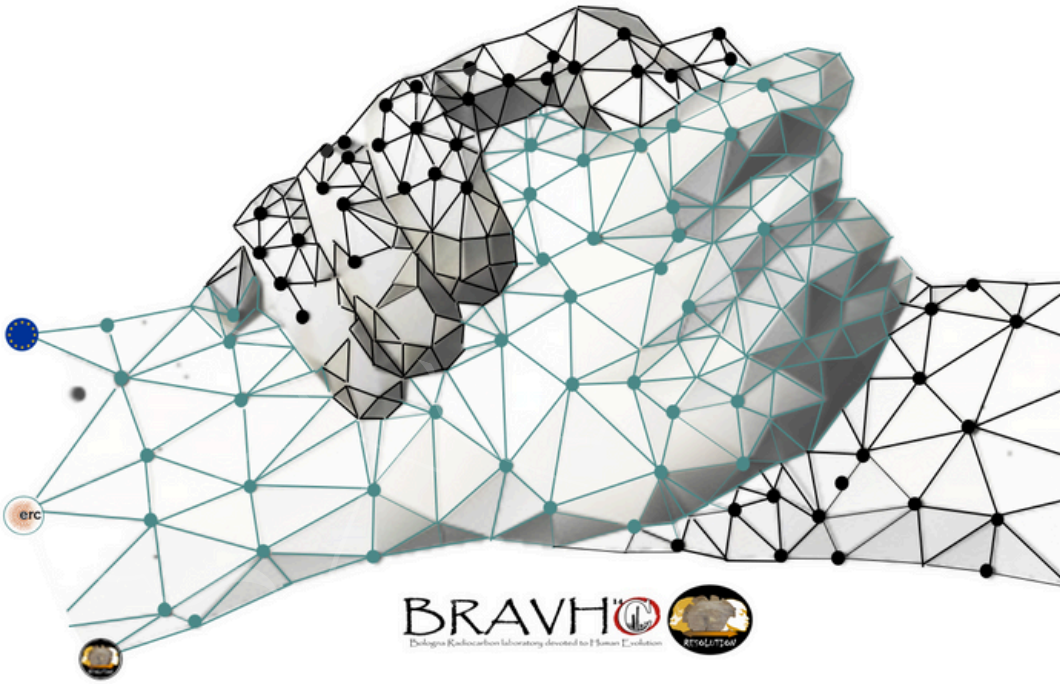
Workshop organized by
Sahra Talamo
Department of Chemistry “Giacomo Ciamician”
Alma Mater Studiorum - Università di Bologna

The HUMAN R-EVOLUTION



through RADIOCARBON RESOLUTIONS

BOLOGNA,
JUNE 10TH - 11TH 2024

ALMA MATER STUDIORUM
UNIVERSITÀ DI BOLOGNA

SPEAKERS

- **Michael Friedrich**, Hohenheim University, Stuttgart, Germany
- **Bernd Kromer**, Institute for Environmental Physics, University of Heidelberg, Germany
- **Lukas Wacker**, Laboratory for Ion Beam Physics, ETH Zurich, Switzerland
- **Florian Adolphi**, Helmholtz Centre for Polar and Marine Research, Bremerhaven, Germany
- **Raimund Muscheler**, Quaternary Sciences, Department of Geology, Lund University, Lund, Sweden
- **Timothy J. Heaton**, School of Mathematics, University of Leeds, Leeds, UK
- **Ronny Friedrich**, Curt-Engelhorn-Centre Archaeometry, Mannheim, Germany
- **Christopher Bronk Ramsey**, Research Laboratory for Archaeology and the History of Art, University of Oxford, UK
- **Giorgia Sciutto & Silvia Prati,** Department of Chemistry "Giacomo Ciamician", Alma Mater Studiorum - Università di Bologna, Bologna, Italy
- **Blagoja Kitanovski**, National Institution Archaeological Museum of the Republic of North Macedonia, Skopje, North Macedonia
- **Zsolt Mester**, Institute of Archaeological Sciences, Eötvös Loránd University, Budapest, Hungary
- **Yuri E. Demidenko**, Ferenc Rakoczi II Transcarpathian Hungarian College of Higher Education, Berehove, Ukraine

