopes in periglacial environments, we collected 535 surface water samples in 2018–2019 across the Pituffik Peninsula in far northwest Greenland. The $\delta^{18}O$, $\delta^{2}H$, and deuterium-excess values of these samples, representing 196 unique sites, reveal great isotopic diversity at small spatiotemporal scales, and this grants us unprecedented insight into the environmental drivers of the region's hydrology. Isotopic variability of lakes is dominated by evaporation, while stream isotopic composition is determined by relative contributions from the ice sheet, tundra snowpack, and lakes. Summer precipitation has a much weaker influence on surface water isotopic composition than typically assumed, and regional climate reconstructions based on that assumption likely require re-evaluation. For Irish paleoclimate reconstructions using water stable isotopes, this study reminds us of the importance of local isotopic monitoring and the risks of assuming that isotope-climate relationships determined for one water body are representative of all water bodies in the region. This is particularly true for Irish lake isotopic records from the late Pleistocene and early Holocene, when the deglaciating Irish landscape bore many similarities to the modern Greenland periglacial environment that we report on here.

Holocene Oceanographic Change in Northwest Greenland

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A full understanding of past Greenland Ice Sheet (GrIS) dynamics in response to climate change is key to modelling and projecting future oceanographic and climatic scenarios. Outside of the Disko Bugt region of West Greenland there is a less well developed understanding of the timing and dynamics of the most recent deglaciation following the Last Glacial Maximum (LGM). For example, the seafloor of the Melville Bugt Trough (MBT) to the northwest of Disko Bugt has only recently been mapped and shows that ice reached the shelf edge at the LGM, making it ~80 km more advanced than previously thought (Newton et al., 2017). If the MBT was fully-occupied by an ice stream at the LGM, as suggested by seafloor landforms, it would have drained an area of the GrIS at least three times larger than Jakobshavn Isbræ, highlighting the need for a better understanding of its post-LGM evolution. The narrowest portion of MBT hosts a large grounding-zone wedge which has been tentatively correlated with an ice-stream stillstand during the Younger Dryas. Sedimentological evidence from shallow sediment cores collected on the grounding-zone wedge surface provide information about the ice stream's subsequent retreat and prevailing palaeoceanographic conditions during the Holocene.

New investigations into the deglaciation of northeast Ireland: initial results from high-resolution geomorphological mapping

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Rapid shutdown of the Irish Sea and Malin Sea Ice Streams *c.* 23-17 ka BP led to the decay of ice centres in northeast Ireland, punctuated by brief readvances in cold climate periods, eventually culminating in the separation of Irish and British Ice Sheets. This region therefore provides an excellent opportunity to study the interplay of internal ice dynamics and rapid climate change during deglaciation at the centre of the last British-Irish Ice Sheet.

However, our understanding of the retreat of a Lough Neagh ice centre, the unzipping of the British and Irish Ice Sheets, and the readvance of Scottish ice in northeast Ireland is founded on low-resolution geomorphological maps and very little chronological information. Our project aims to remedy this using high-resolution geomorphological maps to better understand ice sheet dynamics, combined with a novel multiproxy chronological approach to robustly anchor key ice flow phases for the first time.

Here we present initial results and interpretations derived from the mapping of >11,000 glacial landforms in northeast Ireland using a 40 cm resolution digital surface model. We argue that the demise of a Lough Neagh ice centre was potentially characterised by a transition from ice streaming conditions to a rapid time-transgressive style of retreat influenced by bed topography. Other bedforms and deglacial features reveal additional complexity in the nature of ice sheet readvance onto the Antrim coast. Cosmogenic nuclide ages and a laminated palaeolake sequence are being sought for the first time to constrain the timing of these significant events.

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