Past Environments for Emerging Worlds

The 44th Conference of the Association for Envrionmental Archaeology

Oxford, 12-14th December 2024

Conference Booklet

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Welcome

Welcome to Oxford and the 44th conference of the Association for Environmental Archaeology, which this year is jointly hosted by the School of Archaeology and Department for Continuing Education (University of Oxford) and Oxford Archaeology, one of the leading archaeological practices in the UK.

The theme of this conference is 'Past Environments for Emerging Worlds', which asks What does the world want from environmental archaeology? How should environmental archaeology approach global concerns? and What role does it have to play in contemporary challenges at a range of scales?

Environmental archaeology in academic and professional realms is at a crossroads. In an age of ecological crisis, long term views have never been more important, and are relevant well beyond the discipline of Archaeology.

Environmental archaeology generates new primary data on the distributions, communities and ecologies of plant and animal species (including their microbiomes) that have co-evolved with humans for thousands of years. In interpreting these data, it is possible to reveal alternative ways of living with nature and to identify novel (now extinct) ecological relationships of relevance to ongoing nature recovery practices.

From providing perspectives on global biodiversity loss over thousands of years, to informing emerging habitat creation strategies here in Oxfordshire, environmental archaeologists are in a powerful position to engage in discourse surrounding global challenges well beyond archaeology.

There are a wide range of engaging papers, lightening talks and poster presentations programmed over the three days of the conference, with many opportunities to critically engage with the above and other issues in environmental archaeology, as well as just catch up with colleagues/friends, and to make new ones!

From all of us on the Organising Committee, we hope you have a fantastic conference, and thank you sincerely for choosing to participate, either here in person or via our online facilities.

Organising Committee

Oxford Archaeology

Anwen Cooper, David Kay, Kay Hamilton, Rebecca Nicholson, Richard Palmer and Tina Roushannafas

University of Oxford

Andrés Teira-Brión, Amy Bogaard, Amy Styring, Charlotte Diffey, Doris Vidas, Elizabeth Stroud, Jade Whitlam, Katherine Hearne, Müge Ergun, Shyama Vermeersch, Tom Maltas and Valasia Isaakidou

Volunteer assistants

Ali Siegenthaler, Leah Tavasi, Yan Teng, Huhongyan (Yan) Tian, Marguerite Waechter and Angela Zhang

Host Institutions

Oxford Archaeology Ltd.

Founded in 1973 Oxford Archaeology is one of the largest and longest established commercial heritage service providers in the UK. With offices in Cambridge, Lancaster and Oxford, we have been involved in projects both large and small across the UK and abroad. Each of our offices has dedicated facilities for the processing and analysis of a comprehensive range of materials, from faunal and floral remains to pollen and sediments. Our dedicated and enthusiastic team of specialists work across our projects from small evaluations to large scale excavations whilst contributing to a range of publication needs, from client reports to journals and monographs. Oxford Archaeology has a strong research ethos, and a long history of collaboration with the School of Archaeology and the Department of Continuing Education, including current work on the UKRI-funded 'Rewilding later prehistory' project.

Department of Continuing Education, University of Oxford

The University of Oxford Department for Continuing Education provides opportunities for people from a wide variety of backgrounds to benefit from the University's rich and unique resources, offering learners access to a range of part-time courses. The department's beginnings can be traced back to the 19th century, when Oxford was one of the founders of the 'extension' movement, where universities began to offer educational opportunities to adult learners. Rewley House was acquired by the University in 1927 to be the physical base of continuing education and after two intervening name changes the department became the University of Oxford Department for Continuing Education in 1990. Today the department has over 15,000 part-time students from more than 160 countries.

School of Archaeology, University of Oxford

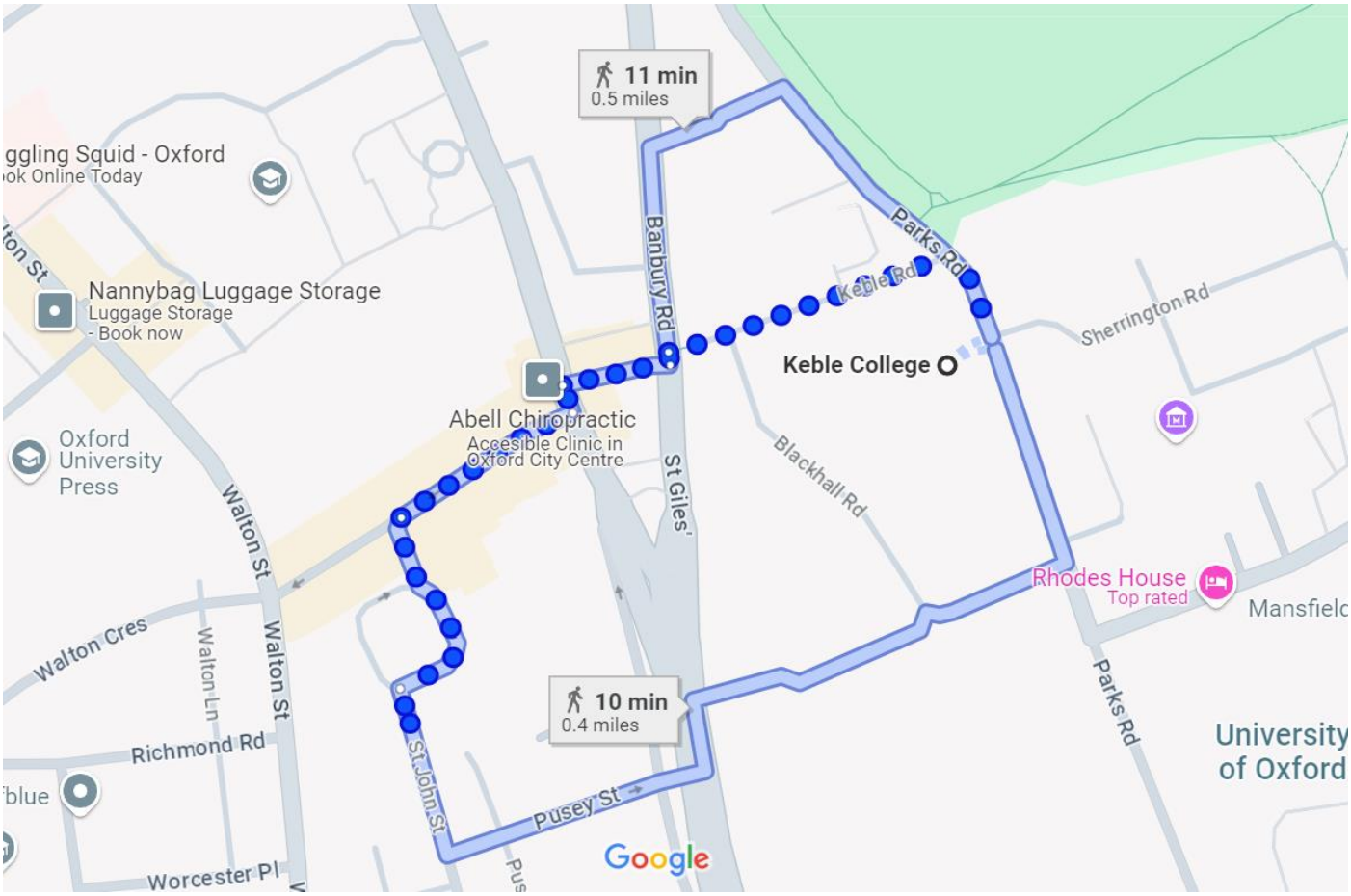
Established in 2000, the School of Archaeology was the successor to the Committee of Archaeology. Based in three locations in central Oxford, staff and students have access to libraries, museums, laboratories and other facilities across the University. Working across the inhabited world, the School uses the full range of theories, methods and techniques available to archaeologists to study the full scope of human history and the environmental settings in which it has existed. The Institute of Archaeology, established in 1962, is the main base for students studying postgraduate degrees in Archaeology and is located adjacent to the Ashmolean Museum.

Venues

The conference is being held at Oxford University's Keble College. Founded in memory of John Keble and opening in 1870 it was the first Oxford College of the modern era. Conference proceedings will be held in the O'Riley Theatre within the Sloane Robinson Building. Internal directions will be available from the main entrance at the Porters' Lodge on Parks Road. The conference itself is also partly financially supported by the Keble College Research Grants Scheme.

A drinks reception will be held on the evening of Thursday 12th December at the Oxford University Museum of Natural History on Parks Road. It is a two-minute walk from Keble College, leaving the front of the College and turning right on Parks Road. The Museum is then on your left-hand side (signposted but partly concealed behind current building works).

The conference dinner (for pre-registered attendees only) will then be held on the evening of Friday 13th December at the University of Oxford's Department of Continuing Education at Rewley House. It is an eight-minute walk from Keble College, leaving the front of the College and turning left on Parks Road, then left again onto Keble Road. Coming to the next road (St Giles'), cross straight over and use the footpath past the church, and again cross the next road (Woodstock Road) before continuing onto Little Clarendon Street. Wellington Square can be accessed on the left-hand side about halfway down Little Clarendon Street, and Rewley House is situated across the Square on the corner with St John Street.



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City Sightseeing Oxford

Embark on an unforgettable adventure with City Sightseeing Oxford's award-winning, fully electric open-top bus tour. Explore Oxford's rich history where ancient and modern worlds coexist. This one-hour tour takes you past iconic sites like Oxford Castle, Christ Church, and the Ashmolean Museum. With 20 stops, you can hop on and off as you please. Enjoy commentary in 14 languages and let kids join Mia Cloo in an interactive Oxford Quest. City Sightseeing Oxford also offers a fantastic range of walking tours and combo tickets with discounts on top attractions. And don't miss climbing Carfax Tower for some breathtaking city views! See the following page for a 20% off voucher, and find out more at:
https://www.citysightseeingoxford.com/

Timetable

Thursday 12th December

10:00 Registration opens

12:30 Welcome

Session 1. Data

Chairs: Elizabeth Stroud and Rebecca Nicholson

12:50 Michelle Farrell and Mette Løvschal
Establishment, expansion and persistence of the north-west European heathlands: implications for present-day conservation management

13:05 Phil Stastney, Rachel Ballantyne, Matt Brudenell and Josh Harry
Fenscapes: data-driven visualisations of (re-)emergent landscapes and ecologies in the Fens

13:20 Tina Roushannafas
*Where *are* the wild things? Situating humans in nature in Later Prehistoric Britain*

13:35 Emma Karoune
Community Building for Increasing Open Data Skills in Environmental Archaeology

13:50 Mark McKerracher
Black Mirror? Reflections in the Palaeoenvironmental Metaverse(s)

13:55 Michael Wallace
Frontiers of environmental archaeology data: a love story

14:00 Marcin Sokołowski
The Three Sisters as an Example of a Potential "New" Paradigm for Cereal Cultivation

14:05 Discussion

14:20 Coffee

Session 2. Soil

Chairs: Tom Maltas and Jade Whitlam

14:55 Qing Wang, Xiaoyan Yang, Yu Gao, Shargan Wangdue, Jingkun Ran, Songtao Chen, Jishuai Yang, Zhengquan Gu, Ying Zhang, Shungang Chen, Yan Tong, Nihanxue Jia, Qingli Sun, Yunzhe Huang, Linda Perry, Jade d'Alpoim Guedes, Xu Han, Feng Liu, Qi Yang, Yunming Wang, Shihua Hu, Yaofei Tian, Jianglong Guo, Xinwei Liang, Ting You, Yazhong Li, Yunan Zhan, Zhenhua Deng, Ling Qin, Yijie Zhuang and Fahu Chen

Lake-centred sedentary lifestyle of early plateau indigenous populations at extremely high elevation 4400 years ago

15:10 David Kay and Eduardo Machicado
The Land Below: Are we making the most of the UK's buried soils?

15:25 Meike van Lit
Long-term impacts of human activity on compaction, acidity and organic content

15:40 Zhen Qin
Rethinking the Anthropocene: insights from archaeological research in Central Plains of China

15:55 Kathryn Przywolnik
Cultural landscape and natural culturescape: arid area environmental archaeology

16:10 Discussion

16:25 Break

Keynote

16:40 Chris Baines
What does the world want from environmental archaeology?

18:00 Wine Reception at the Pitt Rivers Museum

Friday 13th December

Session 3. Sustainability and biodiversity
Chairs: Doris Vidas and Charlotte Diffey

9:00 Daniel Fuks
Can archaeobotany promote present-day agricultural biodiversity?

9:15 Charlie Davies, Joy Singarayer, Oliver Wilson, Rafael Corteletti, José Iriarte and Francis Mayle
Impacts of Holocene land use and climate change upon Brazil's iconic Araucaria Forests

9:30 Katie Campbell, Maia Chichinadze, Serik Akylbek, Ali Alimbekuly, Shynaz Almazuly, Davit Naskidashvili and Karl Smith
Environmental Management at the 'Silk Road' City of Otrar, Kazakhstan

9:45 Rosie Bishop, Kenny Brophy, Ingrid Mainland, Astrid Nyland et al.
Climate, crops and crisis? Examining agricultural adaptation and resilience to climate change in prehistory

10:00 Jishuai Yang and Xiaoyan Yang
Intensive millet-livestock systems supported the development of complex societies in prehistoric North China

10:15 Discussion

10:30 Coffee

Session 4. Wildlife

Chairs: Rebecca Nicholson and Müge Ergun

11:00 Jack Sudds
Deer and Deer Alike: The Story of Britain's Iconic Species

11:15 Hannah Britton
Modern Proto-Domestic Phenomena: Analysing the Possible Domestication of British Falconry Birds Through an Archaeological Framework

11:30 Samuel Walker, Hanneke Meijer and Ellen Hambleton
People & Puffins: Investigating how environmental change and exploitation by past communities has impacted current auk populations

11:45 Carly Ameen
Recalling the Wild: Perspectives on medieval animal management and feralisation

12:00 Rebecca Rickard, Phillippa Gillingham, Richard Stillman, Chris Stevens, John Stewart
The Palaeoecological Links between Climate Change, Vegetation change and British Farmland Birds in the Archaeological Record

12:15 Discussion

12:30 Lunch and AEA AGM

Session 4. Wildlife (continued)

Chairs: Alice Dobinson and Shyama Vermeersch

13:45 Amy Holguin, Rachel Ballantyne, Mike Charles, Müge Ergun, Eugenia Gkatzogia and Amy Bogaard
'Rewilding the Neolithic of south-eastern Europe': On wild plant foods

14:00 Jacqui Mulville, Julia Cussans, Ingrid Mainland, Ash Noble and David Stanton
Wild things: Red deer on the Scottish Isles

14:15 Jessica Peto, Lachie Scarsbrook, Naomi Sykes, Greger Larson, Carly Ameen, Richard Madgwick, Alistair Barclay, Angela Lamb, Andrew Kitchener and Ben Donnelly-Symes
The Zooarchaeological History of Wolves in the British Isles: From the Iron Age (750 BCE) to the Late Modern Period (1900 CE)

14:30 Emma Katrin Onshuus, Samuel J. Walker, Lea Frank, Trond Lødøen and Sanne Boessenkool
Tracking Holocene ecosystem dynamics from a paleo-archive preserved in a cave in high latitudinal Fennoscandia

Session 5. Farming

Chairs: Alice Dobinson and Shyama Vermeersch

14:35 Ophélie Lebrasseur, Jaime Gongora, Laurent Frantz, Pablo M. Fernández, Greger Larson and Ludovic Orlando
Why did the chicken cross the oceans? A zooarchaeological and palaeogenomics approach to Neotropical American chickens

14:40 Evi Margaritis and Kyriaki Tsirtsi
Neopalatial Mochlos: A Study of Domestic and Ritual Interactions

14:45 Julia E. M. Cussans, Ingrid Mainland, Nick Card, Anne Mitchell and Mark Edmonds
Counting Cattle at the Ness of Brodgar, Orkney: Animal bone assessment update

14:50 Hannah Caroe
People, Look East! Archaeobotanical evidence for the transmission of farming eastwards from the Fertile Crescent into Asia

14:55 Discussion

15:10 Coffee

Session 5. Farming (continued)

Chairs: Charlotte Diffey and Tom Maltas

15:40 Sesilia Niehaus
Fossil insects, Neolithic agriculture and environmental change: new evidence from Lin, Albania

15:55 Catherine Longford, Ruth Pelling, Michael Wallace, Emily Forster
Beyond the Silos: Characterising agricultural mosaics across prehistoric England

16:10 Imran Shabir
Neolithic Agricultural Practices and Cultural Insights from Mehrgarh, Balochistan

16:25 Alice Williams, Shadreck Chirikure, Amy Bogaard and Mike Charles
Farming beyond the walls: exploring archaeobotanical remains from Iron Age Great Zimbabwe

16:30 Kyriaki Tsirtsi, Simos Gkinoudis and Evi Margaritis
Harvesting the Periphery: Food and Agriculture in Bronze Age Koumasa

16:35 Sopio Paatashvili, Nelson Almeida, Cristina Barrocas Dias, Anne-France Maurer, Antonio Valera and Vanessa Navarrete
Analyzing Pig Management and Diets in Late Neolithic-Chalcolithic period through Isotopic Analysis at Porto Torrão, Portugal

16:40 Discussion

16:55 Break

Keynote

17:10 Meriel McClatchie
What does environmental archaeology want from the world?