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ALMA MATER STUDIORUM
UNIVERSITÀ DI BOLOGNA

BRAVHO 14
Bologna Radiocarbon laboratory devoted to Human Evolution

RESOLUTION

SPEAKERS

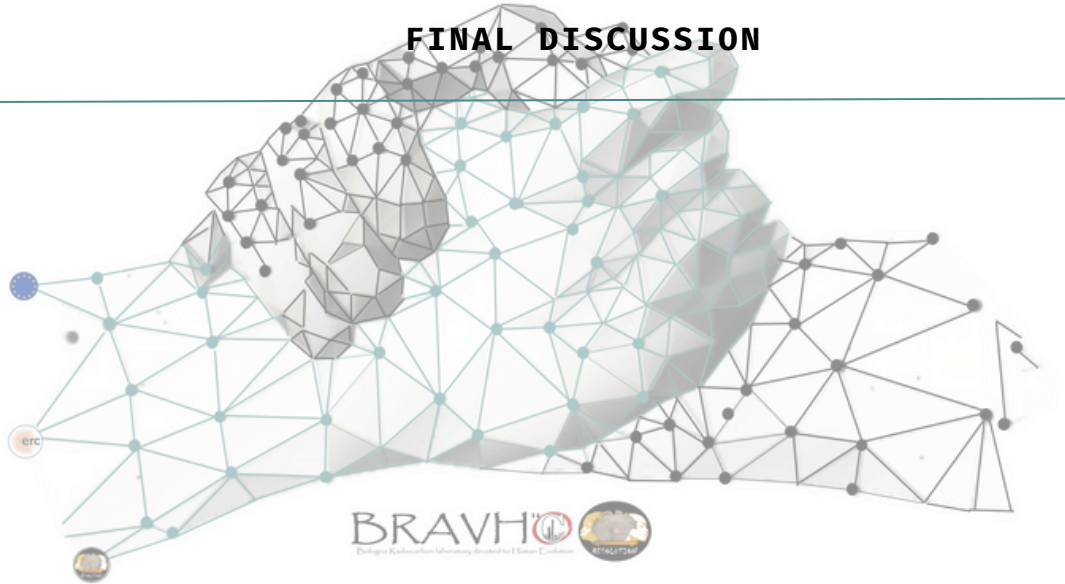
- **Ghenadie Sîrbu**, Centrul de Arheologie, Institutul Patrimoniului Cultural, Chişinău, Republica Moldova
- **Petr Škrdla,** Institute of Archaeology of the CAS, Brno, Czech Republic
- **Paweł Valde-Nowak**, Zakład Archeologii Epoki Kamienia, Kraków, Poland
- **Adrian Marciszak**, Department of Palaeozoology, Faculty of Biological Sciences, University of Wroclaw, Poland
- **Jordi A. Rosell**, Institut Català de Paleoecologia Humana i Evoluciò Social (IPHES), Tarragona, Spain
- **Marie Soressi**, Faculteit Archeologie, Universiteit Leiden, Leiden, Netherlands
- **Mateja Hajdinjak**, Max Planck Institute for Evolutionary Anthropology (MPI), Leipzig, Germany
- **Jean-Jacques Hublin**, College de France, Paris, France
- **Alberto Angela**, Paleontologist, Naturalist, Science Communicator and Writer
- **Guido Barbujani**, Department of Life Sciences and Biotechnology, University of Ferrara, Ferrara, Italy
- **Telmo Pievani**, Department of Biology, University of Padova, Padova, Italy
- **Sahra Talamo**, Department of Chemistry “Giacomo Ciamician”, Alma Mater Studiorum - Università di Bologna, Bologna, Italy

MONDAY, 10TH JUNE, 2024 | 9:00AM
COLLEGIO VENTUROLI
VIA CENTOTRECENTO, 4, 40126 BOLOGNA (BO)

