



INTERDISCIPLINARIA ARCHAEOLOGICA NATURAL SCIENCES IN ARCHAEOLOGY

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Bioarchaeology and Environmental Archaeology at the University of Sheffield

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SCALE: <http://www.shef.ac.uk/archaeology/research/scale>

Zooarchaeology Laboratory: <http://www.shef.ac.uk/archaeology/research/zooarchaeology-lab>

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1. Introduction

The Department of Archaeology at Sheffield University has a long history of bioarchaeology and environmental archaeology teaching and research, and is home today to some of the largest and most active zooarchaeology and archaeobotany research teams in the world. Our members work throughout Britain, Europe and Western Asia, as well as contributing to projects in Africa and elsewhere, and have research interests that span the period from the Palaeolithic to the recent past. The Sheffield department houses substantial laboratories for zooarchaeological, archaeobotanical and geoarchaeological research and teaching, including its extensive modern reference collections. The staff and members of the Centre of Archaeobotany and Ancient Land-use, and the Zooarchaeology Laboratory, are also much involved in teaching activities, and contribute significantly to a variety of undergraduate and post-graduate courses and degree programmes.

and starch as well as a substantial seed reference collection, and is also the home of the recently established Sheffield Archaeobotanical Consultancy (SAC), which offers a range of services to commercial archaeological units.

2. Sheffield Centre for Archaeobotany and ancient Land-use (SCALE)

SCALE is the departmental centre for research into past environments, plant economies and land use, bringing together research in archaeobotany, archaeopalynology and geoarchaeology. It is headed by Prof. Glynis Jones, Dr. Mike Charles and Dr. Gianna Ayala, who lead a team of post-doctoral research associates, research assistants, commercial specialists and PhD students. The centre houses reference collections for wood charcoal, pollen, phytoliths



Figure 1. Fruit and seed reference collection.

2.1 Current research

Research within the centre integrates plant ecology, agronomy, earth sciences, genetics and ethnobotany in the investigation of archaeological research questions. SCALE members conduct research in a wide range of archaeological periods throughout Western Asia and Europe. The centre maintains strong collaborative links with the Departments of Animal and Plant Sciences (Dr. C. Osborne and Prof. M. Rees, Dr. J. Hodgson (retired)) and Mathematics and Statistics (Prof. C. Buck, Dr. P. Blackwell, Dr. N. Fieller and Dr. E. Stillman), at the University of Sheffield; the Faculty of Life Sciences (Prof. T. A. Brown), at the University of Manchester; the Department of Archaeology (Dr. A. Bogaard) at Oxford University; the NERC Geosciences Isotope Laboratory (Dr. T. Heaton); and the School of Chemistry (Prof. R. Evershed), at the University of Bristol.

The Centre is involved in a number of collaborative research projects.

2.1.1 The origins of agriculture

The centre is currently engaged in two complementary research projects on the origins of agriculture in Western Asia, funded by the European Research Council (ERC) and the Natural Environment Research Council (NERC). Together these projects seek to understand the selective pressures driving the evolution of crops through an investigation of the key traits associated with crop domestication, to provide insights into the role of human exploitation and non-human environmental factors in the origins of agriculture. The NERC-funded “Origins of Agriculture” project, in

collaboration with the Department of Animal and Plant Sciences, focuses on the integration of archaeobotanical and ecological evidence, and involves the compilation, analysis and interpretation of a regional archaeobotanical database of epi-palaeolithic and early Neolithic sites in Western Asia, and experimental ecology on early crop species and their wild progenitors. The ERC-funded Evolutionary Origins of Agriculture project extends this research through metrical analysis of archaeobotanical material, GIS (Geographic Information Systems) mapping of archaeobotanical and ecological evidence, experimental investigation of a broader range of plant ecological traits and species, including wild species that were never domesticated, and DNA research on early genetic trait selection in crop plants. This project also extends the research collaboration to include the Faculty of Life Sciences at Manchester.

