

# **CROSSDEM 2019**



## **Cross-Disciplinary Approaches to Prehistoric Demography 2019**

**Abstracts Book**

**UCL Institute of Archaeology**

**29<sup>th</sup>-30<sup>th</sup> March 2019**

# Keynotes

## **Core issues of prehistoric demography in the light of estimates for the Upper Palaeolithic in Europe**

**Andreas Maier (Friedrich-Alexander-University of Erlangen-Nürnberg)**

This paper presents estimates of population dynamics for the European Upper Palaeolithic which have been calculated in the framework of Project E1 of the Collaborative Research Centre 806, “Our way to Europe”, in Cologne. Working with the “Cologne Protocol”, a density-based upscaling approach, different researchers have compiled a consistent set of regionally differentiated demographic estimates spanning the period from the Aurignacian to the Magdalenian. Against the background of these results, five general core issues of research on prehistoric demography are discussed: reference frame of estimates, appropriateness of proxy data, reliability of estimates, environmental influence, and cultural effects.

1) Should estimates be conducted within an absolute or relative frame of reference?

Estimates on developments in prehistoric demography are usually given as either relative or absolute values. In contrast to the former, the latter usually involves incorporating ethnographic data at the cost of an additional source of uncertainty. The advantage of absolute estimates is yet that a number of important questions can be addressed.

2) What data is appropriate to conduct demographic estimates?

Whether a set of proxy data is appropriate for archaeo-demographic estimates depends on its susceptibility to taphonomic loss, temporal resolution (inherent and set), and degree of relatedness to the phenomenon under study.

3) How reliable can demographic values be assessed based on the archaeological record?

Beside the appropriateness of the proxy data, the treatment of gaps in the data structure is crucial for the reliability of archaeo-demographic estimates. Spatial and/or temporal gaps may reflect either prehistoric reality or various biases.

4) What is the relation between environmental factors and population dynamics?

The influence environmental forces may exert on demographic developments depends on several factors, such as the magnitude of change, the economic system (e.g. farming or foraging), the social structure of a population, or its resilience to external factors. Some of these factors are interdependent and population size itself probably also affects demographic developments. This paper shows that fluctuations in solar insolation during the vegetation period are a good approximation of the general trend of the demographic development during the Upper Palaeolithic.

5) What is the relation between population dynamics and cultural developments?

The number of people and the way they are interconnected are probably important factors for the cultural development of a population. A demographic growth and improvement of the network structure from the Aurignacian to the early Gravettian probably allowed for a fast flow of information and improved innovation dynamics. The pronounced demographic decline during the late Gravettian, however, seems to coincide with network-disintegration, a loss of material culture components and increasing dissimilarities in the artefact spectrum. Renewed population growth during the Magdalenian and network reinvigoration again enhanced the flow of information and led to a high degree of similarity in the material culture. The continued

population growth and resettlement of the northern areas probably exceeded the capabilities of the existing networks eventually and stronger regionalization trends become visible.

**“Nothing in evolution makes sense except in the light of demography”, or interdisciplinary perspectives are necessary for understanding our species**

**Rebecca Sear (London School of Hygiene and Tropical Medicine)**

“God has chosen to give the easy problems to physicists” lamented two social scientists in 1975, referring to the challenges involved in understanding human behaviour. Despite significant progress since then in understanding our species, one hurdle is the existence of disciplinary boundaries which separate researchers working on similar issues but from different perspectives. This talk will argue that an interdisciplinary approach is vital if we are truly to make progress in the human sciences. In particular, it will discuss the necessity of embedding a demographic perspective into the interdisciplinary human sciences. Demography matters: population size, structure and demographic rates influence human behaviour and evolution, and are also an indicator of changes over time in both cultural and evolutionary processes. The talk will also argue for a *comparative* demographic approach to understanding humans, using the example of a research programme focused on using demographic data from all world regions to understand the human family. A diversity of data matters for understanding our species too.

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**Changing the Face of the Mediterranean: land cover and population since the advent of farming**

**Stephen Shennan (UCL)**

Co-authors: Andy Bevan, Ralph Fyfe, Alessio Palmisano, Neil Roberts and Jessie Woodbridge

The ‘Changing the Face of the Mediterranean’ project, funded by a Leverhulme Trust grant to the University of Plymouth and UCL, was designed to study long-term landscape change in the circum-Mediterranean region by reconstructing patterns of land cover change through pollen analysis and investigating the extent to which these were linked to changing human demographic patterns inferred from different demographic proxies. Seven different regions across the Mediterranean, from Iberia to the Levant, that had good quality information on both environmental and demographic patterns were selected for detailed study. For some of these, climate change information was also available. The talk will present some of the main conclusions of the project, both methodological and substantive.