9:00AM - 9:15AM	**Sahra Talamo**: Welcome and greetings
9:15AM - 9:30AM	**Michael Friedrich:** European Glacial tree-ring chronologies as a basis for precise radiocarbon calibration in the Palaeolithic.
9:30AM - 9:45AM	**Bernd Kromer:** Subdecadal ^{14}C data from Southern European glacial and deglacial tree chronologies.
9:45AM - 10:00AM	**Raimund Muscheler & Florian Adolphi:** Integrating tree ring ^{14}C with ice core ^{10}Be with the “cosmic ray clock”.
10:00AM - 10:15AM	**Timothy J. Heaton:** Radiocarbon Calibration and IntCal – Improving the essential clock to measure our past.
10:15AM - 10:45AM	**COFFEE BREAK**
10:45AM - 11:00AM	**Christopher Bronk Ramsey:** Integrating data for radiocarbon calibration.
11:00AM - 11:15AM	**Lukas Wacker:** Highest-precision radiocarbon measurements and accurate dating.
11:15AM - 11:30AM	**Ronny Friedrich:** Developments at the AMS facility at CEZA, Mannheim and its impact on the quality of the RESOLUTION data.
11:30AM - 11:45AM	**Giorgia Sciutto & Silvia Prati:** Revealing the unseen: chemical map of collagen distribution in ancient bone with non-invasive NIR hyperspectral imaging.
12:00PM - 1:30PM	**LUNCH BREAK**

MONDAY, 10TH JUNE, 2024 | 1:30PM
COLLEGIO VENTUROLI
VIA CENTOTRECENTO, 4, 40126 BOLOGNA (BO)

1:30PM - 1:45PM	**Blagoja Kitanovski:** The paleolithic site of Golema Pešt (Republic of North Macedonia).
1:45PM - 2:00PM	**Zsolt Mester:** Radiometric dating of Upper Pleistocene human occupations in Hungary: results and problems.
2:00PM - 2:15PM	**Ghenadie Sîrbu:** The story of paleolithic hominids in Prut-Dniester interfluve. Radiocarbon dating a desideratum of time.
2:15PM - 2:30PM	**Petr Škrdla & Yuri E. Demidenko:** Initial and Early Upper Paleolithic in Moravia.
2:30PM - 3:00PM	**COFFEE BREAK**
3:00PM - 3:15PM	**Paweł Valde-Nowak:** The ritual practices of Anatomic Modern Humans in the Obłazowa Cave - the current research challenges.
3:15PM - 3:30PM	**Adrian Marciszak:** The rise and fall of the king: the Pleistocene lion, man or climate. Who was responsible for the disappearance of Homotherium latidens (Owen, 1846) in Eurasia.
3:30PM - 3:45PM	**Jordi A. Rosell:** The Scavengers Project: a new way to understand the Middle Palaeolithic assemblages.
3:45PM - 4:00PM	**Marie Soressi:** Identification of the Laschamps event (~41 ka) in the late Mousterian-Châtelperronian sequence of Quinçay cave in France.
4:00PM - 4:30PM	**FINAL DISCUSSION**



TUESDAY, 11TH JUNE, 2024 | 5:00PM
PALAZZO RE ENZO,
PIAZZA DEL NETTUNO, 1/C, 40125 BOLOGNA (BO)

4:00PM - 4:30PM	**PLANNED ARRIVAL FOR SPEAKERS**
5:00PM - 5:15PM	Official Greetings by **Giovanni Molari** Rector of Alma Mater Studiorum - Università di Bologna, Bologna
5:15PM - 5:45PM	**Mateja Hajdinjak,** “Genomes from the stone age: what ancient DNA can tell us about Neandertal-human interactions” Discussion with **Guido Barbujani**
5:45PM - 6:15PM	**Jean-Jacques Hublin,** “The spread of Homo sapiens in Eurasia” Discussion with **Alberto Angela**
6:15PM - 6:45PM	**Sahra Talamo,** “Misurare la storia. La nuova linea del tempo dell’evoluzione umana” Raffaello Cortina Editore Discussion with **Telmo Pievani**

European Glacial tree-ring chronologies as a basis for precise radiocarbon calibration in the Palaeolithic.