19:00 Conference Dinner at Rewley House, Dept. for Continuing Education

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Saturday 14th December

Panel Discussion

9:00 Sophie Yeo, Ralph Fyfe, Sean Doherty and Martin Lines

10:15 Coffee

Session 6. Landscapes

Chairs: Jade Whitlam and Elizabeth Stroud

10:45 Elisa Paperini, Claudia Sciuto and Gabriele Gattiglia
Ancient pollen, modern algorithms: reconstructing palaeoenvironments in evolving landscapes

11:00 Nicki Whitehouse, Adrian Bass, Jane M. Bunting and Henry Chapman
Using archaeological and palaeoecological data to inform land-use change

11:15 Valentina Pescini, Lorenzo Braga, Roberta Cevasco, Natalia Égüez, Assunta Florenzano, Ilde Menozzi Bruna, Anna Maria Mercuri, Diego Moreno, Eleonora Rattighieri, Ivano Rellini and Vittorio Tigrino
Pastureland of Mount Mongioie: the contribution of environmental archaeology between research and application

11:30 Jonathan Fowler
Remodelling Arcadia: Quantifying French Colonial Agricultural Landscapes in Atlantic Canada

11:45 Claudia Sciuto, Radoslaw Grabowski, Francesca Anichini, Salvatore Basile, Gabriele Gattiglia
Exploring Charcoal Landscapes in the Apuan Alps, Tuscany, Italy

12:00 Ernst Johnson, Carl Regnéll and Anna Linderholm
Using sedimentary ancient DNA to reveal postglacial recolonization patterns in northern Sweden

12:05 Ekaterina Ershova, Pille Tomson and Elena Ponomarenko
Traces of fossorial bees in the soil as an indicator of land use history

12:10 Discussion

12:25 Lunch

Session 7. Perspectives beyond archaeology
Chairs: Shyama Vermeersch and Andrés Teira Brión

13:50 Nafsika C. Andriopoulou, Kleanthis Simyrdanis, Maria Kypriotaki and Nikos Papadopoulos
Enhancing Archaeological Science Communication: A Comic for Engaging Children with Coastal and Submerged Landscapes

13:55 Dylan Gaffney, Agustin Capriati, Ben Utting, Annette Oertle, Daud Tanudirjo, Marlin Tolla, Abdul Razak Macap, Anna Florin, Christoph Parsch, Marlina Flassy, Enrico Yori and Sofwan Noerwidi
The deep human histories and possible futures of ecological management in tropical forests

14:10 Philip Barratt, Hannah O'Regan and Kristina Krawiec
The nature of environmental archaeology: promoting the past in nature-based projects

14:25 Anwen Cooper
Prehistoric understandings of wildlife and their relevance for current nature recovery

14:40 Discussion

14:55 Coffee

Session 6. Perspectives beyond archaeology (continued)
Chairs: Shyama Vermeersch and Andrés Teira Brión

15:25 Valasia Isaakidou and Paul Halstead
Beavers, bears and biodiversity: bioarchaeology, ethnography and community engagement at Lake Orestiada, NW Greece

15:40 Kerstin Kowarik, Valentina Laaha, Hans Reschreiter and Kerstin Hofmann
From Bronze Age pastures to present challenges

15:55 Denisa-Stefania Luca
Exploring Agricultural Heritage Landscapes in the Balkans: Insights from the Danube Delta and the Valley of Roses

16:10 David Jennings
The Living River Project: Attenborough Great Park, Nottinghamshire

16:25 Discussion

16:40 Concluding remarks

17:00 Close

List of Abstracts

Session 1. Data

Full papers:

Establishment, expansion and persistence of the north-west European heathlands: implications for present-day conservation management

Michelle Farrell and Mette Løvschal

Keywords: heathlands, management, conservation, north-west Europe, farming

Heathlands are a priority habitat for conservation, being categorised as 'vulnerable' on the European Red List of Habitats. Initial widespread expansion of heathland in north-west Europe around 5000 years ago is often argued to have been a response to human activity, and palaeoecological evidence indicates that livestock grazing and burning were instrumental in maintaining heaths over the millennia that followed. The main threat to heathlands currently is thought to be a lack of appropriate management. The ERC-funded Anthropogenic Heathlands (ANTHEA) project aims to understand the forms of social organisation that were required to sustain heathlands over several millennia by bringing together landscape archaeology, social anthropology and palaeoenvironmental modelling to develop a new cultural history of these ecosystems. Here we present preliminary pollen-based land-cover models that reconstruct the establishment, expansion and persistence of heathlands in western Jutland, Denmark from 4000 BC onwards. The reconstructions are compared with evidence for management by grazing, burning and turf removal, and with archaeological evidence for social organisation, to understand how and why heathlands were maintained for so long. Analysis of archaeobotanical data from the region is also providing insights into the diversity and sustainability of heathland farming systems in the past. Understanding the processes by which heathlands have been maintained over millennia is crucial for informing their effective future management and conservation. Recent arguments that re-establishing heathlands as 'commons' could enable a better balance to be struck between the needs of agriculture and nature conservation are evaluated in light of our findings.

Fenscapes: data-driven visualisations of (re-)emergent landscapes and ecologies in the Fens

Phil Stastney, Rachel Ballantyne, Matt Brudenell and Josh Harry

Keywords: landscape modelling, data, synthesis, Fens

Popularly associated with uniformity, flatness and extensive arable farming, the Fens of Eastern England are facing substantial near-future change. Through ongoing drainage and peat wasting, buried topographies re-emerge, simultaneously revealing and decaying rich sedimentary archives of past ecologies and diverse human lifeways. This environmental instability makes urgent the need to set the challenges of the present, and the possibilities of the future, into long-term context through environmental archaeology. Key questions include: How "complete" is our picture of the human palaeoecology of the Fens? How "unique" are the spectacular assemblages of sites such as Must Farm and the Flag Fen basin, and the lifeways they reflect? How can data-driven archaeological approaches inform the mitigation and management of future landscapes? Using innovative synthesis of regional-scale geoarchaeological modelling, archaeobotanical and zooarchaeological assemblages, and historic environment record data,

we present visualisations of these complimentary multi-dimensional datasets. We further explore how environmental archaeological data are both a proxy of past ecology and economy and a reflection of the patterns and practice of archaeological investigations to date. By examining regional spatial and chronological trends, we tentatively reveal the diversity of re-emerging past landscapes from the Neolithic to post-medieval periods, and propose new directions and opportunities for research to support future management and restoration initiatives in the Fens.

*Where *are* the wild things? Situating humans in nature in Later Prehistoric Britain*

Tina Roushannafas

Keywords: data synthesis, archaeobotany, zooarchaeology, prehistory, wildlife

The ''Rewilding' Later Prehistory' project focuses on wildlife (and human understandings of it) in Bronze and Iron Age Britain, seeking to counterpoint traditional narratives which focus chiefly on the progression of farming and increasingly bounded and permanent settlement. Such overwhelmingly 'human-centred' approaches are at odds with current environmental discourse, which increasingly challenges the notion that human domination of, and division from, the rest of the natural world is synonymous with progress. Alongside targeted isotopic, charcoal, archaeogenetic and palynological studies which explore archaeological readings of 'the wild', the project has assembled over 70,000 zooarchaeological and archaeobotanical records from diverse case study areas. These records represent the dead, the butchered, the burnt and the buried, among which wild species are a diminishing component. Previous interpretations of such patterns of decline have proposed that the exploitation of wild species became 'taboo' in Iron Age Britain, affirming tendencies to link social development with human control over, and avoidance of, nature. This talk explores how, by critically evaluating how we define 'wildness' in the archaeological record, and by making use of 'big' data, we can begin reframing questions about human-wildlife relationships beyond simple quantitative comparisons. We consider the potential of statistical and functional-based approaches for identifying 'wild' resources and highlighting the capability of nature to regenerate—and indeed flourish—within, and along, the margins of anthropogenic exploitation. It is clear that, even as dependency on agriculture intensified in later prehistory, wildlife continued to significantly shape human lifeways.

Community Building for Increasing Open Data Skills in Environmental Archaeology

Emma Karoune

Keywords: open data, open research, community building, data science

Open data skills, and more broadly open research practices, are gradually permeating through sub-disciplines of Environmental Archaeology but many archaeologists still lack the skills to implement these best practices. This is affecting the speed of transition to open practices leaving Environmental Archaeology behind other disciplines and therefore hindering greater impact such as reuse of data and the adoption of new technologies such as AI. So how can we support this transition to greater use of open data and open research practices in environmental archaeology? Community Building is one way to do this and can be used to upskill and support the adoption of new open research skills such as FAIR data management and stewardship, and reproducible workflows. Training courses are often not sufficient to help researchers implement best practices as they need greater peer-support and mentoring to put what they have learnt into practice. This talk will highlight several initiatives within archaeology and beyond that have started to do this community work such as the FAIR Phytoliths Project—a project that aimed to raise awareness and knowledge of the FAIR data principles in phytolith research, Open Phytoliths Community—this community has been offering training and advise in open research practices, The Turing Way—an open source,

collaborative project that is building a guide to reproducible, ethical and collaborative data science, and also the recently funded People in Data project, which aims to convene existing data professional communities to share knowledge, tackle challenges and build capacity across domains and sectors.

Lightening talks:

Black Mirror? Reflections in the Palaeoenvironmental Metaverse(s)

Mark McKerracher

Keywords: digital archaeology, open data, metaverse

In the age before digital scholarship, data lived on paper and historical reconstructions were founded in the imagination. The fabric of the shared archaeological world was woven in literature, meaningful only with the application of the human mind. Digital scholarship—especially with the advent of open access, semantic web technologies, and intrinsically digital datasets and methods—is transforming this paradigm. These developments are not only facilitating data sharing, re-use and preservation, they are also perforce creating a machine-readable simulacrum, of both physical archaeology and past environments, that lives accessibly but intangibly online. Once archaeological entities enter the digital realm with a unique identifier—be it an OASIS ID for an archaeological intervention, for example, or a DOI for photographed charred grains in the FeedSax dataset—they effectively become part of a "metaverse": a version of the past being steadily modelled in cyberspace. More than this, given that such data are not objective but open to interpretation (e.g. the species data assigned to an animal bone, the ecological implications of particular flora), and given the reality of repeated research into the same physical materials, it could be argued that we are in fact creating a "meta-multiverse". That is to say, the digital palaeoenvironmentalist is no longer just reconstructing an imaginative past, but must work in a virtual space surrounded by uncountable alternative machine-readable pasts. This paper therefore asks: which environments are we now studying—the natural environments of the past, or the digital simulacra of the present?

Frontiers of environmental archaeology data: a love story

Michael Wallace

Keywords: open data, databases, collaboration, commercial archaeology

This presentation will outline recent work in developing a new approach to the creation, storage and dissemination of environmental archaeology data. The importance of bringing together disparate environmental archaeology datasets is a frequently discussed topic. Achieving enables the discipline to make more regular and more profound insights that extend beyond the local and supra-local scales. Significant progress has been made towards the ambitious goal of uniting varied sources of data, but the full realisation of this dream remains some way off. This presentation will showcase the early stages of a practical and pragmatic solution. Like any good love story, this endeavour begins with distinct and seemingly incompatible protagonists, tensions and misunderstandings that threaten their relationship, and a journey of compromise and development. And, of course, we will eventually reach the climactic and mutually beneficial resolution. The outcome we envision is based on three carefully considered tenets: interoperability, usability and accessibility. The intention is that this solution empowers researchers to make the most of well-structured data without compromising the versatility needed for creative and novel interpretations.

The Three Sisters as an Example of a Potential "New" Paradigm for Cereal Cultivation

Marcin Sokołowski

Keywords: pollen, rewilding, anthropogenic, palaeoenvironmental, woodland

Ecosystems are entwined in the activities of multiple species including humans. And yet, this human presence is often thought of in negative terms, particularly in relation to our interactions with forested environments. However, palaeoenvironmental analysis has identified multiple cases of controlled burning and selective deforestation undertaken by humans during the early Holocene, which encouraged species diversity within forests. This not only shows the positive effects that humans can have on plant community composition but has the potential to inform contemporary rewilding and woodland conservation efforts. This poster presents the initial results of my doctoral research, which seeks to use early Holocene pollen records to inform contemporary woodland conservation and rewilding strategies. For this study, I have compiled a database of all palynological records from England that include episodes of early Holocene woodland disturbance. By analysing this data, it is possible to detect signatures of woodland disturbances through the pollen record and how this relates to anthropogenic relationships with the landscape in a time of 'low' environmental, pre-agricultural impact.

Session 2. Soil

Full papers:

Lake-centred sedentary lifestyle of early plateau indigenous populations at extremely high elevation 4400 years ago

Qing Wang, Xiaoyan Yang, Yu Gao, Shargan Wangdue, Jingkun Ran, Songtao Chen, Jishuai Yang, Zhengquan Gu, Ying Zhang, Shungang Chen, Yan Tong, Nihanxue Jia, Qingli Sun, Yunzhe Huang, Linda Perry, Jade d'Alpoim Guedes, Xu Han, Feng Liu, Qi Yang, Yunming Wang, Shihua Hu, Yaofei Tian, Jianglong Guo, Xinwei Liang, Ting You, Yazhong Li, Yunan Zhan, Zhenhua Deng, Ling Qin, Yijie Zhuang and Fahu Chen

Keywords: Tibetan Plateau, sedentism, zooarchaeology, ancient DNA, seasonality

The onset of sedentism on the Tibetan Plateau is often presumed to be associated with the dispersal of agriculture and/or farmers from archaeological sites located in the low elevation margins of the Plateau. Previous studies of the plateau assumed that all foragers were likely mobile, but few systematic excavations at forager sites have been conducted to inform us about their settlement patterns. Here we report the world's highest elevation sedentary site of Mabu Co at 4446 masl, deep in the interior of the Tibetan Plateau 4400-4000 years ago. Our inter-disciplinary study indicates that the site was occupied by indigenous inhabitants of the plateau who employed a sedentary lifestyle primarily supported by fishing at nearby lakes, supplemented by bird and mammal hunting.

The Land Below: Are we making the most of the UK's buried soils?

David Kay and Eduardo Machicado

Keywords: soils, landscape, methodology, interpretation, collaboration

Buried soil horizons, or 'palaeosols', comprise an enormously valuable archive of palaeoenvironmental data related not only to past environmental conditions in general, but also the specificities of past

communities' land management practices, and even episodes of large-scale anthropogenic landscape transformation. However, they are also often perceived as being either relatively uncommon, at least in the course of much developer-funded archaeology, or of secondary importance when designing site-wide sampling strategies and post-excavation analysis programmes. This paper summarises the current state of play when it comes to the identification and analysis of these valuable deposits within UK commercial archaeology and suggests that they are a far more common (and thus eminently exploitable) resource than is generally perceived. Concurrently, it will argue that greater advocacy is needed to ensure that these deposits are reliably recognised by non-specialist archaeological fieldworkers, and better integrated within existing evaluation and excavation methodologies. Finally, it will suggest that a more robust guidance framework could be developed by both geoarchaeologists and other environmental specialists to maximise the interpretive potential of buried soils across the UK, particularly where they occur alongside more conventional archaeological deposits. As such, this paper is very much intended as a call to active collaboration and knowledge-sharing across the community, and hopefully as a jumping off point for more cohesive strategizing in the future.