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**Empirical and theoretical explorations of human cultural change**

**Nicole Creanza (Vanderbilt University)**

Cultural traits, including features of language, can change more rapidly than genes and can be inherited not only from parents but also from teachers and peers. Adding another layer of complexity, humans can create new cultural traits through innovation. In theoretical models of cultural evolution, processes of innovation are often ignored or assumed to occur at a constant rate. This simplified analogy between human innovation and genetic mutation might result in inaccurate predictions about human cultural accumulation. In this talk, I will explore two approaches to the study of cultural evolution: (1) empirical studies of human genomic and cultural variation and (2) theoretical models of genetic and cultural evolution. In empirical studies, we found that genes and languages showed broadly similar signatures of human demographic history despite different mechanisms of change, suggesting that cultural traits can carry information in parallel with genes as humans migrate. In theoretical work, we demonstrated that representing human innovation as a multifaceted process and incorporating demographic processes can shed light on the archaeological record. By integrating theoretical and empirical approaches to the

evolution of genes and culture, this research yields evolutionary insights that could not be achieved by studying either data type alone.

# Contributed papers

## Session 1 (Friday 29<sup>th</sup> March)

*Chair: Phil Riris*

### **Long-Term Regional Demographic Trends in Prehistoric Italy: A Spatial Approach**

**A. Palmisano (UCL)**

The Italian peninsula offers an excellent case study region within which to investigate long-term regional demographic trends and their response to climate fluctuations, especially given the region's diverse landscapes, latitudinal range and varied elevations. In the past two decades, the summed probability distribution (SPD) of calibrated radiocarbon dates has become an important method for inferring population dynamics in prehistory. Recent advancements in this approach have allowed specialists to statistically assess spatio-temporal divergences in demographic trends. Unlike former studies with more limited scope, both geographically and chronologically, in this paper I look to reconstruct population change for the whole Italian peninsula from the Late Mesolithic to the Early Iron Age (10000–2800 BP). How did population patterns vary across time and space? Were fluctuating human populations related to climate change? In order to answer these questions I collated a large corpus of published radiocarbon dates into the largest existing repository of prehistoric radiocarbon dates (n=4026). First, I infer the demographic trends for the Italian peninsula as a whole, and then for five sub-regions (northern, central, and southern Italy, Sicily, Sardinia). Furthermore, I compare the population fluctuations with several paleoclimate proxies (cave, lake, marine records) collected at different latitudes. On a pan-regional scale, the results show a general rapid and substantial increase in population in the Early Neolithic with the introduction of farming at around 8000 BP and a further dramatic increase during the Bronze and Iron Age (~3800–2800 BP). However, I identify different regional demographic trajectories across Italy and a variety of human localised responses to climate shifts. Overall, across the Holocene the population dynamics varied by region and depended on the long-term socio-ecological dynamics prevailing in a given area.

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### **Farmers, Foragers and Friction: assessing regional population growth trajectories in New Zealand**

**Andy Brown (Bournemouth University)**

Past population dynamics play a key role in integrated models of socio-cultural change in Polynesia. A key aspect of these models is the interplay between food-production and population growth. Located on the margins of Polynesia, New Zealand presented considerable challenges to traditional Polynesian food-production, many crops were not successfully established and those that were produced greatly reduced yields. However, despite the hurdles to food production and the likely influence on population, little empirical investigation of Māori population and its variation from neighbouring Polynesian societies has been carried out. In this paper I present a set of regional Maori population models developed using summed probability distributions of radiocarbon dates. These models are diverse and appear well linked to the food production affordance of each region. Specifically, the optimal horticultural zone appears to follow a logistic pattern of growth, while in the sub-optimal zone both a modified logistic curve, representing slower growth than the north, or a 'stepped' pattern are supported. Finally, in the non-horticultural south our results are indicative of a population boom and bust. However, these models may also offer insights into large-scale population movement, the development of resource competition and warfare. Here I compare the SPD models with the rich archaeological and ethnographic record to develop a more integrated understanding of Maori population and society.