2.1.2 Early agricultural practices

The centre is investigating the nature of early agricultural practices through two complementary approaches. Ongoing research, resulting from NERC-funded projects initiated in collaboration with the Department of Animal and Plant Sciences, uses analysis of the functional ecological attributes of crop weeds, as a method for the identification of ancient agricultural practices from archaeobotanical weed assemblages. A database of functional attributes of modern plant specimens, for over 500 archaeologically attested crop weed species from Europe and Western Asia, including measurements of 15 functional attributes, such as canopy size, specific leaf area and leaf dry matter content, size and number



Figure 2. Measuring plant functional attributes: a) canopy height, b) leaf area, c) leaf thickness d) taking impressions of leaf epidermis.

of stomata, length and duration of flowering period, has recently been completed. These functional attributes are now being applied to archaeobotanical crop-weed assemblages to establish early cultivation practices. A second approach has been developed, in collaboration with the universities of Oxford (which led the project) and Bristol, and the NERC Geosciences Isotope Laboratory, to investigate the intensity of crop husbandry practices at early farming sites in Europe and Western Asia, through the analysis of stable nitrogen and carbon isotope ratios in order to detect manuring and irrigation of crops respectively.

2.1.3 The spread of agriculture through Europe

The current NERC-funded “Out of Asia” project, in conjunction with the Department of Mathematics and Statistics, has traced the spread of agriculture across Europe through radiocarbon dating of the earliest domesticated crop remains from archaeological sites, and is using Bayesian statistical analysis to interpret these data in relation to geographic, topographic, vegetational and cultural mapping. This links with the recently completed NERC-funded collaborative project “The Domestication of Europe”, led by the University of Manchester, which used DNA analysis of recently grown crops to explore the roles of human and environmental factors in the spread of early agriculture through Europe. We are now exploring the possibility of extending this type of research using techniques recently developed by our Manchester colleagues to recover ancient DNA from archaeological crop remains.

2.1.4 Economic integration and cultural survival at Neolithic Çatalhöyük, Turkey

The site of Çatalhöyük is renowned for its size, material wealth, agglomerated mudbrick architecture and rich artistic

repertoire. The site is also extraordinary in its durability: it flourished for well over a millennium (c. 7400–6000 cal. BC), and is the only site in central Anatolia known to have survived a major regional population shift in the mid-7th millennium BC. The richness and diversity of the plant and animal remains, coupled with large-scale, systematic sampling at the context level provides a rare opportunity to interdigitate zooarchaeological and paleoethnobotanical evidence as a combined research strategy to address the degree of integration in the Neolithic farming “package”. While it is widely acknowledged that the success and spread of early farming in the region coincided with the dual establishment of cultivation and herding, site-specific studies based on primary scientific evidence are urgently needed to clarify the role of closely intertwined crop and livestock management practices for the spread of the “package” both within and beyond south-west Asia. The NSF funded project brings together U.S., British and Turkish archaeologists specialising in faunal, botanical, and isotopic analyses to investigate potential integration of small-scale crop and livestock husbandry and its effects on cultural stability in an early agricultural society.

2.1.5 Current postgraduate research

The postgraduate research of the centre covers a wide range of topics. Recently completed and current PhD projects include: a functional ecological approach to the origins of agriculture, the plant economy of the Kura-Araxes; the agricultural economies of early urban Mesopotamia; changing arable subsistence in Bronze and Iron Age south-west Britain; a global evolutionary approach to the domestication of pulses; a stable carbon isotope approach to crop watering practices in the Neolithic and Bronze Age; carbon dioxide as a limiting factor for early agriculture.

Figure 3. The recovery of plant remains by flotation at Çatalhöyük, Turkey.



2.2 Sheffield Archaeobotanical Consultancy (SAC) and online archaeobotanical training package

SCALE also offers archaeobotanical services for the specialist analysis of charred and waterlogged plant remains, wood charcoal and pollen through its archaeobotanical consultancy (SAC). SAC offers a complete service for archaeobotanical research, including on-site sampling and processing, sample assessment, full or targeted identification and analysis, and the production of publication-standard interpretative reports. The consultancy's specialists have worked with numerous commercial excavation units, and contributed to research projects both nationally and internationally. Three such departmental research projects are the Stonehenge Riverside Project and the Sheffield Manor Lodge project (UK), and the Çatalhöyük project (Turkey). More information on the services offered by the consultancy can be found here:

<http://www.shef.ac.uk/archaeology/research/scale/consultancy>

As a result of a EU Marie-Curie transfer of knowledge grant, an online training package for “Integrated Archaeobotanical Research” has been created, which provides detailed information and learning resources for most aspects of archaeobotanical research. This powerful training resource is freely available to other researchers and those involved in the teaching of archaeobotany at:

<http://archaeobotany.dept.shef.ac.uk/wiki/>

3. Zooarchaeology Laboratory

The Zooarchaeology Laboratory fosters a welcoming environment dedicated to scholarship, collaboration, and knowledge dissemination. The zooarchaeology team work on a diverse range of research areas within the field of zooarchaeology, across different geographical regions and time periods between the Palaeolithic and modern times. As well as research, the team is involved in teaching, outreach and commercial consultancy.

All of our diverse teaching and research activity is made possible by our substantial osteological reference collection. The collection includes a wide variety of specimens of mammals, birds, reptiles, amphibians, and fishes that live or had once lived in Europe, as well as a more limited range of specimens from other parts of the world. The collection is constantly growing, partly through *Skelecycle*, a project that aims to build links between museums and universities so that material can be shared if an institution lacks the necessary space for its osteological material. The scheme has already enhanced our reference collection in Sheffield and provided us with some rare specimens.

3.1 Current research

3.1.1 The Feeding Stonehenge Project

The Feeding Stonehenge Project, co-directed by Mike Parker Pearson, Umberto Albarella, Oliver Craig and Jane Evans, aims to clarify the nature of the supply of goods to the Stonehenge landscape by using a variety of different lines of evidence. These include the recently excavated animal bones from the famous site of Durrington Walls (Wiltshire, southern England), and a re-analysis of material from similar sites in southern Britain. Umberto Albarella and Sarah Viner have both contributed to the zooarchaeological aspect of this project and, with Jane Evans, are also investigating Strontium isotopes in an attempt to reconstruct patterns of cattle and human mobility.

3.1.2 Zooarchaeology in central England

This project considers animal remains from archaeological sites in central England dating between the Post-glacial period (c. 8000 BC) and the modern era (19th century). Central England includes the areas generally known as the West Midlands, East Midlands and East Anglia. The project is funded by English Heritage, and undertaken by Umberto Albarella and Tessa Pimie. As part of this project a monograph has been produced and is currently being edited. This will be of interest to zooarchaeologists, archaeologists,

Figure 4. a) Careful excavation of skeletal remains, b) Hannah Russ with a pike (*Esox lucius*) ready to be prepared for the reference collection.



curators and historians operating in Britain and elsewhere, as well as a more general readership. The database that has been put together as a basis for the review is available online at:

http://archaeologydataservice.ac.uk/archives/view/animalbone_eh_2007/

The review is structured to facilitate inter-site comparison, and the available evidence has carefully been selected to discuss major archaeological questions, such as Mesolithic extinctions, the beginning of domestication, ceremonial and domestic settlements, feasting and consumption, agricultural intensification, the impact of the Romanization of Britain, villages and towns, regional comparison (particularly east/west), diet, trade and status and late medieval agricultural innovations. In addition, diachronic trends are highlighted, such as, livestock size and improvement over time, primary and secondary products, centre and periphery, hunting and husbandry, use of terrestrial, freshwater and marine resources, extinctions and introductions and urbanization. The discussion of these broad themes provides a critical analysis of the evidence and its potential, as well as the existence of gaps and inadequacies in the available record.

3.1.3 Iron Age–Roman transition

Archaeological evidence has indicated that major cultural changes occurred in Europe between the Late Iron Age and Early Roman periods, although these were neither homogeneous nor universal. Questions, such as the possibility of change and/or improvement of husbandry techniques, the contribution of local breeding, the introduction of livestock, use of land and the role of the market, the influence of local culture and the permanence of the Iron Age ideology will be investigated. The project builds on previous work carried out at a national level, but tries to provide a pan-European perspective by comparing the evidence from the origin of Roman influence – Italy – with that of two of the colonies – Britain and Spain. The project is interdisciplinary as it benefits from several methodological approaches, including taxonomy, demography, biometry and biochemistry. Cattle tooth enamel from selected sites has been subjected to strontium isotopic analysis to investigate the relative diversity/homogeneity of livestock supply in collaboration with Jane Evans from the NERC Isotope Geosciences Lab. Analysis is underway and is starting to produce valuable information about cattle movement during the Iron Age and Roman periods.