Michael Friedrich, Bernd Kromer, Lukas Wacker, Nuno Bicho, Pedro Horta, Florian Adolphi, Raimund Muscheler, Sahra Talamo

So far the terrestrial, tree-ring based high resolution radiocarbon calibration starts at 14.226 years BP. Before this time, the resolution of the calibration curve drops substantially, or relies on ^{14}C data that do not directly reflect atmospheric ^{14}C. That makes precise calibration of ^{14}C-data of the Palaeolithic extremely difficult.

In the Late Pleistocene, a number of floating subfossil tree-ring series exist. Their ^{14}C-series can provide interesting snapshots of past ^{14}C-variability and have tremendous potential. Before they can be used for calibration, the challenge with these floating tree ring series is to establish their absolute chronology by providing high precision, high-resolution ^{14}C-dates as prerequisite for comparisons of the ^{14}C-variability to the ^{10}Be-record of the ice cores.

In this contribution, we present an overview of existing floating Glacial tree-ring chronologies of subfossil trees from the Mediterranean with special respect to established chronologies from Furadouro, Portugal at 32 ka BP and Revine, N-Italy at 18ka, that could be provided by the ERC-project ‘RESOLUTION’. We discuss the actual dendrochronological state of these tree-ring chronologies and the potential and challenges of further Glacial tree-ring series of the Mediterranean that could improve the radiocarbon calibration towards achieving a precise high-resolution chronology of human evolution.

Subdecadal ^{14}C data from Southern European glacial and deglacial tree chronologies.

Bernd Kromer, Michael Friedrich, Florian Adolphi, Raimund Muscheler, Sahra Talamo

We obtained ^{14}C dates in annual to three-year resolution in tree chronologies for two time intervals: Revine, N-Italy (3 groups between 18.4 to 17.4 cal BP) and Furadouro, Atlantic coast of N-Portugal (one group of 190 rings at 29k ^{14}C BP and 1 tree of 100 ring at 20.7k ^{14}C BP). We compare our results to ^{14}C of IntCal20, and to Greenland ice core ^{10}Be to obtain an estimate of the calendar age position. We also discuss high-resolution atmospheric ^{14}C variations recorded by the tree ring data.

Integrating tree ring ^{14}C with ice core ^{10}Be with the “cosmic ray clock”.

Florian Adolphi, Raimund Muscheler

Variations in the solar and geomagnetic shielding of galactic cosmic rays arriving at Earth are directly reflected in the production rates of cosmogenic radionuclides in the atmosphere (e.g. ^{14}C and ^{10}Be). These radionuclides are then deposited in natural archives such as tree rings (^{14}C) and ice cores (^{10}Be) and, after correction for their different geochemical behaviour, they can be used to synchronise ice core and tree time scales. We will discuss examples how tree ring and ice core records can be synchronised with this method and discuss their potential for improving the ^{14}C calibration curve. Furthermore we will review the progress made within RESOLUTION and discuss the potential for future research.

Radiocarbon Calibration and IntCal – Improving the essential clock to measure our past.

Timothy J. Heaton

Radiocarbon dating provides the ultimate clock to study the past 55,000 years – allowing us to better explain our present, and accurately predict/mitigate our future. However, the variations in past levels of ^{14}C mean that all radiocarbon dates need to be adjusted (calibrated) to be understood on a calendar scale. I will aim to give a whistlestop tour of radiocarbon dating and construction of the internationally-agreed radiocarbon calibration curves known as IntCal.

Integrating data for radiocarbon calibration.

Christopher Bronk Ramsey

This talk will focus on the need for systematic organisation of information for the next update of the IntCal calibration curve. In order to understand the data in its environmental context, it is necessary to have not only the radiocarbon data itself but also the associated dendrochronological or other underpinning chronological information, a comprehensive list of publications and other metadata. Often this data is made available in primary publications but for analysis of the IntCal dataset as a whole it is much more useful to have it systematically organised in a coherent way. The IntChron data structure used for the archive of the IntCal20 datasets provides a showcase for how this can be done, and for how this makes data checking and data exploration much easier. The aim of this approach is to provide data in a form which is easy to analyse in a whole range of generic analysis packages such as R, Python and MatLab and also portable to future databases.