Long-term impacts of human activity on compaction, acidity and organic content

Meike van Lit

Keywords: soil health, soil compaction, soil pH, soil organic matter, long-term impact

Healthy soils are vital to ecosystems, climate change, and food security, and many steps are undertaken to improve soil health worldwide. However, one aspect that is relatively lacking from the soil health discussion is the long-term impact of human activities. To understand this impact, modern soil health is measured via a suite of different methods, and past land-use is determined through historical maps, archaeology, and satellite imagery survey. This research hypothesises that many "short-term" effects on soil health are actually long-term effects due to feedback loops. Previous studies have shown that soil compaction recovery is delayed after livestock trampling on heavily grazed land, so this research likewise expects pH, soil organic matter and carbon-nitrogen ratio to have a long-term impact after intensive land-use due to positive feedback loops. In July 2024, 25 soil samples were collected at the Finzean Estate in Aberdeenshire to measure soil health, based on a diversity of soil types and past land-uses. The estate managers of the Finzean Estate use different land management systems to maximise biodiversity and productivity of the estate. This, in addition to archaeological evidence from prehistory through to the modern period, provides an interesting case study for the impact of human activity on soil health. Of the planned measurements, the pH, bulk density, soil organic matter and carbon-nitrogen ratio of the samples are undertaken. This presentation discusses what the preliminary results tell us about the long-term effects of human impact on soil health.

Rethinking the Anthropocene: insights from archaeological research in Central Plains of China

Zhen Qin

Keywords: Anthropocene, agricultural intensification, urbanization, landscape modification, Central Plains of China

The proposal of the "Anthropocene" as a new geological epoch, driven by the increasing impact of human activities on Earth's systems, has received significant attention in academic and public discussions. However, the academic community remains divided on its onset and defining markers. The Anthropocene Working Group, primarily composed of geologists, tends to define the mid-20th century as the beginning

of the Anthropocene, marked by the significant increase in radioactive elements in sediments. Yet, from an archaeological perspective, this timing and marker may underestimate the early human impact on Earth's environment and fail to capture the full extent and duration of human influence. This paper advocates for integrating archaeological perspectives into the Anthropocene debate. Through extensive archaeological research in Central Plains of China, it is shown that around 3000 BP, intensified agriculture and urbanization began to significantly alter the physical, chemical, and biological properties of the region's soil and sediments. This transformation peaked around 2000 BP, leading to the formation of widespread anthropogenic soils and landscapes. Similar developments are observed globally during this period in regions like the Near East, Europe, and Central America. Thus, this paper argues that the period from 3000 BP to 2000 BP should be considered as an early phase of the Anthropocene.

Cultural landscape and natural culturescape: arid area environmental archaeology

Kathryn Przywolnik

Keywords: arid landscape; palaeoenvironment; geoarchaeology; ethnobiology

The Australian arid interior is often portrayed as harsh and inhospitable, yet there is a rich and complex traditional material culture and archaeology that in recent years has seen an exponential growth in research attention. For most of the last thirty to forty years, archaeological research in the rugged Pilbara uplands in northwestern Australia has been driven by the mining industry's regulatory interests, with a narrowly focussed, compliance-oriented lens. In recent years, the focus has recalibrated significantly and now archaeologists engage, and are engaged by, Aboriginal Traditional Owners to investigate their cultural interests and research questions. The central Hamersley Range landscape is semi-arid, hot and dry with occasional monsoon rain, and largely acidic soils. Combined with an ancient late Pleistocene temporal context for many archaeological sites, these are far from optimal conditions for preservation. And yet through an emerging exploration of environmental archaeological techniques, our understanding of the relationship between Aboriginal people and their environment through time is expanding rapidly. Archaeological work has shifted from a heavy reliance on presence and absence of stone artefacts, to investigative approaches shaped by the research interests of Traditional Owners. This paper the examines the data, analyses and approaches that are opening up arid landscape archaeology, bringing new insight, new challenges and new opportunities to examine old questions in new ways.

Session 3. Sustainability and biodiversity

Full papers:

Can archaeobotany promote present-day agricultural biodiversity?

Daniel Fuks

Keywords: agrobiodiversity, archaeobotany, crop history, orphan crops

Biodiversity loss is a global challenge, directly associated with agricultural expansion of a small number of commodity crops. A recent review by myself and others indicated that selective biases in modern agriculture may replicate themselves in environmental archaeology, specifically in geometric morphometric and ancient DNA analyses of archaeobotanical remains. After exploring this evidence, the present paper will draw on case studies from the Middle East and Mediterranean to ask whether the direction of influence can go the other way. That is, can research on ancient agriculture contribute to

present-day biodiversity conservation efforts? Indeed, archaeobotany and related disciplines are uniquely poised to offer a deep historical perspective on how some crops became marginalized while others colonized the globe, and to examine the chronological depth of local growing conditions, agricultural traditions and sustainability. Such data on ancient crops, their past geographic distributions, domestication status, local significance and infra-species diversity could be of great value for designing policies to expand and promote agricultural biodiversity.

Impacts of Holocene land use and climate change upon Brazil's iconic Araucaria Forests

Charlie Davies, Joy Singarayer, Oliver Wilson, Rafael Corteletti, José Iriarte and Francis Mayle

Keywords: Araucaria forests, palaeoecology, climate change, Holocene, land use

Brazil's southern Atlantic Forest, a designated global biodiversity hotspot, is critically endangered, with less than 20% of its original forest cover remaining. Given its global importance and conservation priority, it is crucial to understand how to best maintain its ecosystem functioning and biodiversity in the face of increasing fire, drought, and deforestation, resulting from anthropogenic land use and climate change. This study focuses on the highlands mosaic of Araucaria Forests and Campos Grasslands, the biomes most threatened, yet iconic and ancient formations. Palaeoecological studies have revealed that around 1000 years ago southern Brazil's Araucaria Forests rapidly expanded. But whether this was caused by Indigenous southern Jê peoples or minor climatic shifts altering fire-forest feedback loops, is a topic of extensive debate. The lines of evidence imply complex ways in which Indigenous peoples, climate change and fire interacted in southern Brazil throughout the Late Holocene. But, discriminating between the effects of these potential drivers upon the Araucaria Forest remains difficult. Using novel integrations of new palaeoecological data, agent-based modelling and existing archaeological data, I will assess how pre-Columbian indigenous peoples, climate change, and fire interacted and shaped these landscapes throughout the last 12,000 years. My results should provide important insights into the likely responses of this globally important ecosystem to current and future anthropogenic and climatic changes, and thereby help inform conservation strategy for Brazil's vanishing Araucaria forests.

Environmental Management at the 'Silk Road' City of Otrar, Kazakhstan

Katie Campbell, Maia Chichinadze, Serik Akylbek, Ali Alimbekuly, Shynaz Almazuly, Davit Naskidashvili and Karl Smith

Keywords: water, reservoir, drainage, agriculture

The abandoned city of Otrar in southern Kazakhstan was a major agricultural centre and trading hub through the medieval period. There is increasing evidence that the city and its agricultural hinterland suffered a significant decline in the mid-12th century, many decades before the Mongol Conquest of the region, which began in 1219. This apparent decline led to the abandonment of the canal systems, reservoirs and agricultural industry of the city. This paper will present evidence for the environmental management of the city's suburbs and hinterland, including its canals and water storage, agriculture and drainage. It will consider how the city's inhabitants organised and maintained vital infrastructure to capture and store water in this arid environment as well as preliminary information on the crops and wild plants growing in its hinterland. We present evidence drawn from survey, excavation, archaeobotanical and palaeoenvironmental data to reconstruct Otrar's environment before and after the conquest which has been blamed for its decline. Ultimately, we consider if and how its inhabitants' approaches to environmental management contributed to the city's growth, decline, and eventual abandonment.

Climate, crops and crisis? Examining agricultural adaptation and resilience to climate change in prehistory

Rosie R. Bishop, Kenny Brophy, Ingrid Mainland and Astrid Nyland

Keywords: climate change, archaeobotany, resilience, farming, palaeoclimate

Identifying resilience in relation to climate change in the archaeological record is not straightforward. There are challenges with identifying chronologically and spatially relevant climate shifts that would have affected past human communities, and in establishing causality between contemporary climate changes and human actions in the past. There is also a need to avoid environmental determinism when comparing archaeological and palaeoclimate data. Ultimately, to overcome these issues, sophisticated approaches which combine multiple strands of evidence from different disciplines and diverse theoretical approaches are required. The presentation will outline a new interdisciplinary research project which aims to develop the methodology for identifying resilient agricultural practices in the past in relation to climate change. Using a comparative approach focusing on Atlantic Scotland and Southern Norway throughout prehistory and by incorporating data from different disciplines including archaeobotany, zooarchaeology, and climate science, the project aims to provide a more sophisticated understanding of long-term human-climate interactions in the past.

Intensive millet-livestock systems supported the development of complex societies in prehistoric North China

Jishuai Yang and Xiaoyan Yang

Keywords: farming systems, sustainable intensification, intensive crop-livestock systems, stable isotopic analysis, manuring practices

Archaeology has the potential to provide a truly long-term perspective on the longevity of ancient agricultural systems, sustainable or otherwise, and their effects on the evolution of human societies and natural environment. Here, we report the microfossil and isotopic evidence for the intensive millet-livestock systems which enabled sustainable intensification in agriculture in deep history and fed the earliest complex societies in North China. Over 5,500 years ago, an intensive millet-pig system, characterized by the feeding of millet husks to pigs and the fertilization of millet fields with pig and/or human dung, supported the development of early complex societies in North China. Around 4,000 years ago, new elements of production, such as cattle, sheep and goat were integrated into the existing millet-pig system. These domesticated herbivores were able to convert unfarmable mountainous and deeply gullied grassland resources into meat and dairy, providing humans with fur, draft power, and additional manure. This integration significantly enhanced the productivity of millet agriculture, thereby underpinning the rise of more complex societies, such as cities and states, in this region. The circular and intensive agricultural production exemplifies the remarkable sustainability of crop-livestock systems in human prehistory. Today, 2.5 billion smallholder farmers in mixed crop-livestock systems collectively manage 60% of the world's arable land and produce about half of the world's food. Facing the increasing risk of food security and environmental degradation, sustainable agricultural intensification offers a promising approach to balance food production with ecological conservation for hundreds of millions of smallholders in the developing world.

Session 4. Wildlife

Full papers:

Deer and Deer Alike: The Story of Britain's Iconic Species

Jack Sudds

Keywords: deer, methods, human-animal interactions

Fallow, Red and Roe—the three largest populations of deer in Britain today, each with their own unique zoological and archaeological histories. Today they are pests, prey and livestock, each classification depending more on the person you ask rather than the species or even population being discussed. In late 2022 the Forestry Commission and DEFRA performed a consultation on a new deer management strategy, principally considering the welfare of the animals and the impact of their presence on the natural environment. In the wider continent deer management takes a variety of forms, driven by stakeholder demands and divided along national and municipal boundaries. It is important both environmentally and economically that this be done right. In order to make informed decisions about the present a clear understanding of the past is required to draw from successes and avoid mistakes. I have created a new dental ageing method for red deer (Cervus elaphus) which, when used in conjunction with extant methodologies and wider datasets can begin to shed the necessary light. Insights from archaeological populations of deer and how they are impacted by human actions can inform modern management practices and the stories of the individual animals and the larger herds can provide insights into not only into management but the importance and symbolism associated with them. This paper will share the new and tested method along with preliminary findings.

Modern Proto-Domestic Phenomena: Analysing the Possible Domestication of British Falconry Birds Through an Archaeological Framework

Hannah Britton

Keywords: falconry, raptors, domestication, captivity

Birds of prey are the icons of the wilderness, with falconry practice seen as the epitome of the controlled human interaction with the natural world. This historic practice has seen few adaptations over the millennia and in 2021 was inscribed in 24 countries as a UNESCO ‘Living Human-Heritage’. However, recently in Britain, there has been a dramatic shift to the sport. In 1981 the ‘Wildlife and Countryside Act’ precipitated the necessity for the artificial breeding in captivity to maintain falconry populations, differing from the medieval capture and release tradition. The technological advancements and commercial globalisation of the last thirty years has placed Britain at the forefront of the international export of birds of prey as well as facilitating a turning point for raptor management. Falconry experts have long warned the lasting consequences, with some labelling it as the beginnings of domestication. However, this has been vehemently rejected by academic critics, despite few academic studies addressing this topic, and none considering the deep-time history to contextualise the pivotal changes in captivity practice. This paper uses the archaeological framework of domestication to address this potential modern proto-domestic phenomenon and discusses the applicability of domestic theory to modern species. The findings have implications for not only for understanding the ecological ramifications of these management practices,

but to inform on current policy and legislation. Overarchingly, this discussion will bring the antiquated approach towards domestic theory into scrutiny.

People & Puffins: Investigating how environmental change and exploitation by past communities has impacted current auk populations

Samuel Walker, Hanneke Meijer and Ellen Hambleton

Keywords: seabirds, Alcidae, osteology, archaeology, conservation

Seabirds are important marine ecosystem indicators and have long had an integral place in human culture and economy. They have faced the increasing footprint of humanity during the Holocene as our species has altered the natural world and heavily exploited this group for products such as feathers, skins, eggs and meat. The impacts of past hunting, the introduction of industrial scale fishing and climatic change have all shaped the seabird populations of today. Globally 31% of seabird species are regarded as threatened by the IUCN, and alarmingly 47% show declining population trends. Here we introduce a recently funded project focusing on past human interaction with one of the most threatened seabird families, the auks. The aim of the project is to chart human exploitation of auk species throughout the Holocene and identify seabird responses to past pressures (both environmental and anthropogenic). This will be achieved through several research avenues including mapping past auk distribution across the North Atlantic in comparison to their current breeding colonies. Assessing human exploitation and subsistence value of auks to different coastal communities through time. As well as, identifying skeletal changes in morphology and size in response to environmental and anthropogenic events. So far preliminary work has identified a northward shift in puffins related to Mid-Holocene warming, and a clear isotopic difference in the diets of past and modern puffins. The project will work closely with conservation agencies to develop archaeological data which can be used to help inform policy and protection of at-risk species.

Recalling the Wild: Perspectives on medieval animal management and feralisation

Carly Ameen

Keywords: zooarchaeology, feralization, morphometrics, human-animal relationships

Traditionally, animal management is seen as a continuum of increasingly intensive control, leading towards domestication. Zooarchaeologists have spent much of the last decades searching for morphologies, signatures of genetic lineage, and dietary patterns which distinguish between wild and domestic species. But this continuum moves in both directions and tracking species through time involves monitoring both the tightening and loosening of human-animal relationships, and in particular, an appreciation of feral animals and their role in shaping bio-cultural histories. In the English medieval period, social and cultural upheaval sees substantial changes to humans' relationships with their landscapes, and a reimagining of what is ‘wild’. The pigeon and the rabbit were both introduced Britain during this period as high-status imports carefully managed in bespoke dovecotes and warrens, raised for food, fur and dung. Today, they are among the few species that simultaneously exist as wild populations, as feral pests, and as domestic breeds. Using zooarchaeological, biomolecular and morphometric techniques this paper will explore the medieval management of rabbits and pigeons. Tracking the trajectories and intensification of their relationship with humans, it will discuss their arrival as elite exotica and review the dynamic management strategies and cultural pressures which eventually lead to their modern relationship with humans reverting from pampered pets to feral pests. Within this context, this paper seeks to demonstrate how deep-time perspectives on animal management provide the crucial bicultural datasets to underpin modern management initiatives, and to engage with public perceptions on the cultural value of feral animals.