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## **Population Distribution and the Development of Political Centralization in Ancient Coastal Peru**

**Paul (“Jim”) Roscoe (University of Maine); Dan Sandweiss (University of Maine)  
Erick Robinson (University of Wyoming)**

We present a dataset of 1,350 coastal Peruvian RC dates, a preliminary analysis of what they tell us about changes in the coastal population over time, and a discussion of how these profiles can explain the differential trajectories of political centralization along the north and south coast.

To compile the dataset, we began with the Peruvian coastal dates from Goldberg et al.’s (2016) database, correcting errors in their reporting. We then searched the archaeological literature for coastal Peru, adding dates that Goldberg et al. failed to include (either because they were published more recently, were published in hard-to-discover sources, or were more recent than Goldberg et al.’s upper limit of 2ka BP). We checked our final database against Riris (2018) and added any dates that were not common to both sets. To facilitate comparison, we also divided the dataset at 12°S latitude, because cultural and climatic history both show a persistent north-south break centered on this point. We present the results as Radiocarbon Summed Probability Distributions (SPDs), now routinely used as proxies for population distribution. We apply a LOESS smoother with tension 0.5 to demonstrate overall exponential population growth between 15ka and 0.5ka BP and then use Monte-Carlo simulation to identify fluctuations in population density around the central trend.

Robinson et al. (2018) note that attempts to couple SPD-generated population indices to theoretical expectations about social organization are still uncommon. We use a model grounded in social theory and tested against contact-era New Guinea data (Roscoe n.d.; 1993; 2012; 2017) to link the emergence and development of asymmetrical power relations in early coastal Peru to changes in the size, distribution, and clumping of its populations. We stipulate that political agents construct power differentials by deploying capital (resources) to induce or coerce the behavior of others – to get things done through their agency (Giddens 1979:69,91-92). To succeed, however, political agents must be able to interact with others. The more such others they can interact with, moreover, and the more time they can devote to each interaction, the greater the numbers they can induce or coerce, and the more effectively they can control them. Success in constructing power hierarchies is therefore critically modulated by time budgets, the proportion of time agents can devote to political interaction as opposed to other subsistence and social obligations. Where political interaction is face-to-face and movement is entirely by foot, the amount of time agents must spend traveling between political interactions (as opposed to interaction itself) is a major constraint on their power-building capacities. Consequently, the distribution of population across the landscape – its extent, density, and degree of clumping – severely constrains or enables the construction of political power.

We discuss the implications of these data and arguments for: a) the emergence and development of political centralization on the Peruvian coast; b) the differences that emerged in the political scale of northern and southern polities; and c) how cultivation, irrigation agriculture, and innovations in communication enabled rulers to increase the extent and strength of their control.

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**What are we measuring with growth-rate estimates extracted from archaeological population proxies?**

**Miikka Tallavaara (University of Helsinki) and Erlend Kirkeng Jørgensen (The Arctic University of Norway)**

Developments in the analysis of archaeological human population size and distribution proxies have greatly increased archaeologists' opportunities to contribute to human demography as well as to life history and population ecology. One of the key demographic parameters is population growth-rate, which is increasingly calculated from temporal distributions of archaeological data, such as summed probability distributions of radiocarbon dates. Here we evaluate the validity of such archaeologically-inferred growth-rate estimates. We argue that archaeological growth-rate estimates can be problematic, because their demographic meaning is not clear. We use published archaeological and ethnographic growth-rate estimates, historical demographic time-series from northern Europe, and simulated population dynamics to compare hunter-gatherer population growth rates between these different data sources. These comparisons suggest a major discrepancy, as archaeological estimates are orders of magnitude smaller than estimates from other sources. This may indicate that prehistoric hunter-gatherers were genuinely different from ethnographic and historic hunter-gatherers in terms of their demography. However, using simulated radiocarbon dates, we show that archaeological population proxies fail to detect high-frequency variation typical to hunter-gatherer population dynamics in historical data and population simulations. Consequently, archaeological proxies cannot yield such population growth-rates as are documented in the ethnographic and historic records. Instead of tracking actual population trajectories, archaeological proxies track changes in the long-term average population size or density, which is controlled by environmental productivity in our simulated archaeological data. Based on these results, we argue that 1) because archaeological and ethnographic growth-rates are measuring unrelated things, their differences are not useful in determining potential differences in the demographic properties between prehistoric and ethnographic/historical hunter-gatherers; 2) comparisons of archaeological and ethnographic growth-rates are generally meaningless; and 3) one has to be careful even when comparing archaeological growth-rate estimates, because differences in long-term growth-rates may only reflect differences in external conditions and not in the intrinsic growth potential of given populations.