Highest-precision radiocarbon measurements and accurate dating.

Lukas Wacker, Nicolas Brehm, Marcus Christl, Hans-Arno Synal

The latest generation of compact radiocarbon dating systems allows for highest-precision radiocarbon measurements on a routine base. Measurement uncertainties down to 1 to 2‰ are now possible, even with instruments working with tiny 50 kV accelerators. We will explain how new state-of-the-art instruments are build and what is needed to obtain reproducibly high-precision results.
Finally, we will use new annually resolved radiocarbon records from tree-rings to demonstrate on a few examples how precise and accurate radiocarbon ages are obtained.

Developments at the AMS facility at CEZA, Mannheim and its impact on the quality of the RESOLUTION data.

Ronny Friedrich, Johannes Wintel, Susanne Lindauer

The Mannheim AMS facility at the Curt-Engelhorn-Center Archaeometry (CEZA) was chosen as one of the participating dating laboratories to analyze samples for the RESOLUTION project. Throughout the project, which frequently involved samples of considerable age, significant attention was devoted to blank determination and sample reproducibility, leading to numerous discussions. In this presentation, we will share results obtained from a newly installed MICADAS AMS system in our laboratory and compare its precision and dating limits with those of the previous system, which was used for the analysis of the majority of RESOLUTION samples.

ABSTRACTS

Revealing the unseen: chemical map of collagen distribution in ancient bone with non-invasive NIR hyperspectral imaging.

Giorgia Sciutto, Cristina Malegori, Paolo Oliveri, Silvia Prati, Rocco Mazzeo, Sahra Talamo

Preserving the integrity of rare prehistoric bones while accurately determining their age is crucial for cultural and historical studies. Traditional radiocarbon dating, although effective, poses limitations due to its destructive nature. Recently, NIR-HSI has been applied to obtain spectral maps that reveal the collagen distribution in large bones. However, this method offers only an estimation of the distribution of collagen.

In this study, we propose a non-destructive approach utilizing near-infrared spectroscopy (NIR) coupled with a camera with hyperspectral imaging (HSI) to quantify collagen presence in ancient bones and to localize its distribution. Combining the acquisition non-invasive approach with a multivariate partial least squares (PLS) regression model, we obtained chemical maps of the collagen distribution. This model quantifies the collagen at every pixel and thus provides a chemical mapping of collagen content, correlating the relative collagen amount and NIR absorptions. The proposed approach allows for precise collagen quantification and localization within bone samples, facilitating the selection of optimal regions for subsequent radiocarbon dating analysis.

Our findings promise significant contributions to the study of human evolution by minimizing bone material destruction, thereby safeguarding our cultural heritage and providing accurate chronological context to valuable artifacts.

The paleolithic site of Golema Pešt (Republic of North Macedonia).

Blagoja Kitanovski

At 466.5 a.m.s.l., Cave Golema Pešt sits 65 km southwest of Skopje, North Macedonia. Measuring 12 m wide, the cave mouth opens southeast, overlooking Lake Kozjak now filling the Treska valley. This simple dry cave formed in Mesozoic conglomerates. Golema Pešt has one room, 31 m long by 18.5 m wide. Its deposits exceed 21 geoarchaeological distinct layers > 4.5 m deep. Lithic assemblages are mainly produced on local quartz varieties. The lithic industries' characteristics show the production of Levallois and Discoid technological systems. From ESR and OSL analysis, dates were obtained that correspond to the technological-typological and faunal repertoire of the caves.

Radiometric dating of Upper Pleistocene human occupations in Hungary: results and problems.