The Palaeoecological Links between Climate Change, Vegetation change and British Farmland Birds in the Archaeological Record

Rebecca Rickard, Phillippa Gillingham, Richard Stillman, Chris Stevens and John Stewart

Keywords: birds, archaeology, agriculture, climate change

Populations of farmland birds, such as grey partridge, have declined dramatically over recent decades and are listed as species of conservation concern. Many of these species are also represented in the archaeological record under the Category F list published by the British Ornithologists' Union Records Committee (BOURC), though this remains a greatly understudied resource. This study aims to investigate the implications of environmental change and human land-use change on farmland birds in Britain from the late Pleistocene to the Medieval period. Whilst farmland birds were found within the open habitats of the Late Pleistocene, the effects on these species of the warming climate and spread of woodlands throughout the early Holocene are yet unclear. Forest clearance in the Neolithic is then likely to have allowed farmland bird species to re-capitalise on newly opened, anthropogenic habitats. This study will utilise published pollen data to estimate the abundance and relative rates of change of open or closed habitats in Britain throughout this period, and utilise niche models based on the present distribution of focal bird species and current climate data to examine the changing relationships between vegetation regimes and possible farmland bird distributions. These data will be integrated with climate data from the Last Glacial Period into the Holocene to infer where/when the climate would have been suitable for each species, and the predicted distributions of birds compared with archaeological records. The results will be used to infer how climate-driven vegetation changes and anthropogenic land-use changes have influenced farmland birds over time and support future conservation efforts by identifying where resources should be placed as future vegetational shifts occur due to contemporary climate change.

'Rewilding the Neolithic of south-eastern Europe': on wild plant foods

Amy Holguin, Rachel Ballantyne, Mike Charles, Müge Ergun, Eugenia Gkatzogia and Amy Bogaard

Keywords: foraging, prehistoric, waterlogged, Balkans, diversity

In south-eastern Europe, most excavated Neolithic sites are situated in dryland settings with plant macrofossils typically preserved in a charred state. Such assemblages are potentially biased towards crop material and underrepresent the diversity of prehistoric plant food-systems and the contribution of 'wild' taxa. The waterlogged lake-dwellings of Ploča Mičov Grad and Lin 3 (Lake Ohrid), and Dispilio (Lake Orestiada), investigated as part of the EXPLO project, preserve uncharred plant remains and demonstrate that 'wild' plant foods were an important aspect of Middle/Late Neolithic diets. Collected fruits and nuts included both mediterranean (e.g. *Pistacia terebinthus*, *Vitis* and *Ficus carica*) and temperate (e.g. *Quercus*, *Corylus avellana* and *Malus*) components, reflecting the study region's environmentally transitional location in the upland southern Balkans. This evidence shows that foraging was a flexible practice adapted to different settings to incorporate locally available taxa. While the abundance of many 'wild' taxa and intra-site plant diversity is unusual at these lakeshore sites, all of the 'wild' plant foods recovered have also been identified (albeit sporadically) at dry sites in the southern Balkans. We suggest that lake-dwelling food-systems were not different, but rather that waterlogged preservation of anthropogenic assemblages clarifies the real breadth of prehistoric plant food spectra.

Wild things: Red deer on the Scottish Isles

Jacqui Mulville, Julia Cussans, Ingrid Mainland, Ash Noble and David Stanton

Keywords: red deer, metrics, genetics, management, conservation

Archaeological investigations on the outer Scottish islands have revealed exceptional and early evidence for the human control and manipulation of animals used as food resources. Detailed records of faunal introduction and interactions suggest that early settlers introduced red deer to a pristine environment across the dividing seas. On the Northern and Western Isles, red deer populations flourished and became integral to insular lives, just as farming systems spread across the UK and wild food usage declined. Deer, alongside sheep and cattle, became embedded in insular social, ritual and subsistence practices. Limited landmasses and challenging weather systems forced islanders to develop and adapt practices that allowed a wild species to thrive alongside domestic stock and crops for millennia. Wild Things—a BA/Leverhulme Small Research Grants funded project—has focused on a comparative analysis of red deer within the North Atlantic islands to examine the diverse ways our ancestors used this species to adapt to insular conditions. There are three main areas of enquiry: the introduction of red deer, their management, and their response to island life. This presentation will discuss our results and reflect on the role that archaeology must play in the present and future management of red deer on islands and beyond.

The Zooarchaeological History of Wolves in the British Isles: From the Iron Age (750 BCE) to the Late Modern Period (1900 CE)

Jessica Peto, Lachie Scarsbrook, Naomi Sykes, Greger Larson, Carly Ameen, Richard Madgwick, Alistair Barclay, Angela Lamb, Andrew Kitchener and Ben Donnelly-Symes

Keywords: zooarchaeology, extinction, canids, isotopes, morphometrics

Synthesis works on the historical populations of wolves in the British Isles often imply the presence of a ‘pest’ population, surviving in some sources into the seventeenth century before being eradicated primarily through trapping and hunting. However, the zooarchaeological record does not corroborate this, in which wolf elements are extremely rare particularly in the historical period. Through this project, we have identified and confirmed only one historical wolf individual—a single mandible—radiocarbon dated to 1750 CE. One reason for the lack of material recovered may be the difficulty in distinguishing large dog and wolf remains, a difficulty often quoted as a major hurdle for the study of wolf extinction. We have shown that the most comprehensive way to answer this question is with a collaborative and interdisciplinary approach, this paper will discuss the stable isotope analysis and morphometrical data aiding the genetic data.

Lightening talks:

Tracking Holocene ecosystem dynamics from a paleo-archive preserved in a cave in high latitudinal Fennoscandia

Emma Katrin Onshuus, Samuel J. Walker, Lea Frank, Trond Lødøen and Sanne Boessenkool

Keywords: ancient DNA, zooarchaeology, caves, biodiversity

The Holocene is generally considered to be a climatically stable period in comparison to the preceding Pleistocene. Nonetheless, climate and anthropogenic pressures during the last 10,000 years have shaped the ecosystems we see today. Caves offer a unique opportunity to study past ecosystems, and in their

relatively protected environment we often find excellent preservation of organics. Here we present a faunal assemblage excavated in 2023 from Krytjahola, a small cave from the Fauske region in Northern Norway. We combine comparative morphology and ancient DNA bulk-bone metabarcoding to greatly enhance the identification of faunal diversity, especially for birds and fish. Radiocarbon dating reveals two distinct periods, with 8725–8395 cal. BP covering the Holocene Thermal Maximum and an upper layer dating to 1540–1505 cal. BP. Zooarchaeological analysis of the bone assemblage reveals a diversity of taxa, including mammals, birds and fish. Small mammals are by far the best represented, and are excellent environmental indicators often underrepresented from sites in the region. In addition, the discovery of a feline molar could indicate an early domestic cat in the region or alternatively an expansion of wildcat further north than previously considered. Supplementing the zooarchaeological analyses with ancient DNA analyses of the unidentifiable bone fragments will expand the diversity of taxa we identify and present a more complete overview of past biodiversity. Krytjahola, along with other excavated caves in northern Fennoscandia is contributing to a more detailed and extensive understanding of the spatial and temporal ecosystem dynamics in a region currently facing rapid environmental changes.

Session 5. Farming

Full papers:

Fossil insects, Neolithic agriculture and environmental change: new evidence from Lin, Albania (online)

Sesilia Niehaus

Keywords: Neolithic, fossil insects, agriculture, biogeography

The Neolithic is characterised by the intensification of human impact on the environment and major societal shifts resulting from the introduction of agriculture. An unintended consequence of the expansion of agriculture was the introduction of a highly synanthropic insect package, comprising invasive and destructive pest species, to new parts of Europe. The expansion of these insects out from their original niches constitutes an early form of human-induced environmental change, with several species eventually becoming cosmopolitan in distribution. Although the study of fossil insects can provide unique insights into human-environment relationships, agricultural expansion and early environmental change, insects are a severely underused proxy in the Southern Balkans, where some of the earliest European Neolithic sites are located. This paper presents fossil insect results from recent archaeological excavations of Lin 3, a Neolithic pile-dwelling settlement in Albania, with uniquely excellent organic preservation. Through the identification of insect fossils from this site, a better understanding of the local environments and agricultural practices, such as the prevalence of bulk storage, have been attained, deepening the understanding of the early Neolithisation of Europe. Notably, results include some of the earliest records of crop pests outside their original niches, refining the timelines of insect introductions in Neolithic Europe.

Beyond the Silos: Characterising agricultural mosaics across prehistoric England

Catherine Longford, Ruth Pelling, Michael Wallace and Emily Forster

Keywords: agriculture, stable isotope analysis, UK, Neolithic, Bronze Age

As agriculture spread through Europe, cereal stable isotope evidence indicates that farmers manured their crops from the Early Neolithic as a consistent management strategy. In Britain however, recent data from Scotland and Wales suggests crops were not manured in the Early Neolithic unlike in mainland Europe.

Until now, very few stable isotope analyses of grain from early prehistoric sites in England have been conducted to investigate cultivation practices. The Beyond the Silos project presents c. 400 single grain C and N stable isotope analyses from 17 archaeological sites to assess crop management strategies from the Neolithic to Middle Bronze Age across England. This paper will discuss the regional and temporal variations in stable isotope results to examine the mosaic of cultivation strategies employed by early prehistoric farmers in England. As projects like Beyond the Silos generate more stable isotope results, archaeologists need to consider can we use this data beyond archaeology. This paper will reflect on how crop stable isotope data can provide ancient environmental comparisons for contemporary challenges. Beyond the Silos is a collaborative Knowledge Exchange project between the University of Sheffield, Historic England and archaeobotanists from nine UK archaeological companies (Archaeology SE, Canterbury Archaeology Trust, Headland Archaeology, MOLA, Oxford Archaeology, Oxford Archaeology North, Wessex Archaeology, Worcestershire Archaeology, ULAS).

Neolithic Agricultural Practices and Cultural Insights from Mehrgarh, Balochistan

Imran Shabir

Keywords: Neolithic, Mehrgarh, farming, Balochistan, pastoralism

Balochistan is rich in terms of Cultural Developments and witnessed several wars and expeditions thus sought the attention of archaeologists to carry out researches and discovered archaeological sites like Mehrgarh Neolithic which considered to be the earliest farming society in South Asia. The site was continuously inhabited from around 7000 BCE to 2500 BCE and it is notable for its early evidence of sedentary occupation, agriculture, and pastoralism. This paper explores recent findings on Mehrgarh's agricultural innovations, focusing on crop cultivation, irrigation techniques, and soil management. Located outside the wild progenitor regions of domesticated einkorn and emmer wheat, Mehrgarh's early inhabitants developed advanced farming methods adapted to their arid environment. By analysing plant remains, irrigation structures, and soil samples, we reconstruct the sophisticated farming systems that supported this early community. Additionally, the study highlights the increasing sophistication in ceramic decoration during Mehrgarh period III, linking technological advancements with broader cultural shifts. This research not only enhances our understanding of Neolithic agriculture but also offers parallels to contemporary sustainable farming practices. Integrating archaeological findings with modern agricultural science, the paper emphasizes the relevance of ancient practices for addressing current sustainability challenges and underscore the importance of interdisciplinary research in archaeology.

Lightening talks:

Why did the chicken cross the oceans? A zooarchaeological and palaeogenomics approach to Neotropical American chickens

Ophélie Lebrasseur, Jaime Gongora, Laurent Frantz, Pablo M. Fernández, Greger Larson and Ludovic Orlando

Keywords: *Gallus gallus domesticus*, Neotropical America, zooarchaeology, palaeogenomics, historical period

Chickens reached Neotropical America ~500 years ago through human-mediated means and have grown to acquire a socio-economic status of particular importance, yet the nature and timing of their introduction(s) as well as their cultural history on the continent remain for the most part unknown. A pilot study funded by the AEA in 2018 followed by the ARAUCANA project in 2021-2023 are stepping-stones

towards remediating this knowledge gap. Through international and interdisciplinary collaborations, we collected an assemblage of nearly 600 bird bones from 15 archaeological sites located in Argentina, Brazil, Mexico, and Peru, and dating from the early 16th to the 19th century. Following a comprehensive zooarchaeological study, 80 chicken bones from this assemblage were sampled for palaeogenomic investigations. We here present the results of our full suite of analyses which, once combined, address the issues surrounding bird species identification, inform on the importance of chickens in relation to local wild birds and their roles within local societies, and hint as to their likely introduction(s). Our findings provide an overall understanding of how these non-native birds reached the continent and grew to become essential to its economy in the span of half a century, whilst also highlighting the implications for the cultural and biological heritage of these South American chicken populations.

Neopalatial Mochlos: A Study of Domestic and Ritual Interactions

Evi Margaritis and Kyriaki Tsirtsi

Keywords: Minoan Crete, ritual performance, domesticity, urban centres

The archaeological site of Mochlos, located in Eastern Crete, stands as a pivotal example of a multiphase Minoan settlement. During the Late Minoan IB period, which constitutes the largest portion of the excavation, Mochlos thrived as a prosperous centre for manufacturing, trade, and religious activities, marking the zenith and final century of Minoan civilization. The meticulous excavation of various neighbourhoods and their corresponding structures has enabled a detailed reconstruction of the domestic and craft practices of its inhabitants. This has been further enhanced by the application of comprehensive scientific analyses across nearly all categories of material culture. Notably, Mochlos was among the first Minoan sites to implement a systematic recovery program for organic remains, including archaeobotanical sampling, which has significantly contributed to our understanding of the site's agricultural activities and culinary practices from the Prepalatial to the Hellenistic periods. This paper focuses on the Late Minoan IB phase, examining two major areas within the site that encapsulate a combination of craft, ritual, and domestic activities. The primary objective is to explore and elucidate the relationship between the inhabitants of Mochlos and their natural environment, shedding light on their agricultural practices and assessing the variability between different households. The study reveals that Mochlos utilized a limited array of plant resources, with generally sparse concentrations of plant remains across the site. An exception to this pattern is identified in a significant cache of cereals, which appears to be associated with specific ritual performances. Through this analysis, the paper aims to contribute to a deeper understanding of Minoan socio-economic structures, resource management, and the interplay between daily life and ritualistic practices during a critical period in Aegean prehistory.

Counting Cattle at the Ness of Brodgar, Orkney: Animal bone assessment update

Julia E. M. Cussans, Ingrid Mainland, Nick Card, Anne Mitchell and Mark Edmonds

Keywords: cattle, Neolithic, Orkney, status, feasting

The Ness of Brodgar excavation came to a close this summer after 20 years of excavation. The site represents a monumental settlement complex located at the centre of the Heart of Neolithic Orkney UNESCO World Heritage site. There are many aspects to this project and a huge number of specialist disciplines involved, and while much post-excavation work has been carried out between the excavation seasons the project is now embarking on a huge post-excavation phase. As part of this, a complete assessment of all the recovered animal bone is underway. Following this assessment, specific parts or aspects of the assemblage will be analysed in more detail. This lightning presentation will briefly go over

what we know so far; what research questions we have relating to the animal bone assemblage and how we might go about answering these and integrating the animal bone data with the many other strands of evidence recovered from the site. Themes explored will likely include day to day food processing and provisioning; special events and feasting; the practical roles of cattle at the site (were they simply the preferred food source or were they also used for traction and other functions?); and how this related to kinship and status of the site inhabitants. The roles of other animals found at the site such as deer, voles and dogs will also be briefly explored.

People, Look East! Archaeobotanical evidence for transmission of farming eastwards from the Fertile Crescent into Asia

Hannah Caroe

Keywords: Eastern Fertile Crescent, Iran, 'two-corridors' hypothesis, transmission of domesticated crops, 'crop packages'

This paper presents research on the transmission of domesticated crop-types and Neolithic lifeways eastwards from the Zagros into Iran. Specifically, it aims to test tenets of what is here termed the 'two corridor hypothesis' (TCH). This suggests that, owing to geomorphological barriers across much of Iran (mountain ranges and desert areas), movement of people, animals, plants and ideas would have been funnelled along two natural corridors, to the north and south of the region respectively. To investigate the TCH, archaeobotanical assemblages from five Epipalaeolithic and Neolithic sites located on or close to the proposed routes for the corridors (Hotu, Kamarband and Komishani Tappeh on the Iranian Caspian shore in the north and Toll-e Sangi and Tappeh Poustchi in the south) are analysed, in conjunction with previously published archaeobotanical data from Iranian sites. Preliminary results indicate locally specific trends in the adaptation of 'crop packages'. There is also evident reliance at some sites on crops that are not part of the canonical Neolithic 'founder crop package'. This ongoing project represents a unique opportunity to compare and contrast assemblages from parts of southwest Asia which have as-yet benefitted little from systematic archaeobotanical assessment.