## **Session 2 (Friday 29<sup>th</sup> March)**

*Chair: Andy Bevan*

### **Population growth and material culture patterning in the Neolithic eastern Mediterranean**

**Beatrijs de Groot (UCL)**

Summed probability distributions of radiocarbon dates from Neolithic Europe have provided evidence for a signature of regional population growth from the beginning of the introduction of farming onwards, followed by a sudden decline ('bust'). This pattern has also been recognised in the area covering western Anatolia, Greece and the southern Balkans where the first farming settlements appeared from around 6700/6600 BCE. Although the evidence for regional population growth is vital to understanding the mechanism behind the process of Neolithisation of Europe, the relationship between summed probability distributions and observations from the archaeological record on the ground have not yet been systematically explored. For example, what are the implications of population growth on the sharing of material knowledge between regions during the Neolithic?

Ceramics can serve as a proxy for understanding the timing and location of intergroup cultural transmission, providing an important class of artifacts to study social interaction. Using a dataset of ceramic assemblage similarities from Neolithic Anatolia, Greece, and the Balkans (c. 6600-5500 BCE) derived from my PhD research, I will compare the summed probability distribution (SPD) of radiocarbon dates from this region to the long-term development of patterns in the similarity between Neolithic sites. Using spatial statistics and network analysis it has been possible to identify a signature of increasing regionalisation, indicated by the gradually improving positive relationship between spatial distance and ceramic assemblage similarity through time. This presentation will examine this pattern more closely by comparing different similarity measures and comparing patterns in the similarity between sites based on different attribute groups (shapes, decorations, technical variants). These will then be compared to the SPD curve to discuss the relationship between population fluctuations and regionalisation in the dataset of ceramic attributes. This will not only inform a discussion about the possible methods to bridge the gap between population scale processes and the archaeological record, but also discuss the relationship between demographic growth and long-term cultural change and variation.

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### **Environmental carrying capacity, demography and the Late Pleistocene expression of backed artefact making traditions in Africa**

**W. Archer (Max Planck Institute for Evolutionary Anthropology and University of Cape Town)**

The mechanisms underpinning later human evolution are highly contested. Many complex cultural behaviours evolved in Africa, but early evidence for these behaviours varies both spatially and temporally. Scientists have not been able to explain this transient pattern, which is present even in sites and regions clearly occupied by *Homo sapiens*. Certain later Middle Stone Age technologies are useful archaeological proxies for complexity, as the skills necessary for their production would have required high fidelity - potentially process-oriented - learning and cooperation. Backed stone artefacts are arguably one such technology, and are widely accepted to be synonymous with skills like composite weapon design and various multi-phase lithic production processes. To analyse this flickering pattern of behavioural complexity, data are drawn from all known African archaeological sites between 125 ka and the Holocene ( $n=116$  sites,  $n=409$  assemblages,  $n=893$  dates). Backed artefacts show a broad but spatially and temporally uneven distribution in Africa, prior to their association with *Homo sapiens* dispersing into Europe 45-40 ka. The presence and frequency of evidence for backed stone artefact

production is modelled against climate driven, continent-wide, time series population estimates, and the preliminary results of these analyses will be presented.

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## **Demography and the distribution of axes in the British Neolithic**

**Peter Schauer (UCL)**

The study of Neolithic flint and stone axes in Britain has a long history, but has so far largely been confined to analysis of distribution patterns, typology and materials. The steady accumulation of radiocarbon dates and improved methods for their application to archaeological problems has made it possible to expand the range of questions which can be addressed regarding the production of Neolithic flint and stone axes in Britain, which has formed the basis of the Neomine project.

In this paper, we compare the spatial distribution of radiocarbon dates with the spatial distribution of axes and identify regions in which demographic change is associated with change in levels of axe diversity. Dates are further compared with other indicators of cultural change, including pottery types, enclosures, long barrows and axes imported from Europe. By combining these different lines of evidence, we can create a more complete picture of the relationship between demography and cultural change in the Neolithic.