Zsolt Mester

Although the first radiocarbon measurement of a Palaeolithic site in Hungary was made as early as in 1957, the application of radiometric dating was very scarce until the 1990s. Thereafter the new ATOMKI laboratory in Debrecen provided local facilities of radiocarbon dating for the Hungarian prehistoric archaeology. This was profitted mainly by the Neolithic and Chalcolithic research. Concerning the chronology of the Palaeolithic in Hungary, non-serial datings for Middle and Late Upper Pleistocene human occupations were obtained. Paralelly, international research projects tried to date some well-known Hungarian cave sites linked to the problems of the Aurignacian and the spread of the first modern humans in the Middle Danube basin. In this presentation, we summarize the recent results and problems.

The story of paleolithic hominids in Prut-Dniester interfluve. Radiocarbon dating a desideratum of time.

Ghenadie Sîrbu

In archaeological research there is an increased accent on interdisciplinary analysis, and radiocarbon dating occupies a special place in this discipline. For the Paleolithic period, this dating method was long considered a desideratum of the time, one of the impediments being the lack of qualitatively preserved samples. Research carried out in recent decades has allowed sampling and radiocarbon dating. Even so, the interpretation of the results remains at an early stage. The accumulation of a database will allow a new approach and analysis of radiocarbon data, and the results will allow the creation of a new picture of the Paleolithic periodization of the Prut-Dniester interfluve.

Initial and Early Upper Paleolithic in Moravia.

Petr Škrdla, Yuri E. Demidenko

Moravia is situated at the intersection of two pan-European migration routes: a north-south route connecting the Mediterranean region and the Balkan Peninsula with the north European lowlands along the Danube, Morava, and Oder Rivers, and an east-west route along the Danube River.

Approximately 50–35 ky cal. BP during the IUP and EUP periods, in the wider Eurasian context, Anatomically Modern Humans (AMH) replaced the Neanderthals. During this time, lithic technologies in Moravia are generally characterized by evolved Levallois technology in the Bohunician (Škrdla 2003; 2017), bifacial reduction in the Szeletian (Škrdla 2017), Jezmanowice-type (J-type) points in the Lincombian-Ranisian-Jerzmanowician (LRJ) (Demidenko, Škrdla 2023), and carinated technologies in the Aurignacian (Demidenko et al. 2017).

While the Szeletian is rooted in local MP technological traditions, the Bohunician has an intrusive character in Moravia and represents a glass in the Initial Upper Paleolithic techno-complex mosaic of sites broadly distributed over Eurasia. The Bohunician technology shows a high degree of similarity with the material from levels 1–3 at Boker Tachtit site, Israel (Škrdla 2003). While the Szeletian is thought to be the product of acculturation and the last archaeological signature of the Neanderthals (e.g. Valoch 2000), the Bohunician is purported to be the oldest archaeological signature of immigrants from the Near East (e.g. Hublin 2012; Svoboda and Bar-Yosef 2003; Škrdla 2003).

LRJ is now proposed to be a Late IUP being a result of a smooth technological transition in Moravia (Demidenko, Škrdla 2023), in Central Europe from IUP Bohunician, based mostly on the change in the way tips for hunting weapons were made - a shift from Levallois point manufacture to the production of J-type blade-points. The LRJ industry was produced by Homo sapiens groups who then spread across the northern latitudes of central and western Europe.

Aurignacian techno-complex is securely represented in Moravia by in situ sites of Middle Aurignacian / Aurignacian II of French tradition. At the same time, Early and Proto-Aurignacian sites are well-known in the areas neighbouring Moravia. Their apparent absence in Moravia could perhaps be explained by site location, taphonomy, and survey peculiarity issues.

Initial and Early Upper Paleolithic in Moravia.

Petr Škrdla, Yuri E. Demidenko

The IUP scheme presented above (Szeletian, Bohunian, LRJ) and EUP (Aurignacian) typological-chronological scheme for a geochronology between GI-12 and GI-7 is supported by many dates using the ^{14}C, TL, and OSL methods but there are still a number of uncertainties and new high resolution dates have the potential to significantly improve the scheme for a better understanding of the human cultural interactions and development in Moravia.