Farming beyond the walls: exploring archaeobotanical remains from Iron Age Great Zimbabwe

Alice Williams, Shadreck Chirikure, Amy Bogaard and Mike Charles

Keywords: archaeobotany, Great Zimbabwe, social complexity, farming

Great Zimbabwe is an iconic World Heritage site and a centre point of archaeological investigation in southern Africa. Research suggests a long-standing and far-reaching society, with established trade networks within the region and extending to the Indian Ocean. Prior and ongoing study of the site examines the stone masonry, metallurgy, cattle herding and trading connections. However, can we determine the nature of the agricultural basis and plant economy of Great Zimbabwe? Here, we present the results of analysis of macrobotanical remains recently recovered from the Hill Complex of Great Zimbabwe as part of the 'Archaeometry and social formation in southern Africa' project. Preliminary analyses have identified the presence of cereal crops (*Soghum bicolor*, *Eleusine coracana*, *Setaria*, and *Pennisetum*) and legume species throughout the excavated sequence on the Hill Complex (~AD 1200-1400). These remains correspond with previous findings at contemporary sites in the region and reaffirm the potential importance of these species as staple crops. The quality of preservation of charred clusters of sorghum and the range of wild seeds recovered indicate the potential for uncovering further material in excellent, undisturbed preservation. Questions remain around where and how these crops were grown, how

domestic and wild plants were used, and what role they had in everyday life. Our ongoing work will show how farming and use of wild plants shaped the wider social and environmental context of Great Zimbabwe.

Harvesting the Periphery: Food and Agriculture in Bronze Age Koumasa

Kyriaki Tsirtsi, Simos Gkinoudis and Evi Margaritis

Keywords: macrobotanical remains, microbotanical remains, settlement, agriculture, Bronze Age, Crete

This paper presents a novel approach to understanding the daily life and culinary practices of the Minoan settlement of Koumasa, situated on the periphery of the Mesara Plain in Crete. Unlike previous research, which has primarily concentrated on the cemetery and ritual practices of the Early Bronze Age, this study shifts the focus to the settlement itself, spanning from Late Minoan I to Late Minoan III (ca. 1600-1300 BCE). By employing interdisciplinary methods, including the analysis of archaeobotanical macro-remains (seeds and other plant parts) and micro-remains (starch granules), this paper aims to reconstruct food procurement, consumption, and culinary practices at Koumasa. This innovative approach combines traditional archaeobotanical analysis with starch analysis from pottery and ground stone tools, offering a more comprehensive understanding of food-related activities at the site. Additionally, the study situates Koumasa within its broader landscape context, considering its location between the Asterousia Mountains and the Mesara Plain. By examining landscape management and agricultural development, the paper seeks to shed light on the role of peripheral centres in Minoan Crete and their interactions with more central sites. The findings from Koumasa will be compared with previous research on the cemetery and other contemporary sites in Crete, providing valuable insights into regional variations in food practices and agricultural strategies. Overall, this study contributes to our understanding of everyday life in Minoan Crete and the diverse ways in which ancient societies interacted with their environments.

Analyzing Pig Management and Diets in Late Neolithic-Chalcolithic period through Isotopic Analysis at Porto Torrão, Portugal (online)

Sopio Paatashvili, Nelson Almeida, Cristina Barrocas Dias, Anne-France Maurer, Antonio Valera and Vanessa Navarrete

Keywords: zooarchaeology, δ13C and δ15N stable isotopes, diet, animal management, bulk collagen

Differentiating between *Sus domesticus* and *Sus scrofa* from bone remains in the Iberian Peninsula during the Neolithic period poses a challenge due to their anatomical similarities. In this sense, studying the management practices of these animal species, and specifically feeding strategies, can be a key element to understand pig breeding and differentiate between species. This study utilizes stable carbon and nitrogen isotope analysis in bulk collagen to tackle this challenge and gain insights into the dietary habits and status of these species during the Late Neolithic and Chalcolithic transition at the archaeological site of Porto Torrão. By analysing zooarchaeological data and isotopic results, it was found that two individuals, initially classified as *Sus scrofa* based on their appearance, had lower δ15N values, indicating that their "wild" status may need to be considered due to a diet low in animal protein. The data suggest that the pigs were raised in the same pasture areas as domestic and wild herbivores and, consequently, had a diet dominated by plant products. The results indicate no significant changes in feeding management practices during this transitional period, with a focus on using meat from adult domestic species, including cattle, pigs, sheep, and goats. In addition to domestic species, hunting also contributed to the presence of wild animals in the faunal assemblage. This research emphasizes the importance of further studies to explore the different ways domestic pigs were managed, providing insights into human-faunal interactions in a domesticated landscape during the Neolithic-Chalcolithic transition.

Session 6. Landscapes

Full papers:

Ancient pollen, modern algorithms: reconstructing palaeoenvironments in evolving landscapes

Elisa Paperini, Claudia Sciuto and Gabriele Gattiglia

Keywords: random forest, neural networks, paleoenvironmental reconstruction, human-centred AI

The application of Artificial Intelligence (AI) to the archaeological analysis of pollen data raises questions due to the integration of disciplines with different methodologies: how can species be grouped for biome classification, and what "unusual" patterns can AI reveal? Are these patterns scientifically valid? Such inquiries open new perspectives overlooked when studying data through a single discipline. To explore AI techniques and establish a form of ground truth, last year we tested both predictive and generative AI techniques on datasets containing pollen counts from modern sites (the last 100-150 years); now, it is time to try these algorithms on ancient pollen data. This research uses open data covering Europe (focusing on Switzerland, Germany, and Sweden) sourced from databases such as EMPD, Neotoma, SEAD, and BRAIN. Data were normalized, clustered by species and chronological intervals, and encoded for compatibility with computer systems. Subsequently, data were used to train and test algorithms like random forests and neural networks, aiming to identify common patterns among different plant species and biomes present in a given area and time. Despite the challenges of using AI methods in environmental archaeology—primarily the lack of data, leading to difficulties in examining areas on a large scale or within a restricted chronological period—AI offers advanced capabilities for pattern recognition and predictive modelling to support expert work. Predictive models can be relevant not only in interpreting past data but also in understanding how current and future ecosystems might respond to various environmental changes based on historical data.

Using archaeological and palaeoecological data to inform land-use change

Nicki Whitehouse, Adrian Bass, Jane M. Bunting and Henry Chapman

Keywords: land-use, peatlands, palaeoecology, carbon sequestration, historic environment

Peatlands are one of the world's most important habitats and the largest terrestrial carbon store. 80% of UK peatlands are damaged and deteriorating, meaning they are often a carbon source rather than sink. Restoring peatland is therefore an urgent UK action, necessary to meet net zero commitments. The UK Committee on Climate Change has recommended restoration of at least 50% of upland peat and 25% of lowland peat by 2050 to contribute to the net zero target. Changing agricultural use of peatland is likely to lead to the highest per hectare emissions savings implementable in the UK. However, the number of peatland hectares restored remains low despite support mechanisms in Scotland and England. We introduce the RESPECT project, which takes a holistic approach to support landholders to undertake peatland restoration and reduce carbon emissions through land use change. Two case study regions—the Forth and Humber Catchments in Scotland and England—are being investigated in-depth, where tensions exist between food production, historic environment preservation, carbon sequestration and ecological restoration. We highlight interdisciplinary approaches taken by the project that include the novel application of the archaeological, palaeoecological and carbon record to map and assess peatland resources and carbon stores to support the UK's transition to net zero, alongside mapping of sensitive archaeological areas at risk. In doing so, we highlight the opportunities provided by the environmental archaeological record to contribute to global challenges.

Pastureland of Mount Mongioie: the contribution of environmental archaeology between research and application

Valentina Pescini, Lorenzo Braga, Roberta Cevasco, Natalia Égüez, Assunta Florenzano, Ilde Menozzi Bruna, Anna Maria Mercuri, Diego Moreno, Eleonora Rattighieri, Ivano Rellini and Vittorio Tigrino

Keywords: historical sustainability assessment, landscape archaeology, bio-sedimentary archives, landscape management

This contribution presents the results of an interdisciplinary investigation ("TRANSEANT" project) carried out in Mount Mongioie (Piedmont, Italy, 1530 masl), a summer pastureland historically affected by transhumant livestock from the Tyrrhenian coast and the Po valley. High-resolution multi-proxy research is proposed, combining pedoanthracology, palynology, biomolecular analysis, soil micromorphology, and chemistry with radiocarbon dating and historical ecology observations. These evidences have been cross-checked with documentary and iconographic sources (historical texts and maps) to unravel the complex historical practices related to the use and management of grazing resources. The integration of these different types of evidence has shed new light on the environmental changes that have occurred from Roman times to the present day, revealing both continuities and shifts in the systems used to manage pastoral resources over the centuries. The studies aim to uncover the trajectory of environmental formation and transformation processes over time, contributing to a more comprehensive understanding of current environmental changes. In particular, since the 19th century, the progressive abandonment of the local agro-sylvo-pastoral practices and the onset of a general process of "renaturalization" has negatively affected local biodiversity, leading to an increase in wildfire risks. TRANSEANT has not only deepened our understanding of historical and current environmental dynamics but has also led to practical applications in several areas. The research has informed better environmental management policies and enhanced bio-cultural heritage. Additionally, it has helped to characterize situated foodways and foodscapes, enriching our understanding of the connection between the local environment and its gastronomic heritage.

Remodelling Arcadia: Quantifying French Colonial Agricultural Landscapes in Atlantic Canada

Jonathan Fowler

Keywords: farming, reclamation, Acadians, remote sensing, GIS

Between ca. 1640 and 1755, a small population of French colonists dyked and drained thousands of acres of tidal wetlands in what are now Canada's Maritime Provinces. Their labours converted vast, resource-rich areas of the Indigenous landscape into productive arable land. Their handiwork is generally well known to both scholarship and the heritage industry, but its extent has never been properly quantified. Landscape archaeology and remote sensing offer new opportunities to measure the staggering scale of the landscape changes they introduced. This paper summarizes the Acadian story; reviews our research methodology, which includes historical research and the analysis of aerial photos and aerial LiDAR data; and presents new evidence quantifying the extent of landscape change introduced by the Acadians. The findings have important implications for how we understand the Indigenous-newcomer relationship as well as the broader economic and political histories of the region.

Exploring Charcoal Landscapes in the Apuan Alps, Tuscany, Italy

Claudia Sciuto, Radoslaw Grabowski, Francesca Anichini, Salvatore Basile and Gabriele Gattiglia

Keywords: charcoal kilns, mountain archaeology, anthracology, geoarchaeology, HLC

This presentation outlines the results of the first campaign to study charcoal production sites in the mountainous area of the Stazzema municipality, situated in the Versilia side of the Apuan Alps (northern Tuscany). The project is part of a broader research initiative on the archaeo-ecological traces of past agro-silvo-pastoral activities in mountain territories, focussing on the mapping of evidence from a diachronic and transdisciplinary perspective. During field surveys conducted in 2021-2022, numerous locations with evidence of charcoal burning were identified. The autumn 2023 campaign involved a more detailed investigation of these sites through a specific protocol, which involved a series of cores and the excavation of small test trenches. A total of 18 charcoal kilns were examined. Data from the cores helped define depositional and post-depositional dynamics related to the clearings and identified different phases of use. Soil samples from charcoal-rich sediments were collected for anthracological analysis. The anthracological analysis consisted of taxonomic identification, estimation of the size classes of the used wood, and evaluation of the state of the wood by documenting pre-carbonization fungal and insect degradation. Since several kilns contained exclusively charcoal from younger branches, the possibility of coppicing was investigated, and attempts are made to reconstruct the coppicing cycles. The resulting data were compared with historical cartography and land use data from Historical Land Characterization. This comprehensive analysis enabled a detailed reconstruction of charcoal production practices as well as the forest management and subsistence practices that characterized life on the mountain slopes for centuries.

Lightening talks:

Using sedimentary ancient DNA to reveal postglacial recolonization patterns in northern Sweden

Ernst Johnson, Carl Regnéll and Anna Linderholm

Keywords: ancient DNA, lacustrine sediments, recolonisation

As the Fennoscandian ice sheet gradually retracted from northern Sweden, plants and animals—including humans—started migrating into the early Holocene postglacial landscape. There are settlements from the first pioneers in the archaeological record dated to around 9-11 cal. ka BP, but no human remains have been found. Without a genetic profile available, the answer to the question of who they were and where they came from is clouded with uncertainties. Currently, there are two main hypotheses: western hunter-gatherers coming from Denmark through the south of Sweden and coastal Norway, or eastern hunter-gatherers coming from Russia through Finland. Both of these migration routes occurred, but the archaeological record is inconclusive in determining which of the groups occupied the settlements. Genetic studies on later populations have revealed that the two groups eventually mixed, which resulted in a third genetically distinct group: the Scandinavian hunter-gatherers. In an effort to bring clarity to the matter, alternative archives for genetic material are investigated: lacustrine sediments. Ancient DNA has been shown to preserve in lake sediments across timescales of millennia, and can provide valuable insights to the colonisation routes of both plants and animals as a complement to more conventional osteological and paleolimnological studies. By retrieving sediment cores from lakes in close proximity to the archaeological sites and extracting ancient DNA which is then shotgun sequenced and bioinformatically analysed, the postglacial recolonisation patterns of flora and fauna and the genetic profile of the human pioneers are closer than ever before to being resolved.

Traces of fossorial bees in the soil as an indicator of land use history

Ekaterina Ershova, Pille Tomson and Elena Ponomarenko

Keywords: slash-and-burn cultivation, buried soils, pollen

An important sedimentary morphological signature of slash-and-burn cultivation (SABC) is a pattern created by the dense nest aggregations of fossorial sweat bees in swidden horizons. The pattern is an assemblage of short tunnels ending in tear-shaped brooding chambers; both the tunnels and chambers appear as charcoal-infilled round spots in horizontal sections. In ard-ripped soils, such dark-grey spots and "fingers" form a continuous fringe beneath the uniformly colored cultivation layer. Pollen spectra of buried swidden horizons at the southern extent of the forest zone are dominated by *Betula* (birch), *Tilia* (basswood), and *Chamerion* (fireweed). The high proportion of birch can be explained by its recruitment in fallows that are an imminent part of SABC landscapes. The abundance of basswood and fireweed pollen in swiddens requires another interpretation, as pollen of these taxa is underrepresented in the contemporaneous layers of neighbouring wetlands. Moreover, the proportion of fireweed pollen in buried swidden horizons is higher than in any modern settings. We hypothesized that the specific pollen signature of swidden horizons reflects selective deposition of pollen by fossorial bees. This was tested by comparing pollen spectra in samples from modern sweat bee colonies with those from the surrounding soil. Indeed, the pollen spectra of sweat bee constructions reflected a set of species preferred by the pollinators, not the range of taxa present in the pollen rain. That explains why no modern analogues were found for the swidden pollen spectra and confirms the importance of sweat bee traces as an indicator of past SABC.

Session 7. Perspectives beyond archaeology

Full papers:

The deep human histories and possible futures of ecological management in tropical forests

Dylan Gaffney, Agustin Capriati, Ben Utting, Annette Oertle, Daud Tanudirjo, Marlin Tolla, Abdul Razak Macap, Anna Florin, Christoph Parsch, Marlina Flassy, Enrico Yori and Sofwan Noerwidi

Keywords: zooarchaeology, archaeobotany, Pleistocene, Holocene, forests

Tropical forests—the lungs of the planet—are at the forefront of cultural and existential risks facing our global society. This paper describes our interdisciplinary research, conservation, and outreach project exploring the changing ecology of rainforests in the Raja Ampat archipelago of West Papua, in the Asia-Pacific. These islands lie at the heart of the coral triangle, host to the highest marine diversity on the planet and abundant endemic plant and animal species. The project is exploring how humans transformed these environments in deep time, including people's capacity to extirpate, translocate, and conserve fauna and flora. Archaeological survey and excavation are documenting the chronology of human colonisation in the islands and have produced zooarchaeological and artefactual records that attest to over 50,000 years of human interactions with forest environments. To understand how these ecologies have changed over time, archaeological sequences are being compared with present-day fishing, hunting, cropping, and collecting strategies, and citizen science surveys of the local plant and animal life. Insights about how humans transformed rainforests in the past and the present will be used to consider the possible futures for these ecologies.