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## **The Beaker transition in Britain: an integrated view of the funerary evidence**

**Anna Bloxam (UCL)**

The first appearance of the Beaker phenomenon in Britain marks the transition from the Neolithic to the Chalcolithic, with the changes seen in this period setting the path for future developments across the Early Bronze Age. This 'Beaker period' (c.2450-1950 BC) is also associated with widespread indications of demographic change: the archaeological evidence indicates the sudden appearance of new ways of life and approaches to death; the osteological evidence reveals morphological changes to the people present in burials; and the genetic evidence suggests that the period saw a near-total genomic replacement of the pre-existing Neolithic peoples of Britain. While some of these findings have been considered in conjunction with each other (for example in Olalde *et al.*'s 2018 genetics paper), our archaeological interpretations of the period have yet to catch up with the availability of new forms of evidence. Perhaps more crucially, a re-evaluation of the funerary practices of this period suggests that our existing understanding of the Beaker phenomenon in Britain may be overly reliant on outdated assumptions of the homogeneity of cultural expressions across the period.

In this paper, I present new work on the burial practices of the Beaker period, including new archaeological, osteological, and radiocarbon analyses, and compare my findings to the published genomic research. I seek to move past existing stereotypes surrounding the archaeological data, in order to explore the evidence for cultural diversity and inter-group interaction across this transitional phase in British prehistory. In incorporating a wide range of the available data, I aim to provide a more nuanced consideration of the nature, scale, and temporality of the cultural and population changes of the Chalcolithic. I argue the importance of avoiding a return to the culture-historical narrative of a 'Beaker Folk', and demonstrate that by integrating multiple strands of evidence it is possible to both enrich and continue to develop our understandings, even in intensively-studied periods and place



## **Session 3 (Saturday 30th March)**

*Chair: Fabio Silva*

### **Boom and bust cycles in Neolithic Europe: climate sensitivity or social dynamics?**

**Kai Wirtz, Carsten Lemmen, Detlef Gronenborn**

With the arrival of agropastoralism across western Eurasia, local population densities rapidly increased. This boom in population density can be understood as the result of social and technological transformations supporting higher reproduction rates. Maximum population densities and boom durations, however, differed between European regions, as revealed by our re-analysis of the integrated EUROEVOL data set. Also, the population declines („bust“) following each local boom lasted from a few decades to many centuries, a pattern that again differed greatly between regions. Some regions even exhibit multiple boom and bust cycles. We investigated the correlation of the different bust timings and intensities for the period 8,000-3,500 a BP with a large data set for paleoclimate variability. Our analysis reveals a poor correlation of long-term trends in population dynamics with climate anomalies and a moderate coincidence between boom periods with climatic events. Using a mechanistic numerical model of socio-technological dynamics we estimated the relative importance of environmental perturbation and endogenous societal transformation in shaping regional population cycles. Model results suggest that robustness of a region against endogenous and exogenous collapse factors may have depended on its socio-technological history.

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### **On the threshold of collapse – demographic viability and the pioneer colonisation of southern Scandinavia**

**Jesper Borre Pedersen and Felix Riede (Aarhus University)**

Palaeolithic archaeology offers rare opportunities to study pioneer colonisation events of humans moving into truly empty landscapes. In many interpretations of such colonisation scenarios, the notion of continuity following initial movement into a region stands strong. Yet, there are anecdotal yet persistent reports of unsuccessful colonisation attempts in the historical period, raising the question of continuity versus punctuation also in deep prehistory. Were such pioneer colonisations successful or unsuccessful? And how can we discriminate between these diverging scenarios archaeologically? The earliest human colonisation and occupation of southern Scandinavia is associated with the Hamburgian culture (~14,500-14,000 cal BP) and has since its discovery been interpreted as a successful expansion and the start of a process of demographic and cultural continuity that continued throughout the Late Glacial and into the Holocene. Informed by demographic reasoning, recent re-analyses of the available numerical dates and patterns evident in the material culture, we here suggest an alternative reading: We argue that the data available to us hints at brief and ephemeral use of the recently de-glaciated landscape (cf. Riede 2014). Hamburgian locales at the margins of its occurrence are few and concentrated into two discrete micro-regions. Furthermore, there are few stray-finds from this otherwise highly diagnostic period – in sharp contrast to subsequent periods of the Final Palaeolithic in the region. The material culture, too, can be re-analysed in this light: all southern Scandinavian Hamburgian sites contain projectile points of the so-called ‘Havelte’ style, but they fall into distinct variants which are near-identical and co-occur across sites. These projectile point variants can tentatively be seen as the signatures of just a few people or micro-traditions. Together, these lines of evidence suggest that a population consisting of very few individuals – and below a viability threshold – explored the recently

deglaciated disequilibrium landscapes of southern Scandinavia but did not succeed in establishing a bridgehead for successful further colonisation (Pedersen, et al. submitted; Riede and Pedersen 2018).