Silvia Valenzuela-Lamas, Claudia Minniti, Kim Vickers, Andy Hammon (English Heritage) and Umberto Albarella have all been working on animal bones from the Iron Age/Roman period sites. Claudia is focusing on differences in animal husbandry techniques between Italy and Britain during this period, while Silvia is comparing Spain and Britain. Both Claudia and Silvia join us funded by European Union Marie Curie grants.

3.1.4 Aegean zooarchaeology

Sheffield has a long-standing involvement in Aegean zooarchaeology, with partners including the Greek Ministry

of Culture, the American, Belgian, British and Italian schools of archaeology in Athens, and Athens, Bryn Mawr, Cincinnati, Louvain and Thessaloniki Universities. Analysis by Paul Halstead and Valasia Isaakidou of faunal data from the Bronze Age “Palace of Nestor”, Pylos, offers a rare opportunity for comparison with Linear B animal-related texts, as well as yielding early evidence of burnt bone sacrifice. Early and Middle Neolithic assemblages from Knossos, Paliambela-Kolindrou and Revenia-Korinou demonstrate a clear contrast between the butchery and consumption practices of the earliest farmers and their later Neolithic counterparts. In Late Neolithic northern Greece, evidence from Makriyalos for commensality on an exceptional scale is now enriched by the recently completed PhD thesis of Vaso Tzevelekidi on Toumba Kremastis-Koiladas and current doctoral research on Promachon. Isaakidou is working with current and past MSc students on a range of prehistoric and early historic projects in Crete and on the large later Bronze Age assemblage from Kynos in central Greece, while Angelos Hadjikoumis has just completed post-doctoral research on later prehistoric assemblages around Athens. In addition, Halstead and Isaakidou have also conducted ethnographic studies of “traditional” animal management and consumption in Greece and northern Spain.

3.1.5 Zooarchaeology in Qatar

Hannah has been working on animal remains recovered during excavations at Rubayqa, northern Qatar as part of the Qatar Islamic Archaeology and Heritage Project (QIAH). QIAH is a collaboration between the University of Copenhagen (Denmark), the University of Wales, Trinity St. David (Lampeter, Wales) and the Qatar Museum Authority (QMA). Analysis of the animal remains recovered from Rubayqa demonstrate the diversity and importance of these resources during the site’s occupation during the 19th and early 20th centuries.

3.1.6 Current postgraduate research

The research of the zooarchaeology team is extremely diverse. In addition to the research themes above, several other projects are currently being undertaken by PhD candidates. These include zooarchaeology of the early Medieval period in Northern Spain; a methodological approach to the understanding of the role of the goat in English medieval husbandry; the zooarchaeology of Forcello di Bagnolo San Vito (Mantova); society, economy, environment and climate in the Upper Pleistocene of Southern Italy; the history of the European aurochs from the late Pleistocene to its extinction.

3.2 Consultancy and outreach

The Zooarchaeology Laboratory undertakes assessment and analysis of animal bone assemblages from most periods (Upper Palaeolithic to modern) and all areas of Britain and Europe. Our team of experienced zooarchaeologists offer a range of expertise including analysis of mammal, bird and fish bone, microfauna, marine molluscs, crustacean and insects. Our specialists have carried out consultancy work



Figure 5. a) shelves from the Zooarchaeology Laboratory teaching reference collection, b) skulls from the reference collection, c) Umberto Albarella teaching a class on the “Understanding Zooarchaeology” short course.

in collaboration with many organisations throughout the country, and are always keen to create closer links with archaeological units and other organisations involved in developers’ funded archaeology. In Sheffield we can provide the expertise, the enthusiasm, the facilities and the know-how to carry out consultancy work in zooarchaeology.