The nature of environmental archaeology: promoting the past in nature-based projects

Philip Barratt, Hannah O'Regan and Kristina Krawiec

Keywords: archaeology, land-use, ecosystem services, palaeoecology

Environmental challenges are driving modern land-use change at a range of scales. These include nature-based interventions, which can seek to fundamentally restructure existing landscapes. Such activities create significant challenges for heritage but also opportunities for archaeology. To realise these opportunities the policy frameworks and incentives that are guiding land-use need to be engaged with and the benefits of archaeology advocated. A significant factor is the financialisation of the environment. Natural capital and ecosystem services provide a framework supporting a market-based approach to managing the environment. Existing survey methods from the physical sciences enable quantification of natural assets that are relatively easily transposed into monetary values. The credit and offset markets for carbon and biodiversity attest to this. As an intangible asset, cultural heritage is at a disadvantage in such a quantified value-based system. As offset values rise, despite questions about their effectiveness, the incentive to change land-use to participate in the rewards becomes greater. Archaeology needs to be included, from site to landscape, in the accounting system. In doing so, our heritage can be part of the planning process for future nature-based interventions, offering more resilient and sympathetic solutions. It would additionally provide community support for the interventions through the recognition of the relevance of their historic landscapes. In our talk we will outline some of the challenges in integrating archaeological datasets to provide useable information to help promote the use of archaeology and palaeoecology in nature-based conservation, and provide examples of where this has and has not been successful.

Prehistoric understandings of wildlife and their relevance for current nature recovery

Anwen Cooper

Keywords: wildlife, prehistoric Britain, nature recovery

Environmental archaeology produces important evidence for past wildlife in the form of pollen, mollusc, insect, vertebrate and plant macrofossil remains. This evidence has traditionally been understood as an ‘environmental background’ to human activity, as an increasingly minor component of foodways, as an intriguing element of ritual practices, as a proxy for characterising farming activities, or as a marker of growing human control over landscapes leading to the local extinction of species like aurochs and elk. Such accounts are predicated on contemporary understandings of wildlife—how we, as archaeologists, define ‘wild’ species now. Thus far, prehistoric perspectives on wildlife have mainly been considered in abstract discussions about the relevance (or not) to prehistoric people of how nature and culture are currently defined. This paper examines formal deposits of ‘wild’ taxa—from a pierced limpet shell in a Bronze Age inhumation burial, to an Iron Age box containing mixed fragments from wild and domesticated species—as starting points for scrutinising understandings of wildlife from 2600 BC-AD 43, a key period in the transformation from ostensibly ‘wild’ to ostensibly ‘tamed’ landscapes in Britain. By examining later prehistoric ideas about wildlife, it is possible to reflect on current understandings of nature and to ask whose version(s) of wildness should hold sway as we restore nature and build more biodiverse futures.

Beavers, bears and biodiversity: bioarchaeology, ethnography and community engagement at Lake Orestiada, NW Greece

Valasia Isaakidou and Paul Halstead

Keywords: zooarchaeology, oral history, rewilding, Greece

The old town of Kastoria, located on Lake Orestiada (one of the few EU NATURA reserves in Greece), is widely believed to be named after the beaver (ancient Greek 'kastor') because of the latter's role in its long history as a centre of furriers. With recent decline in the fur trade, Kastoria is increasingly dependent on tourism attracted to its rich historical monuments and, more contentiously, wildlife. ERC-funded ('EXPLO') zooarchaeological research focussed on the nearby lakeside Neolithic settlement of Dispilio, coupled with oral history interviews with elderly local residents exploring traditional farming, hunting and fishing, has illuminated the area's long- and short-term ecological history. Residents have faced multiple recent changes to their environment: e.g., expansion of the lake-edge reed belt, due to cessation of grazing by cattle and buffalo; disappearance of some migratory birds due to loss of open lakeshore; escape of farmed mink; and rapid expansion of protected bears, that imposes a nighttime curfew on villagers. Perhaps unsurprisingly, some residents responded unenthusiastically to a recent proposal to re-introduce beavers. More surprisingly, some claim that beavers are alien to the region, although their presence is indicated from at least the 6th-millennium BCE by zooarchaeological evidence and within living memory by oral testimonies. Our concern here is with how (and whether) our findings can inform debate and shape policy on environmental change, conservation and rewilding. We seek to influence national stakeholders bottom upwards, using popular public presentations of Neolithic Dispilio to inform and shape local opinion.

From Bronze Age pastures to present challenges

Kerstin Kowarik, Valentina Laaha, Hans Reschreiter and Kerstin Hofmann

Keywords: biodiversity, beyond archaeology, multispecies, sustainability

Is the high biodiversity of mountain regions linked to historic and prehistoric land-use? If so, what are the consequences for present and future land management strategies in mountain regions and how can archaeology contribute to these challenges? Recent research building on a variety of analytical approaches has shed new light on the depth, extent and timing of human and non-human entanglement in mountain areas. In particular, (agro-)pastoral activity in high mountain areas has been connected with long-term increases in biodiversity, but other land management practices have also been demonstrated to have positive long-term effects on biodiversity. In addition, changing conceptual frameworks are rearranging dichotomous categories such as "domestic" and "wild" or "cultivated" and "uncultivated". These developments have affected the way we think about "humans and the environment" in archaeology. But is this enough? A number of researchers have pointed out that these new insights and changing perspectives need to be integrated into present and future landscape management strategies to increase landscape resilience and habitability of landscapes in view of climate change. In this talk I will discuss these developments and present a case study on the Dachstein mountain range, where we aim to capture multi-species entanglements and their change over time, as well as how this might or should affect actors outside of archaeology.

Exploring Agricultural Heritage Landscapes in the Balkans: Insights from the Danube Delta and the Valley of Roses

Denisa-Stefania Luca

Keywords: agricultural heritage, cultural landscapes, Balkans

By offering lessons on historical experiences, archaeology can help address environmental challenges in the Anthropocene. However, this information can be applied in climate crisis mitigation or in increasing resilience in affected communities has yet to be defined. The present analysis proposes that archaeology can be a novel dimension in characterising and managing agricultural heritage landscapes (AHLs), which are traditional farming systems with outstanding universal value through their unique landscape-derived culture. The Balkans represent an intriguing study area, possessing understudied landscapes and housing communities that still practice traditional farming. The present analysis explores the traditions of fishing in the Danube Delta, Romania and rose oil production in The Valley of Roses, Bulgaria, aiming to characterise them according to the AHL framework. Moreover, there is an emphasis on the archaeological dimension of the landscapes and an attempt to integrate them into a food systems dimension. This approach reveals novel potential management strategies and emphasises the need for a revised methodology encompassing the above-mentioned perspectives. The discussion explores the urgency of action in protecting AHLs in the Balkans and emphasises the essential role archaeology plays in offering solutions. It also highlights the lack of policy and legislative frameworks protecting culture and landscapes altogether and points out various potential AHLs in the Balkans. Hence, archaeology, through its extensive lessons on the past, can inform policy in the context of AHLs, and help them retain their identity as they navigate the climate crisis.

The Living River Project: Attenborough Great Park, Nottinghamshire

David Jennings

Keywords: public engagement, new narratives, attraction

Aldo Leopold, the American philosopher, conservationist and ecologist wrote “We abuse the land because we see it as a commodity belonging to us. When we see land as a community to which we belong, we may begin to use it with love and respect”. Environmental archaeology, with its exploration of deep time offers extraordinary opportunities to demonstrate humans’ radical changes in their relationship to fauna, flora and the planet. Using the results of 150 years of archaeological and environmental research, York Archaeology and partners intend to build a world-class visitor attraction in the Trent valley, which will address the climate crisis by engaging people with humankind’s long history and the history of the wider ecosystem. We will invite our visitors to reform their relationship with the environment and stimulate them to build a wilder future and better more sustainable life. Addressing the questions of the conference abstract, we believe that environmental archaeology not only has an ability to address global concerns but an obligation to be an active agent for positive change. The Living River Project, as a fusion of archaeological, environmental and earth sciences, presents issues of narrative definition and how we translate complex cross-disciplinary perspectives in ways that are engaging, authentic and potentially transformative to mass audiences. The paper is offered to the conference as one way in which the profound relevance of our discipline as a reflective tool that will lead us through the climate crisis can be activated.

Lightening talks:

Enhancing Archaeological Science Communication: A Comic for Engaging Children with Coastal and Submerged Landscapes

Nafsika C. Andriopoulou, Kleanthis Simyrdanis, Maria Kypriotaki and Nikos Papadopoulos

Keywords: science communication, comics for education, visual storytelling, archaeological imagination, coastal and submerged landscapes

Archaeological science communication is essential for nurturing an appreciation of natural and cultural heritage while stimulating imagination and scientific inquiry among children. Comics serve as an effective medium for this purpose, using sequences of image panels complemented by text and other visual elements to convey ideas. This study focuses on narrating a story using a script and illustrations, aimed at introducing early primary school-aged children to archaeological science, with a particular emphasis on coastal and submerged landscapes. This comic aims to engage young audiences with archaeoenvironmental research through compelling narratives and visuals, making complex concepts accessible and exciting. The development of the comic involves several key stages: conceptualisation, character design, pre-sketching, page layout, pencil drawing with dialogues, inking, colouring and finalising designs. Central to the story are an ancient magical hourglass, symbolising timeless human knowledge, and a group of fantastical creatures—heroes representing distinct scientific fields, including coastal and underwater archaeology, geology, geophysics, and aerial/satellite remote sensing. The successful completion of the comic builds upon the interdisciplinary research programme "ClepsYdra: Translating Submerged and Buried Cultural Heritage from Shallow Water to Digital Environment with Geoinformatics", coordinated by the GeoSat ReSeArch Lab (IMS-FORTH) and funded by the Hellenic Foundation for Research and Innovation (HFRI). In the near future, this comic will serve as a primary resource for the design, development, and implementation of an augmented reality (AR) application aimed at enhancing real-time sensory experiences during interactive cultural tours for children, including those with special educational needs/disabilities, such as sensory disorders.

Session 8. Posters

A stable, harmonious, and resilient anthropogenic ecosystem on the Tibetan Plateau 4400–2300 years ago

Xu Han and Xiaoyan Yang

Keywords: sedaDNA, anthropogenic ecosystem, Tibetan Plateau, resilience

Over the past millennia, human’s conflict with native ecosystems has triggered numerous ecological crises, such as habitat fragmentation, overexploitation, and species invasions. The ecosystem of the Tibetan Plateau is fragile and sensitive, standing as one of the world's largest pristine natural environments. Mabu Co site is the world's highest elevation Neolithic site with a sedentary lifestyle at 4446 masl, deep in the interior of the Tibetan Plateau 4400–2300 years ago. This site was located on the paleo-shorelines of Mabu Co Lake, where ancient indigenous populations employed a lake-centred lifestyle primarily supported by fishing, supplemented by mammal and bird hunting, and later also engaged in farming and herding. Did 2,000 years of human activities at ultra-high altitudes impact fragile ecosystems? Here, we reconstructed

the watershed ecosystem during the occupation period of the site, through sedaDNA, combined with geochemical, and palynological records from Mabu Co Lake sediment core. The results demonstrate that the landscape was stable lake-meadow-shrub steppe. The prolonged human occupation did not cause significant damage to the native ecosystem; instead, a harmonious relationship was established. Although the ecosystem experienced occasional cyanobacterial blooms and pikas outbreaks, it rapidly recovered to pre-disturbance conditions. This case exemplifies the resilience and sustainability of past anthropogenic ecosystems in the high-altitude, extreme environment of the Tibetan Plateau in the past.

Better Biodiversity Net Gain for the past, present and future

Nick Overton, Anwen Cooper, Graeme Clarke and Leo Webley

Keywords: biodiversity net gain, nature recovery, historic environment

In February 2024 it became a legal requirement of developments in England to deliver a 10% increase in biodiversity as part of the development. If this cannot be achieved within the 'onsite' limits of the development, habitat creation can instead be undertaken at 'offsite' locations. However, offsite biodiversity net gain (BNG) developments are not legally required to consider the historic environment in the way other developments must, and it is unclear how the historic environment is currently being incorporated into the planning, execution and presentation of offsite BNG projects. Oxford Archaeology has just begun a new project, funded by Historic England, to explore the relationship between the historic environment and Biodiversity Net Gain (BNG) developments. The project will examine our current knowledge of how specific habitat creation practices impact the historic environment, the potential opportunities historic environment elements offer for creating biodiverse habitats, and how to encourage public engagement in them. It will explore how knowledge of the historic environment is spread across diverse stakeholders involved in BNG developments and explore whether the currently available resources are suitable for non-specialists to understand the relevant issues relating to the historic environment in BNG projects. This project aims to establish ways to maximize the inclusion of the historic environment in BNG projects, not just to ensure heritage assets are protected, but also to ensure the historic environment positively contribute to nature recovery schemes in the future.

BOAR: A Biocultural Odyssey of Archaeological wild boar: Reconstructing the deep-time dynamics of boar in Britain

Alisha Barker

Keywords: human-animal-environment interactions, zooarchaeology, extinction, reintroduction

Represented on Iron Age gold coins, early medieval helmets, high medieval and post-medieval heraldry, the wild boar (*Sus scrofa*) has maintained its cultural significance in Britain for over two thousand years, far beyond their extinction on our shores. In recent years, the wild boar has controversially made its way back to British soil, with escapees from wild boar farms reestablishing viable breeding populations in multiple regions across Britain. This has sparked a divisive debate surrounding the wild boar's fundamental right to exist within the British landscape. The future of British wild boar is dependent on contextualising the species' deeper history on the island. However, reconstructing the historical biogeography of the species has long been hindered by issues of identification that span the historical, iconographic and (zoo)archaeological records. The BOAR PhD project will implement a multi-scalar interdisciplinary strategy

integrating cutting-edge scientific techniques with traditional zooarchaeology, historical texts and iconographic data to not only address this core barrier to furthering historical wild boar research, but also greatly expand on our knowledge of wild boar from the past 10,000 years. This involves the pioneering integration of δ2H isotopic analysis alongside carbon, oxygen, nitrogen, sulphur and strontium with 2D and 3D geometric morphometric analysis to create a high-resolution reconceptualization of deep-time human impact on the species, which will serve to provide a rich deep-time context for very poignant modern issues including reintroduction, conservation and rewilding.

Bugging the Abandoned: Tracing Entomofaunal Changes in an Apuan Alps Shelter

Matilde Stelli and Philip Buckland

Keywords: archaeoentomology, insects, abandonment, contemporary archaeology

The Apuan Alps in northwest Tuscany once hosted mining, agricultural, pastoral and forestry activities. Since the post-World War II period, these mountains have experienced significant depopulation, which resulted in the abandonment of lands and buildings. The field of archaeoentomology provides valuable proxies for reconstructing the history of this area. Our research focuses on an abandoned shelter in Pomezzana, located beneath a cave, where we conducted two shovel test pits. The soil samples taken from the various layers were processed to search for insect fossils, following the standard techniques: organic components were separated from inorganic ones using a 300 µm sieve under water, and the resulting samples were then sorted under a low-power binocular microscope. The insect fossils retrieved were identified by comparing them with modern reference material. Additionally, six pitfall traps were placed inside and outside the shelter, in order to observe the current entomofauna in the abandoned structure. By comparing insect assemblages from different layers and from the pitfall traps, this study examines the changes in entomofauna throughout the phases of the site's usage. The results offer us insights into the history of the archaeological site, and, in a broader perspective, give us the chance to further understand the relationship between humans and environment, in an area characterized by abandonment.