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- Valoch, K. 2000: More on the Question of Neanderthal Acculturation in Central Europe. Current Anthropology 41(4), 625–626.

The ritual practices of Anatomic Modern Humans in the Obłazowa Cave – the current research challenges.

Paweł Valde-Nowak

Research on the Obłazowa Cave, located in southern Poland, yielded assemblages of finds from six Middle Palaeolithic layers (Mousterian and Micoquian), a layer of one of the transitional cultures with leafe points (Szeletian) and Upper Palaeolithic layers. Among the latter, layer VIII is particularly unique, associated with the ritual activity of the AMH. It was here, within a circle of massive boulders, that a boomerang made of a mammoth tusk was found, as well as two phalanges of human hands, perforated fossil shells covered with ocher, and tooth arctic fox ornaments. The interpretation of this exceptional deposit is to assume a symbolic burial or a votive gift for some special purpose. The most current task is to determine the precise final chronology of the oldest of the world boomerang and its cultural affiliation as well as the palaeogenetic relationships of AMH from Obłazowa.

The rise and fall of the king: the Pleistocene lion, man or climate. Who was responsible for the disappearance of Homotherium latidens (Owen, 1846) in Eurasia.

Adrian Marciszak

Homotherium latidens (Owen, 1846) was one of the species of large carnivores that achieved the greatest evolutionary success. This is reflected in its dominant role, long period of occurrence (over 4 mya) and presence on 5 continents. It was also the largest cat in the period between 4 and 0.8 mya in Europe, with male weighing up to 400 kg and female up to 220 kg. However, from 0.7 mya everything changes. Homotherium latidens is still widespread in Eurasia, but its size has significantly decreased. There is no trace of massive, huge individuals in the Middle Pleistocene.
Homotherium had noticeably decreased in size and especially in massiveness. Middle and Late Pleistocene individuals are much smaller and more gracile build, with weight of 150–220 kg for male and 100–130 kg for female. The most important thing is to find out what factor was responsible for the dwarfing and disappearance of this once apex carnivore.

The Scavengers Project: a new way to understand the Middle Palaeolithic assemblages.

Jordi Rosell, Ruth Blasco, Maite Arilla

Anthropogenic sites often arise from overlapping activities and/or occupations, presenting as disordered palimpsests that are difficult to interpret. The challenge escalates with the effects of carnivore scavengers, whose actions can lead to the remobilization or disappearance of many remains without leaving obvious traces. This phenomenon carries significant implications for archaeological studies, particularly when applying theories derived from ethnographic observations in high-resolution temporal contexts. SCAVENGERS involves monitoring experimental reproductions of hearth-related assemblages, like those found in archaeological contexts, exposed to different species of wild carnivores, such as hyenas, lions, bears, wolves, and other smaller carnivores. The results will then be subsequently tested on different well dated Middle Palaeolithic assemblages. The main aim is to generate enough cross-sectional data that can be applied to all periods and geographic areas, overcoming the limitations of traditional archaeological methods to make accurate inferences about past human behaviour. The results of this project will contribute to the development of a new paradigm, challenging some preconceived ideas about Prehistory.

Identification of the Laschamps event (~41 ka) in the late Mousterian-Châtelperronian sequence of Quinçay cave in France.

Marie Soressi, Ola T. Lygre, Igor Djakovic, Mark J. Sier

The Laschamps event is a geomagnetic excursion first identified in the Massif Central, France, with an age estimated at around 41 thousand years ago (ka) and a duration estimated to be approximately one thousand years (Channell et al., 2020 and references therein). This event appears to have caused a significant increase in atmospheric C levels, estimated to be more than 700% (Reimer et al 2020; Cooper et al., 2021). Despite the lack of direct evidence for the impact of this event on the ground (Picin et al., 2021), some consider it a potential driver of global environmental and evolutionary changes (Cooper et al., 2021). Here, we present a paleomagnetic study of the archaeological sequence of Quinçay, France, where the Laschamps event is found to straddle the Mousterian and Châtelperronian layers.

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