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## **Human population dynamics at the Atlantic façade of Iberia during the Late Glacial and Early Holocene: empirical grounds and methodological strategies**

**Rowan McLaughlin, Magdalena Gómez-Puche, Sergi Lozano, Javier Fernández-López de Pablo (IPHES, Catalan Institute of Human Paleoecology and Social Evolution; Àrea de Prehistòria, Universitat Rovira i Virgili)**

Investigating population dynamics in Late Glacial and Early Holocene coastal settings is a challenging yet important aspect of palaeodemographic research. These environments were heavily exploited by hunter-gathers, and the archaeological evidence is often rich. The Atlantic façade of Iberia represents one such case, although like coastal settings elsewhere, the record from this region poses a number of special challenges. The archaeological sites formed under radically different sedimentary regimens at different times, for example a notable contrast is that caves and rockshelters dominate the record of the Late Glacial, whereas shell middens are more prominent during the Mesolithic. In terms of palaeodemographic modelling, a complication is that sea-level rise reduces the visibility of earlier sites, resulting in intense pressure of research on later, better-preserved sites. A further complication is found in the nature of the radiocarbon data, which are much more diverse than inland settings. Because marine resources were important to hunting-gathering populations, the influence of the marine carbon reservoir on many radiocarbon samples calls for new analytical protocols in the calibration and aggregation of these data via summed probability distributions (SPD). This effects how individual dates are dealt with in the SPD analysis, and the development of null models via simulation that assess the statistical significance of the SPD results.

In this contribution we present the results from an ongoing investigation into prehistoric demography and settlement dynamics during the late glacial and Early Holocene, with special focus on the Atlantic façade of Iberia. We present here our methods for dealing with the appropriate calibration of marine and mixed-reservoir radiocarbon dates and their inclusion in subsequent SPD-based time series analysis, and how bootstrapping and model-fitting techniques allow us to develop estimates of evolving demographic trends. These techniques will be of wide interest to workers attempting similar studies elsewhere. By conducting analysis at multiple scales, considering both short- and long-terms patterns, and looking to other demographic proxies, we can identify research biases and assess their influence and significance. In addition to SPD analysis we have analyzed the data spatiotemporally using point pattern and kernel density techniques, and we compare the results from the Atlantic region to elsewhere in Iberia. Finally, we assess the correlations that exist between the population dynamic and records of palaeoenvironmental change, for which regional case-studies such as this are well-suited.

This work is funded by the European Research Council (ERC CoG 683018)

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## **Estimating Past Mobility Using Sparse Data: Application to Human Genetic Variation**

**Liisa Loog, Marta Mirazón Lahr, Mirna Kovacevic, Andrea Manica, Anders Eriksson, Mark G Thomas**

Mobility is one of the most important processes shaping spatio-temporal patterns of variation in genetic, morphological and cultural traits. However, current approaches for inferring past migration episodes in the fields of archaeology and population genetics lack either temporal resolution or formal quantification of the underlying mobility, are poorly suited to spatially and temporarily sparsely sampled data, and permit only limited systematic comparison between different time periods or geographic regions. Here we present a new estimator of past mobility that addresses these issues by explicitly linking trait differentiation in space and time. We demonstrate the efficacy of this estimator using spatiotemporally explicit simulations and apply it to a large set of ancient genomic data from Western Eurasia. We identify a sequence of changes in human mobility from the Late Pleistocene to the Iron Age. We find that mobility among European Holocene farmers was significantly higher than among European hunter-gatherers both pre- and postdating the Last Glacial Maximum. We also infer that this Holocene rise in mobility occurred in at least three distinct stages: the first centering on the well-known population expansion at the beginning of the Neolithic, and the second and third centering on the beginning of the Bronze Age and the late Iron Age, respectively. These findings suggest a strong link between technological change and human mobility in Holocene Western Eurasia and demonstrate the utility of this framework for exploring changes in mobility through space and time.