Comparing low- and high- resolution sampling methods for stable oxygen isotope analysis of animal teeth: implications for future research

Johanna Evans, Petra Vaiglova and Xinyi Liu

Keywords: zooarchaeology, tooth development, isotopic methods

Sequential sampling of tooth enamel allows researchers to track changes in stable isotope values over the course of enamel formation, providing evidence of past animal diet, mobility, and behaviour. These studies commonly employ the hand-drilling method, which removes powdered enamel in regular (approx. 1mm) intervals starting at the chewing surface and ending at the enamel root junction. However, this strategy does not strictly follow the geometry of tooth growth development. Recent applications of the Sensitive High-Resolution Ion Microprobe (SHRIMP) have enabled in-situ measurements of stable oxygen isotope values from tooth enamel. This study aims to compare sequences achieved using the low-resolution (hand-drilling) and the high-resolution (SHRIMP) sampling of two teeth (one sheep and one cattle) from the Hexi Corridor in northwestern China. SHRIMP analyses were carried out by placing sampling locations at intervals corresponding to a week of enamel formation, using the positions of identifiable daily growth lines as a guide. The presentation will explore ways of visualizing and interpreting the temporality of each

dataset and assess the degree to which the low-resolution sequences are attenuated through mixing. The findings will enable us to better define the limits of interpretations of sequential enamel datasets obtained using the two approaches, with the aim of combining previously published results using meta-analyses.

Continuity and change in cultivation practises between Later Iron Age and Roman Cambridgeshire: evidence from the Isle of Ely and Cambridge

Stella Quast and Alexander Weide

Keywords: functional weed ecology, crop processing

This study has utilised functional weed ecology to characterise the cultivation regimes of two agricultural settlements in Cambridgeshire, Lancaster Way Plot B in Ely (LAW) and 5/6 Clerk Maxwell Road in Cambridge (CMR, part of Vicar's Farm), to better understand how the cropping practises at these sites relate to broader trends in arable farming during the Later Iron Age to Roman periods. Archaeobotanical analysis revealed that spelt wheat (*Triticum spelta*) was the dominant cereal present at both sites, followed by emmer (*Triticum dicoccum*) and barley (*Hordeum vulgare* s.l.). The samples from the two sites represent later stages of crop processing activities, which were classified as fine-sieving products and by-products in a crop processing analysis. Functional ecological analyses indicated that extensive farming practises prevailed at LAW and CMR, suggesting continuity in principal farming strategies from later Iron Age to Roman times. Higher densities of stinking chamomile (*Anthemis cotula*) found in the Roman samples from the sites, however, denote an increase in cultivation on heavy soils, possibly indicating agricultural expansion. Overall, the results from this small-scale study suggest that both sites were associated with broader trends of extensive agricultural practice during the later Iron Age, which continued and potentially expanded into previously uncultivated areas during the Roman period, presumably linked to population growth after the Roman conquest.

Deriving Wet-Dry Seasonality Signals from Land Snail Shell Isotopic Composition

Xin Wang

Keywords: paleo-precipitation, seasonality, stable isotopic analysis, land snail shells, millet cultivation, northwestern China

Seasonal climate changes have profound effects on socio-economic systems and may have significantly influenced the development of ancient civilizations. However, capturing seasonal signals from terrestrial geological and archaeological records remains challenging, as high-resolution archives such as marine fossils, corals, and tree rings are often restricted to oceanic regions or recent periods on land. In this study, we introduce a novel proxy index for paleo-precipitation seasonality, derived from the range of stable oxygen isotope values within individual land snail shells (intra-shell Δ δ18O). Our analysis reveals consistently lower intra-shell Δ δ18O values in winter precipitation-dominated western Central Asia compared to summer precipitation-dominated northern East Asia. Applying this method to archaeological samples from northwestern China, we demonstrate that past global warming reduced wet-dry seasonal contrasts in monsoonal Asia. Additionally, we observe a significant increase in carbon isotope values in land snail shells starting around 7,000 years BP, which were link to the onset of millet cultivation in the region. These findings suggest that changes in climate, seasonality, and human activities significantly altered landscapes and ecosystems during this period. This study provides a powerful new tool for exploring

paleo-precipitation seasonality in archaeological contexts and enhances our understanding of how climate changes and human activities influenced socio-ecosystem changes in ancient times.

Exploring the drowned environments of Doggerland—an initial multiproxy study on palaeo-lake sediments off the coast of Heligoland

Sascha Krüger, Berit V. Eriksen, Stefan Dreibrodt, Wolfgang Rabbel and Sebastian Krastel

Keywords: Doggerland, palynology, late Palaeolithic, vegetation history, reindeer

The names of the most important Late Palaeolithic cultural groups of reindeer hunters in northern central Europe (Hamburgian and Ahrensburgian) derive from eponymic sites located north of the river Elbe, where the past hunters repeatedly set up hunting camps. Unquestionably, the Elbe palaeo-valley would have marked a very important migration route throughout the Weichselian late glacial and Early Holocene. This route took reindeer and their hunters straight to Heligoland, which surely stood out as a permanent landmark in a vast and transforming landscape of Doggerland. This now submerged area close to Heligoland was the focal point of the TRAPA research cruise that took place in May 2024. The project on board the German research vessel Maria S Merian not only provided high resolution hydroacoustic data but also 20 sediment cores from the submerged North Sea Plain close to the island of red sandstone. Here we present preliminary palaeo-environmental investigations into one of these cores, which happens to be the first laminated palaeo-lake core from the area of Doggerland. The sequence spans the Pleistocene-Holocene boundary and offers valuable insights into Doggerland's diachronic vegetation change as well as changes in presence of large herbivores. The correlation with high-resolution terrestrial records from Germany and Denmark underlines differences in landscape and biozones that were home to Late Palaeolithic hunter-gatherers.

Extracting high-resolution environmental information from enamel: a case study using modern wild horse molars from Japan

Oscar Balla, Petra Vaiglova and Manabu Uetsuki

Keywords: stable oxygen isotope analysis, zooarchaeology, animal mobility, rainfall proxy

Faunal teeth preserve well at archaeological sites, and their stable oxygen isotope values (δ18O) can provide useful insight into past animal behaviour, mobility, and agropastoral management. In the case of wild animals, tooth enamel can be used as a proxy for inferring past climate and environmental factors such as rainfall seasonality. This talk will present the preliminary results of the first large herbivore study that measured tooth enamel δ18O with an approximately weekly resolution. In this study, thin sections (~70 µm thick) were obtained from a Misaki horse that lived in Cape Toi, Japan, in the 1980s. The developmental patterns, and in particular the visible daily growth lines in these teeth, were mapped using high-power microscopy. This information was then used to guide in-situ δ18O measurements using the Sensitive High Resolution Ion Microprobe (SHRIMP) at the Australian National University. The presentation will compare the enamel δ18O sequences to known rainfall patterns from the region and assess the degree to which the sequences were dampened through body fractionation. The discussion will consider implications for inferring seasonal fluctuation in local environmental water and mobility patterns of large herbivores from the archaeological record.

Landscapes, Species and Anthropogenic Change

Hannah Rigden, Sander Aerts, Ines Lopez-Doriga, Lizzie Garwood, Amy Wright, Andrew Valdez-Tullett and Ed Treasure

Keywords: archaeological evidence, nature recovery

Natural England recognises that little if any of our habitats are natural and instead represent changes made by humans over time. For an adviser dealing with conservation and the enhancement of biodiversity in the present, and in a time of crisis, whilst there may have been little change for a century or so, the long-term picture may have been radically different. Our “Landscape, Species and Anthropogenic Change” project set out to gather integrated natural and cultural capital information about our Priority Habitats. We believe it is vital that this is understood when planning future interventions to help us meet government targets for nature recovery. By ignoring archaeological and historical evidence we will miss opportunities for integrated nature recovery and solutions to issues, while risking unintentional damage to the historic record itself. Our contractors Wessex Archaeology brought together the most up-to-date published evidence on the who, what, why, when and how of human habitat changes to enable Natural England advisers to find information more efficiently. It is presented through beautiful illustrations and timelines which open up this complex story of how our most special habitats came to be to a wide audience.

Light shines through the cracks: the lichens of abandonment

Carlotta Hollestelle, Gabriele Gattiglia, Luca Paoli and Claudia Sciuto

Keywords: lichenometry, environmental archaeology, lichens, abandonment

This study aims to explore the possibilities of lichenology and lichenometry as a proxy for the study of ecological dynamics in the mountainous areas of northwest Tuscany, particularly the Versilia side of the Apuan Alps. The area has experienced constant depopulation since the 1970s, with the interruption of all agro-sylvo-pastoral activities that characterised the life of human communities on the slopes. The investigation focuses on creating a transdisciplinary protocol for studying lichens found on now-abandoned residential structures as chronological and ecological indicators. Historical cartography provides information to define the chronological boundaries about the abandonment of the structures, and combining this data with that from lichens, we can formulate a calibration curve for certain species' growth. These seasonally occupied buildings have a simple floor plan, sometimes with a first floor or a stable on the lower floor. With the collapse of the first floor and/or the roof, sunlight has allowed lichen growth. Those examined, have a circular thallus, developed on a regular surface and free from evident competition phenomena. Lichens that had grown after the structures had been abandoned (on collapsed walls, internal shelves or lintels of doors or windows) were particularly examined. We characterized epiphytic lichens on the bark of nearby trees to describe the surrounding ecology. This project is a methodological synthesis of environmental archaeology within contemporary archaeology, proposing a functional methodology and protocol for the ecological characterization of lichens and their value as chronological and ecological indicators.

New Windows to the Past: Two innovative approaches to disentangle past ecosystems through animal fossil remains

Miriam Ibáñez-Herranz, Ana B. Marín-Arroyo and Raúl Fernandez-López

Keywords: deuterium, eDNA, paleoecology, herbivores, northern Iberia

To understand past ecosystems, it is essential to study not only the organisms that made them up, but also the relationships between them and the climatic conditions they had to cope with. To this end, we propose a new multidisciplinary approach based on two research lines: first, by measuring deuterium in animal bone collagen, and second, by studying the environmental DNA obtained from herbivores' dental calculus. Several authors have found that the deuterium ($\delta 2H$) incorporated through food and water intake into mammal bodies can be correlated with temperature and precipitation at the time the species lived, thus allowing inferences about past climatic conditions. To do so, we are working to establish a direct spatial correlation between current regional climate in northern Iberia and isotopic fractionation in contemporaneous animals. Complementarily, we are investigating interspecific relationships using metagenomic analysis. Because of its ability to embed and protect fragments of genetic material from an individual's own microbiome and diet, known as environmental DNA (eDNA), dental calculus is ideal for unravelling the contemporaneous environmental conditions. Here we focus on establishing the methodology to disentangle the vegetation of an animal's diet, and thus the vegetal landscape available at the time that herbivore lived. We here focus on studying the diet of herbivore remains associated with Palaeolithic human groups, aiming to reconstruct the ecology of the animal species and the ecosystems these humans exploited. This double approach shows the immense potential of these methods for understanding how species' relationships have evolved over time and how climatic variations have influenced their adaptability to different geographical environments throughout the Palaeolithic.

New finds of opium poppy from northern Greece and the southwest Balkans: revisiting biogeography, cultivation and domestication

Müge Ergun, Amy Holguin, Rachel Ballantyne, Eugenia Gkatzogia, Michael Charles, Raül Soteras, Ferran Antolín, Aurélie Salavert, Kostas Kotsakis, Albert Hafner, Willy Tinner and Amy Bogaard

Keywords: archaeobotany, waterlogged, oil seed crops, Neolithic, southeast Europe

Recent archaeobotanical finds of wild opium poppy seeds in northern Greece and the southwest Balkans open up new questions about the distribution of this plant in the Neolithic and its role in early farming communities in southern Europe. Here we report on new results from the ERC Synergy 'EXPLO' project (Universities of Oxford, Thessaloniki and Bern), featuring uncharred (waterlogged) opium poppy seeds from three lakeshore settlements: Dispilio on Lake Orestias, western Greek Macedonia, and two sites on Lake Ohrid, Lin (Albania) and Ploča Mičov Grad (North Macedonia). We consider the role of opium poppy in these early farming communities in light of current results on taxonomy, chronology and domestication status. We also discuss linkages with early opium poppy seeds from Neolithic sites in the central-western Mediterranean zone, including the lakeshore settlements of La Marmotta near Rome and La Draga, Catalonia, and from Central Europe.

Opportunity and adaptation: the role of non-domestic animals in the medieval urban environment

Alison Foster

Keywords: urban, industrial, commensal, decline, recovery

Excavations at The India Buildings site in Edinburgh, prior to redevelopment of the area, revealed a sequence of well-stratified, excellently preserved deposits dating from the present to the foundation of the burgh. Remains recovered include a large assemblage of animal bone. Features and deposits from the period between the 12th and 16th centuries represent industrial activity, particularly tanning, and the majority of the bone assemblage is consistent with this, having a large component of cattle crania and horn cores as well as the remains of sheep, goats and horses. There is also evidence for a significant number of non-domestic mammals and birds, particularly those species which would have exploited the living spaces and feeding opportunities afforded by the buildings and refuse of this working area of the settlement. Many of these animals suffered serious decline during the post-medieval period through persecution and loss of habitat, often to the point of local extinction, but some are seeing a recovery in numbers and a return to the towns and cities. The presence of their remains in the deposits of medieval Edinburgh offers an opportunity to consider the complexity of human-animal associations and changing attitudes towards those uninvited species that share our urban spaces, both in the past and present.

Phytoliths in Roman Cattle Dental Calculus: Unveiling Dietary and Environmental Insights from Silchester, UK

Felix Sadebeck and Nafsika C. Andriopoulou

Keywords: phytoliths, dental calculus, Roman cattle, microscopy, archaeobotany

Phytolith analysis from dental calculus (mineralised dental plaque) has emerged as a promising method for reconstructing dietary and environmental histories in ancient animals. This study employs Optical Light Microscopy (OLM) and Scanning Electron Microscopy with Energy Dispersive X-Ray Spectroscopy (SEM/EDS) to analyse phytoliths extracted from the dental calculus of ten Roman cattle mandibles (*Bos taurus*) from Silchester, UK. Phytoliths, microscopic SiO2-rich biominerals formed in plant tissues, become entrapped in dental calculus during consumption and can remain preserved over time, providing a direct record of plant ingestion. Our analysis identified a few phytolith morphotypes, including those characteristic of grasses (Poaceae) and dicotyledonous plants, suggesting mixed feeding strategies. These findings may also reflect changes in vegetation availability across different seasons and environments. The presence of certain phytolith mophotypes also suggests the influence of agricultural practices, such as foddering and pasture management, on cattle diets. While microscopy-based phytolith analysis provides valuable archaeobotanical insights, the preservation of phytoliths in dental calculus may be impacted by taphonomic and biogeochemical processes, which could lead to an incomplete or biased dietary record. Phytolith production also varies among plant species, with some plants producing more phytoliths than others, potentially skewing the representation of the diet. Incorporating multi-proxy approaches, including experimental archaeology, stable isotope analysis and ancient DNA studies, is necessary to obtain a more comprehensive understanding of cattle feeding behaviours and (archaeo)environmental adaptations. Future studies should address the thermal alteration of samples, according to our initial observations, as heat exposure may affect phytolith preservation and interpretation.

Ploughing, Pasture and Pannage in the Peaks

Tudur Davies

Keywords: medieval, pollen, open field system, pannage, Peak District

This paper presents the results of a pollen study undertaken at Under Whitle, located in the Peak District between the boundaries of the dark peak and limestone plateau near Buxton. A pilot study on the site established the presence of organic rich sediments of medieval date containing very high percentages of cereal-type pollen and other arable indicators. The sampling site is uniquely situated in the immediate vicinity of a ridge and furrow field system of presumed medieval date. This is highly unusual, given that pollen sampling sites are usually located in upland settings away from the traditional focus of arable activities and core settlement areas. In recognition of the unique potential of the site to provide information relating to medieval agriculture, the Tudor Farming Interpretation Group (TFIG) obtained funding from the Farming in a Protected Landscape (FiPL) programme to undertake a detailed palynological study. By sampling every 0.5 cm of the core within a section dating to the mid-9th to late 15th century, this work provides a continuous record of vegetation change and land use in the later medieval period. Earlier deposits dating as far back as the 7th century were also sampled at a slightly coarser sampling interval. This presentation examines some of the results of this analysis, including the evidence for pannage and the origins of open field agriculture in the Peak District.

Quantifying the effects of early Holocene woodland disturbance and its effects on species biodiversity

Mai Walker

Keywords: pollen, rewilding, anthropogenic, palaeoenvironmental, woodland

Ecosystems are entwined in the activities of multiple species including humans, yet this human presence is often thought of in negative terms, particularly in relation to our interactions with forested environments. However, palaeoenvironmental analysis has identified multiple cases of controlled burning and selective deforestation undertaken by humans during the early Holocene, which encouraged species diversity within forests. This not only shows the positive effects that humans can have on plant community composition, but also has the potential to inform contemporary rewilding and woodland conservation efforts. This poster presents the initial results of my doctoral research, which seeks to use early Holocene pollen records to inform contemporary woodland conservation and rewilding strategies. For this study, I have compiled a database of all palynological records from England that include episodes of early Holocene woodland disturbance. By analysing this data, it is possible to detect signatures of woodland disturbances through the pollen record and how this relates to anthropogenic relationships with the landscape in a time of 'low' environmental, pre-agricultural impact.

Reconsidering how we can use developmental growth patterns in teeth to improve resolution of palaeodietary and palaeoclimate studies

Petra Vaiglova, James Nichols, Horst Kierdorf and Carsten Witzel

Keywords: enamel growth, stable oxygen isotope values, zooarchaeology

Sequential analyses of tooth enamel stable isotope values have provided valuable insight into patterns of ancient animal behaviour and mobility. However, the sampling strategy used in these studies often does not closely follow the geometry of tooth growth development. As a result, the biggest challenge to interpreting these hand-drilled enamel samples (commonly spaced ~1 mm apart) is that each sub-sample represents a different and unknown unit of time. This talk will use histological insight into developmental growth patterns of teeth to build a mathematical simulation that maps dietary inputs across the daily growth lines of two types of teeth: one sheep and one pig. Taking into consideration both the secretory and the maturation stages of enamel development, the outputs of the model will allow us to test hypotheses regarding the feasibility of detecting geographically specific dietary and seasonal patterns. The talk will illustrate the applicability of the model using examples from distinct agropastoral settings and discuss the benefits of this approach for (a) refining inferences of already-published sequential isotope datasets, and (b) informing future research design and planning.

Reversion, Conversion or Adversion? The Quandary of Utilising Palaeoenvironmental Evidence in Authentically Presenting Prehistoric Archaeological Sites: A Case Study of the Cotswolds

Pete Moore

Keywords: palaeoenvironments, reconstruction, public, ecology

Palaeoenvironmental research has long provided rich insights into the past vegetational character of our landscapes and the interrelationship that human lifeways had within these spaces. However, the integration of this data with informing and enhancing contemporary approaches to protecting and managing these spaces is limited. Today, many archaeological sites occupy environmental settings vastly at odds with their past, detaching the modern experience of these sites from their true conditions. The composition and character of local vegetation is important and would have dramatically influenced how these spaces were encountered and perceived, whilst additionally leading to erroneous (e.g., phenomenology) or potentially fabricated (sightlines) observations in the present. Should archaeological sites be more authentically represented to better convey their environmental settings they occupied, or is this circumstantial? Many landscapes across the world today are suffering from multiple pressures, both human and climatic, which are greatly impacting its cultural heritage and ecology. Can or should archaeological sites be better integrated in enhancing biodiversity and can this be done without damaging or obscuring their protected character and assets? This poster seeks to explore the complexity and potential of using palaeoenvironmental insights into authentically presenting and experiencing archaeological sites and how this could benefit ongoing efforts to combat climate change. A range of sites across the iconic landscape of the Cotswolds, southwest Britain, will be used to explore such issues.

Sailing through Time—Tracing the Roots of Nordic Seafaring with a Pollen Perspective

Morten Fischer Mortensen, Lisbeth Prøsch-Danielsen, Helge Irgens Høeg and Per Lagerås

Keywords: cannabis, retting, Iron Age, Viking period, pollen

Considering the fragmented nature of direct evidence regarding the origins of sailing ships, we often need to turn our focus to the examination of essential raw materials instead. This involves scrutinizing the sourcing of wood for ship construction, wool for sail production and plant fibres for the rigging ropes. Large quantities of Cannabis pollen in lake sediments are a well-known indicator for hemp retting and thus the use of hemp in the production of ropes and textiles. Within well-dated sediments, these traces offer a unique insight into the local onset, duration, peaks and decline of hemp-related production. In this study, we examine an assemblage of such production sites from Norway, Sweden, and Denmark to trace periods of high intensity in hemp retting across time and space and discuss a possible link to the origin of the sail in a Nordic context.

Sedimentary Ancient DNA (sedaDNA) from Mesolithic sites across the UK reveals Early Holocene Landscape Change

Sam Hudson, B. Pears, M. Bell, D. Jacques, R. Scaife, B. Taylor, C. Waddington, I. G. Alsos and T. Brown

Keywords: sedaDNA, Mesolithic, palaeoecology, early Holocene

Sedimentary ancient DNA (sedaDNA) is beginning to be applied more widely in archaeological contexts as a tool for reconstructing past landscape change. This research highlights sedaDNA analysis of plants and mammals from a number of prominent Mesolithic sites across the UK, including No Name Hill, Yorkshire, Ufton, Berkshire, Blick Mead, Wiltshire, and Killerby, Yorkshire. In combination with traditional palaeoecological methods such as palynology the DNA assemblages are able to identify common features between the sites, and ecologies unique to particular locations, demonstrating the flexible nature of the technique. However, the data also shows how factors of preservation bias, and biases of catchment, need to be considered in any application of the methodology. SedaDNA ultimately provides a new avenue to examine landscape change in sedimental contexts previously thought devoid of environmental evidence, and here we showcase its potential to environmental archaeology.

Sub-surface sedimentological mapping and analysis of the River Avon, UK reveals hidden palaeohydrological character and landscape change in early prehistory

Ben Pears, M. Allen, C. French, C. Gaffney, V. Gaffney, S.Hudson, D. Jacques, A. Köehler, M. Kreck, M. Pohle, C. Tomsett, U. Werban and T. Brown

Keywords: sub-surface mapping, geophysics, chemostratigraphy, early prehistory, River Avon

Over exploitation of British chalk river systems through drainage and water meadow creation has over the last 500 years led to the loss of distinctive and sensitive geomorphological characters which have been used in other fluvial systems to reconstruct past environmental conditions. Here we demonstrate a distinctive multiproxy approach including Electromagnetic Induction (EMI), Electrical Resistivity Tomography (ERT) and Direct Push Colourimetry survey techniques alongside traditional sedimentology

and chemostratigraphy to look through surface disturbance in the Wiltshire Avon floodplain on the edge of the Stonehenge environs. The combination of these innovative, mult-analytical methods with scientific dating has been invaluable in the discovery of discrete palaeochannels and fluvial deposits associated with the early history of the Avon fluvial landscape, particularly from the Mesolithic period to the Bronze Age. Indeed, the development in our understanding of early to mid-Holocene fluvial dynamics and hydrology will provide a greater context for human activity and occupation of the area.

Tarmachan peatbog: a palynological study

Philip Gould

Keywords: peat, pollen, palaeoecology, landscape restoration, carbon offsetting

This project presents the research methods and findings from a palynological investigation of Tarmachan Peatland, Ben Lawers, near Killin, Perthshire, Scotland. The project was carried out as part of the National Trust for Scotland Tarmachan Peatland Restoration Project, as an undergrad dissertation at the University of Glasgow. Palynological and LOI testing was carried out creating a deep-time perspective on the landscape. The peat inception is estimated to be circa 4000 BP at Tarmachan, with the archaeological record showing that there was already anthropogenic activity within this landscape predating the inception of peat on site. The anthropogenic disturbance continued throughout the Bronze Age, Iron Age and the medieval period with the introduction of grazing animals into the wider landscape. Peat cutting is evident in this sequence and seems to have had a large effect on the stratigraphy of the site. Grazing animals may have been introduced onto the peat land itself at a slightly later date, and the effects of draining on the flora may be visible in this record. Overall, this palynological investigation has shown how people have impacted the flora present at Tarmachan over centuries and hopes to further inform restoration and public outreach work at the site. Peatland restoration has a distinct role in carbon offsetting, a role which palaeoenvironmental archaeology can aid.

Using ancient DNA to better understand farming transitions and the impact of disease

David Ziliang Hu, Johan Nordgren, Richard Ågren, Ainash Childebayeva, Magdalena Neijd, Marie Hagbom, Kay Prüfer, Lennart Svensson and Hugo Zeberg

Keywords: ancient DNA, farming, epidemiology

A genetic variant truncating the enzyme FUT2 protects against viral gastroenteritis. This variant has been selected for with the Neolithic transition as farming becomes a more popular subsistence lifestyle. Here, we track this variant through time by analysing ancient DNA of 5638 individuals. Although the variant can be traced back as far back as ~43,000 years ago on the European continent, it is virtually absent in pre-agricultural Europe. Coinciding with the introduction of farming through archaeological evidence, we observed a rapid increase in allele frequency to 30-50% in Europe. Over the last 10,000 years, this variant, has had a larger change in frequency than 99.96% of the genotyped variants in the ancient DNA database. We also see that the earliest high rates of this variant in Anatolians of modern-day Turkey, where we often point to as the origin of farming practices. Viral transmission dynamics suggests that the present-day frequency of homozygous carriers improves population fitness when faced with viral gastroenteritis. Our study hence suggests that the reduction in social distancing following the transition from a hunter-gatherer

lifestyle to a semi-sedentary agricultural lifestyle drove selection of this allele in Europe following introduction of the allele through migration from Anatolia.

Venice Lagoon (Italy) through time: insights from Environmental Archaeology from Roman Time to Middle Age

Alessandra Forti, Carlo Beltrame, Adele Bertini, Paolo Mozzi and Gabriele Niccolini

Keywords: Venetian Lagoon, landscape, archaeobotany, geoarchaeology, palynology

The Venetian Lagoon (Northeastern Italy) has been inhabited since the Bronze Age due to its environmental resources. Environmental archaeology has provided archaeobotanical and geoarchaeological data to reconstruct ancient landscapes. Archaeobotanical remains from six northern lagoon sites reveal critical insights into environmental exploitation and crop diversity. At the Roman sites of Altino and Lio Piccolo, deciduous oak (*Quercus* sp.) was used primarily for poles and piles. Palynological analyses indicate diverse agricultural practices including the cultivation of fruits (e.g., *Prunus* spp., *Vitis*, *Juglans*, *Olea*), vegetables (*Cucumis sativus*), legumes (*Pisum sativus*), and cereals (*Avena*/*Triticum*-type), suggesting a highly diversified agricultural landscape. Since late Antiquity, oak has been supplemented with other woods for construction and land reclamation. In Torcello, San Pietro di Castello, Jesolo Antiche Mura, and Jesolo San Mauro, primary woods include Rosaceae, hornbeam (Carpinus betulus), and English ash (*Fraxinus excelsior*). From late Antiquity to the medieval periods, there was significant crop diversity. Fruits (*Vitis vinifera*, *Prunus avium*, *Prunus persica*) and vegetables (*Cucumis sativus*, *Cucumis melo*) were found at Jesolo Antiche Mura, Jesolo San Mauro, Torcello, and San Pietro di Castello. Cereals (*Triticum* spp., *Hordeum* sp.) were identified in Jesolo sites and Torcello; legumes (*Vicia faba*, *Pisum sativum*) appeared exclusively in both Jesolo settlements. Limited cultivable space led to evolving subsistence strategies. Timber was sourced from mainland deciduous forests. Cereals were also imported. Environmental changes and the dynamic relationship between land and relative sea levels led to adaptations in settlement patterns, seen in San Pietro di Castello, Torcello, and Ca' Foscari.

What's cooking in St Kevin's Kitchen? Investigating foodways at the ecclesiastical site of Glendalough, Ireland, AD 600-1500

Keelin Murphy

Keywords: archaeobotany, medieval, farming, monastic, foodways

From the first Roman missionaries to the arrival of St Patrick and beyond, the early medieval and medieval periods in Ireland (AD 400–1150 and AD 1150–1550, respectively) have long been associated with the spread and influence of Christianity and the development of the institution of the Church as an epicentre of worship, economy and settlement. Many large monastic, or episcopal-monastic, centres and settlements, such as that of Glendalough, began to emerge, bringing with them a wealth of clerics, penitents, monastics and tenants. As food consumption, alongside production and culinary practices, can provide a lens through which to understand social identities, newly formed religious communities would have not only actively farmed and consumed food, but also may have done so in a specific way, in a way that shifted and changed over time, or even in a way like or unlike similar religious or non-religious settlements from the same period. Despite its acclaim as one of Ireland's most iconic religious landscapes,

there is very little understanding of the way people interacted with food at Glendalough and comparatively little archaeological research on scientific evidence such as plant-macro remains and on broader foodways or farming practices. Through a new analysis of archaeobotanical remains and related evidence, alongside a review of historical and textual sources, this project aims to explore this ecclesiastical community's engagement with food, farming and gardening, in order to provide new insights into the concept of the 'monastic garden', alongside the landscape, food production and consumption practices of religious communities in Ireland.

Wood, Fire and Sea: Perspectives on resource selection and environmental change in Early Historic Orkney

Joshua Harry, Rachel Ballantyne and James Barrett

Keywords: fuel selection, Orkney, environmental change, woodlands, early medieval

The nature and chronology of environmental change in the Norse North Atlantic, particularly in Orkney, is a topic of some discussion. By comparison to the richness of investigation into the islands' prehistory, the Early Historic period is more poorly documented, and the environmental impact of Norse settlement particularly underrepresented. Here, the analysis of charcoal assemblages from the Brough of Deerness, a high-status, multi-period settlement in the west of Orkney, offers some insight into these human-environment interactions. The research highlights the exploitation of marine and woodland resources and strategies of fuel selection, as well as attesting to the value of charcoal as a tool for reconstructing past habitats, in conjunction with - and in the absence of - traditional pollen data. These perspectives offer some insight into the 'novel ecological relationships' that defined past settlements and populations in Orkney, as well as into strategies for conservation and habitat regeneration in the present. Strategies that are as relevant to non-archaeological audiences as they are to archaeologists. Given the increased focus on "rewilding" and reforesting by government at a national and local level in the Northern Isles, such approaches attest to the continued relevance of environmental archaeology (including the study of charcoal) not just as a window into the past, but also as a means of developing nature recovery practices for the future.

Zootropolis: Multi-species archaeological, ecological and historical approaches to animals in medieval urban Scotland

Jovita Fawcett, Edouard Masson-Maclean, Jackson Armstrong and Kate Britton

Keywords: isotope analysis, zooarchaeology, textual analysis, animal palaeoecology, medieval Scotland

In the Medieval period, urban settlements were defined and created by intense anthropogenic activity. However, humans were not the only creators of urban spaces, which were also shaped by non-human animals. Integrated studies using bioarchaeological methods and historical analysis provide an opportunity to illuminate human-animal-environmental interactions in the past through the incorporation of complementary (and sometimes opposing) lines of evidence. Using an integrated approach of isotope archaeology, zooarchaeology, and textual analysis of historical sources, this research investigates the economic, ecological, and social spaces that animals occupied in the Burgh of Aberdeen (AD 1200–1500). Here, zooarchaeology informs on the various species that were present; the locations in which animals and

animal-centred activities were found; the nature of animal lives and animal deaths. Stable isotope analysis of the faunal skeletal remains is shedding new light on diet, feeding ecology and movements for wild, domestic and commensal species, allowing us to examine the creation (and filling) of novel urban niche spaces, the management and provisioning of past animals, and contemporary trade networks. Bioarchaeological analyses are complemented by textual analysis of the historic Aberdeen Burgh Records (AD 1398–1511), allowing the examination of the social spaces occupied by animals and the ways in which animals were utilised, managed, and regarded by the Aberdonian populace.