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## **Scaffolding Irish Demography with ancient genomes**

**Lara Cassidy and Dan Bradley (Trinity College Dublin)**

Ireland provides a relatively contained microcosm in which to study the defining demographic events that have shaped European populations. It has acted as the geographic terminus for major migrations in the Mesolithic, Neolithic and Bronze Age, while its island status has afforded it some level of genetic continuity over the past four millennia. We explore the impact of such events on the genomes of over 100 ancient Irish. These encompass all eras of the island's history, from the Mesolithic to Early Modern period. Dense sampling across time intervals of known demographic flux allows us to examine the complex interplay between geography and culture in the assimilation of new peoples to the island. We find persistence of older divergent ancestries in the western extremes during both the Neolithic and Bronze Age transitions, suggesting geography may drive recurrent genetic and demographic trends time and time again. Genomic sequencing to a median of 1X allows for the imputation of diploid genotypes, providing haplotypic data to dissect subtle patterns of population structure and relatedness among more homogenous Irish populations during periods of demographic continuity. With these methods we find cultural drivers of structure during the Irish Neolithic period, related to burial type. Diploid data can also be used to define genomic runs of homozygosity, the size distributions of which give insight into both ancient and recent inbreeding bottlenecks. Most strikingly, two Irish Mesolithic genomes show the highest recorded levels of short homozygous segments, suggesting an isolated restricted island population. Signals of genetic continuity and change after the initial establishment of the modern Irish population in the Bronze Age are also explored, with haplotypic diversification evident across the four millennia.

## **Session 4: (Saturday 30th March)**

*Chair: Jennifer French*

### **System changes and demographic cycles in European Prehistory**

**Andreas Zimmermann and Isabell Schmidt (University of Cologne)**

Long-term and large scale population dynamics of hunter-gatherer populations, farming, and state-level societies in Europe are subject to investigation within two projects based at the University of Cologne (LUCIFS [Land Use and Climate Impact on Fluvial Systems during the periods of agriculture], 2002 – 2017; Collaborative Research Center 806, “Our way to Europe”, Project E1, 2009 – ongoing). The produced data provide information on the development of size, density, and spatial distribution of populations.

To produce comparable estimates of human populations from different epochs, a theoretical and methodological framework is needed allowing integration of different types of data, which are characteristic for specific periods. The result is the “Cologne Protocol”, embedded within an upscaling procedure with simple transfer functions between scales.

Our long-durée perspective on population dynamics in prehistory confirms Child’s scenario of “revolutions” with stepwise increases in human population between epochs, as well as oscillating/cyclic changes occurring during such epochs. We will present a first version of modelling long term population dynamics, interpolating between our estimates by Logistic Equation. We understand the big transformation of human history as the result of feedback loops driven by economic and social changes of societies, which affected existing patterns of fertility and/or mortality.

To better understand oscillating/cyclical changes, Logistic Equation is used too. In a case study of the Linearbandkeramik in the Rhineland an approach is suggested which allows assessing several possible causes of population decrease at the end of this period. The result is in line with reasoning of the Adaptive Cycle Model. The bandwidth of population densities within one epoch is understood as an addition of many such regional cycles/oscillations. We conclude by providing perspectives on future avenues of our research.

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### **Size Matters: A large-scale review of hominin demographic proxies**

**Adam Benton (University of Liverpool)**

Hominin demography has often been invoked to explain many key developments in our lineage. Given the potential significance of demography in palaeoanthropology, many researchers have attempted to find proxies for it in the archaeological record. These could be used to test some of these demographic hypotheses against real world data. However, the reliability of these archaeological proxies is questionable.

Multi-proxy analysis offers an opportunity to test the reliability of an individual proxy by cross-referencing its results with other proxies for the same demographic factor. If they are reliable, there should be an internal consistency in this dataset. Previous efforts at this have proven highly successful, vindicating several demographic proxies and helping answer important archaeological questions.

However, many of these multi-proxy tests have been limited in scope, examining only a single site or limited geographic area, over a small time period, and focusing on a small number of demographic

factors. This research aims to rectify this gap in the data, conducting a large-scale multi-proxy review of hominin demography; examining proxies relevant to several demographic variables, including include raw material movement and completed tool movement, artefact density, faunal density and diversity, and tool/debitage proportions. Data comes from the entirety of France during both the Upper and Middle Palaeolithic.

Initial results vindicate the reliability of this approach, showing the expected inter-proxy consistency in many cases, thus also validating many of these measure of hominin demography. However, some proxies fail to align with this, suggesting that they may not accurately reflect the aspects of demography they were hypothesised to.

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## **Demographic change in the British Lower Palaeolithic**

**Rob Davis (Queen Mary University of London); Nick Ashton (British Museum); Simon Lewis (Queen Mary University of London)**

The punctuated nature of human occupation of Britain during the Pleistocene, driven by global climate change and alterations to the palaeogeography of northwest Europe, suggests that demographic change was a key feature of the British Lower Palaeolithic. Each phase of occupation is likely to have witnessed the arrival in Britain of new populations of humans derived from one or more source areas in Europe. It is likely that each group brought with it a set of traditions that manifested in the manufacture, use and discard of material culture. Potential examples of temporally and spatially discrete traditions of stone tool manufacture, such as the High Lodge scrapers or the plano-convex handaxes from Wolvercote, have long been recognised, but in the main attempts to unpick the Lower Palaeolithic record have been frustrated by poor chronological resolution and the complex web of factors that must also be considered as drivers of variation. However, as greater chronological resolution has been achieved in recent years, more temporal and spatial patterning has emerged that casts some light on the nature of demographic change during the Lower Palaeolithic.

Some general patterns of demographic change have been suggested by studies of the fluvial archive of some of Britain's Pleistocene rivers. Using artefact density as a proxy for population size and river terrace sequences as chronological frameworks, it has been argued that the most intensive phase of Lower Palaeolithic occupation of Britain occurred during Marine Isotope Stage 11 (MIS 11; c. 400ka), with declining populations thereafter. At the same coarse scale, patterning has been identified in the stone tool assemblages. Pre-Anglian handaxe assemblages are typically dominated by ovate forms, MIS 11 is characterised by both ovate-dominated and point-dominated assemblages, whilst MIS 9 (c. 330ka) is characterised by point-dominated assemblages, including those with ficrons and cleavers.

Further light can be shed on some of these general patterns by considering the British MIS 11 record. A series of sites with detailed environmental records enable fine-tuned correlations between sites and a corresponding series of distinctive material cultures, revealing a series of population incursions from mainland Europe. Initially, Britain is occupied by populations with lithic technology that does not include the manufacture of handaxes, assemblages traditionally termed 'Clactonian'. Then later during MIS 11c new populations arrive with handaxes. In East Anglia the handaxe assemblages are dominated by ovates, while pointed forms are prevalent in the Thames Valley. Following a probable hiatus in occupation during MIS 11b, new populations arrive in MIS 11a. Assemblages in the Thames Valley are characterised by the presence of twisted ovates, while a distinctive scraper assemblage has been recovered from Hoxne in Suffolk. The fine-grained resolution of the MIS 11c record in particular enables demographic change to be considered almost on an ethnographic scale, providing an opportunity to explore questions of group size, territory, behaviour and society.

## **A spatially explicit model of Final Palaeolithic population densities for southern Scandinavia – initial results**

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In studies of population dynamics, recent research has considered past population densities as important drivers of culture change, not least in the archaeological record of the Palaeolithic. Methods for obtaining such estimates vary, but lately, the so-called Cologne Geospatial Protocol has emerged as one of the most innovative ways of capturing such dynamics at the centennial-to-millennial scale by utilizing sophisticated geospatial analytical techniques (Maier and Zimmermann, 2017, Maier, 2017, Schlummer, et al., 2014) and demographic parameters from forager groups in the ethnographic record (Binford, 2001). So far, however, the application of this method has been somewhat limited by the steep data requirement related to the explicit spatial delineation of raw material catchment areas. In this contribution, we present initial results of attempts to circumvent this and in turn transfer the method to a region where such data are absent or at the very best, difficult to estimate. With a focus on southern Scandinavia and the Late Glacial period between 14,000 and 12,700 cal BP (the Allerød chronozone), we discuss how such a transferral may be implemented and present our initial results. Grounded in intensive source-critical attention to the archaeological record in question, we produce minimum and maximum estimates of population density, following the Cologne Geospatial Protocol. The population density figures derived for this period and region diverge strongly between local and global estimates, thus suggesting localised pockets of human presence, floating in wider regions that are only sparsely inhabited. The very low global population densities suggested for this region may be seen to indicate intermittent settlement at or below the viability threshold. Viewing Final Palaeolithic population dynamics in this way also has implications for our interpretations of the archaeological record and models of cultural continuity and discontinuity in a region that represented the very northern fringes of human occupation.

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