The zooarchaeology team are involved in outreach including the AHRC funded Researching Community Heritage project, lifelong learning schemes and workshops, events and classroom support for schools, museums and local interest groups. The Laboratory also offers a three-day “Understanding Zooarchaeology” short course specifically designed for people with little or no previous experience in zooarchaeology. An ideal introduction to our field for archaeology and heritage professionals, students, and enthusiasts, our short course aims to provide a firm basis for further training, as well as contributing to a knowledge base for anyone interested in the research area. More information on the short course can be found here:

<http://www.shef.ac.uk/archaeology/research/zooarchaeology-lab/short-course>

4. Master of Science (MSc) programmes

4.1 MSc in Environmental Archaeology and Palaeoeconomy

The MSc in Environmental Archaeology and Palaeoeconomy has been training students in the skills of archaeobotany, zooarchaeology, archaeopalynology, geoarchaeology, (and previously palaeoentomology) since it began in 1980, and has been a starting point in the careers of a significant proportion of the specialists in environmental and economic archaeology employed in universities, and in other professional positions, in the UK, as well as other parts of Europe and further afield. The programme provides intensive practical training in the four sub-disciplines taught, and the opportunity to specialise in one of these. This practical training is situated within a broader theoretical understanding of the interaction between people and their environment, and the economic exploitation of crops and livestock.

4.2 MSc in Osteoarchaeology

The Zooarchaeology Laboratory has recently launched a new MSc in Osteoarchaeology. This programme combines the

study of human and animal bones from archaeological sites, allowing the students the opportunity to focus on either, or both, research specialisms. The teaching includes both lab-based practical sessions and theoretical lectures and focuses on methods and theoretical approaches applicable to many different types of archaeological questions, regardless of the period or geographic area. Students benefit from exposure to leading research teams in both human and animal bones, with ample opportunity to engage in discussions with postgraduate and postdoctoral students and staff, both inside and outside the classroom.

4.3 MSc in Geoarchaeology

This Masters programme is taught jointly with the Department of Geography, and provides practical training in geoarchaeological techniques, including field and lab-based training in Geographical Information Systems (GIS), aerial photography, field survey, remote sensing, palynology, characterisation of sediments and the use of sediments for dating. As in all our programmes, we stress the integration of “science-based” and “humanities” approaches to produce a deeper understanding of past humanity.

More information on all our MSc programmes can be found at:

<http://www.shef.ac.uk/archaeology/postgraduate/masters/courses-available>

5. Selected recent publications

- ALBARELLA, U., DOBNEY, K., ERVYNCK, A., ROWLEY-CONWY, P. (eds.) 2007: *Pigs and Humans. 10,000 years of interaction*. Oxford University Press, Oxford.
- ALBARELLA, U., DOBNEY, K., ROWLEY-CONWY, P. 2009: Size and shape of the Eurasian wild boar (*Sus scrofa*), with a view to the reconstruction of its Holocene history, *Environmental Archaeology* 14(2), 103–136.
- ALBARELLA, U., JOHNSTONE, C., VICKERS, K. 2008: The development of animal husbandry from the Late Iron Age to the end of the Roman period: a case study from South-East Britain, *Journal of Archaeological Science* 35, 1828–48.
- ALBARELLA, U., PAYNE, S. 2005: Neolithic pigs from Durrington Walls, Wiltshire, England: a biometrical database, *Journal of Archaeological Science* 32(4), 589–599.
- ALBARELLA, U., TRENTACOSTE, A. (Eds.) 2011: *Ethnozoarchaeology. The present and past of human-animal relationships*. Oxbow Books, Oxford.
- BOGAARD, A., CHARLES, M., TWISS, K., FAIRBAIRN, A., YALMAN, N., FILIPOVIC, D., ARZU DEMIRERGI, G., ERTUĞ, F., RUSSELL, N., & HENECKE, J. 2009: Private pantries, celebrated surplus: saving and sharing food at Neolithic Çatalhöyük, *Antiquity* 83, 649–668.
- BOGAARD, A., JONES, G., CHARLES, M. 2005: The impact of crop processing on the reconstruction of crop sowing time and cultivation intensity from archaeobotanical weed evidence, *Vegetation History and Archaeobotany* 14, 505–509.
- BUNNING, S. L., JONES, G., BROWN, T. A. in print: Next generation sequencing of DNA in 3000-year-old charred cereal grains, *Journal of Archaeological Science*.
- CUNNIFF, J., CHARLES, M. P., JONES, G., OSBORNE, C. 2010: Was low atmospheric CO₂ a limiting factor in the origin of agriculture? *Environmental Archaeology* 15, 113–123.
- CUNNIFF, J., OSBORNE, C. P., RIPLEY, B. S., CHARLES, M. P., JONES, G. 2008: Response of wild C₄ crop progenitors to subambient CO₂ highlights a possible role in the origin of agriculture, *Global Change Biology* 14, 576–587.
- FRASER, R., BOGAARD, A., HEATON, T., CHARLES, M. P., JONES, G., CHRISTENSEN, B., HALSTEAD, P., MERBACH, I., POULTON, P., SPARKES, D., STYRING, A. K. 2011: Manuring and stable nitrogen isotope ratios in cereals and pulses: towards a new archaeobotanical approach to the inference of land use and dietary practices, *Journal of Archaeological Science* 38, 2790–2804.
- HADJIKOUMIS, A., ROBINSON, E., VINER, S. (Eds.) 2011: *The dynamics of Neolithisation in Europe: Studies in honour of Andrew Sherratt*. Oxbow books, Oxford.
- HALSTEAD, P. 2005: Resettling the Neolithic: faunal evidence for seasons of consumption and residence at Neolithic sites in Greece. In: Bailey, D., Whittle, A., Cummings, V. (Eds.): *(Un)settling the Neolithic*. Oxbow, Oxford, 38–50.
- HALSTEAD, P. 2006: Sheep in the garden: the integration of crop and livestock husbandry in early farming regimes of Greece and southern Europe. In: Serjeantson, D., Field, D. (Eds.): *Animals in the Neolithic of Britain and Europe*. Oxbow, Oxford, 42–55.
- HALSTEAD, P. 2012: Food production. In: Erdkamp, P. (Ed.): *A Cultural History of Food in Antiquity*. Berg, London, 21–39.
- HALSTEAD, P., ISAAKIDOU, V. 2011: Revolutionary secondary products: the development and significance of milking, animal-traction and wool-gathering in later prehistoric Europe and the Near East. In: Wilkinson, T., Sherratt, S., Bennet, J. (Eds.): *Interweaving Worlds: Systemic Interactions in Eurasia, 7th to 1st Millennia BC*. Oxbow, Oxford, 61–76.
- HALSTEAD, P., ISAAKIDOU, V. 2011: Political cuisine: rituals of commensality in the Neolithic and Bronze Age Aegean. In: Aranda Jiménez, G., Montón-Subías, S., Romero, S. (Eds.): *Guess Who's Coming to Dinner: Feasting Rituals in the Prehistoric Societies of Europe and the Near East*. Oxbow, Oxford, 91–108.
- HALSTEAD, P., ISAAKIDOU, V. 2011: A pig fed by hand is worth two in the bush: ethnoarchaeology of pig husbandry in Greece and its archaeological implications. In: Albarella, U., Trentacoste, A. (Eds.): *Ethnozoarchaeology: the Present and Past of Human-Animal Relationships*. Oxbow, Oxford, 160–74.
- HEATON, T. H., JONES, G., HALSTEAD, P., TSIPROPOULOS, T. 2009: Variations in the ¹³C/¹²C ratios of modern wheat grain, and implications for interpreting data from Bronze Age Assiros Tomba, Greece. *Journal of Archaeological Science* 36, 2224–2233.
- ISAAKIDOU, V. 2006: Ploughing with cows: Knossos and the “secondary products revolution”. In: Serjeantson, D., Field, D. (Eds.): *Animals in the Neolithic of Britain and Europe*. Oxbow, Oxford, 95–112.
- ISAAKIDOU, V. 2007: Cooking in the labyrinth: exploring “cuisine” at Bronze Age Knossos. In: Mee, C., Renard, J. (Eds.): *Cooking Up the Past: Food and Culinary Practices in the Neolithic and Bronze Age Aegean*. Oxbow, Oxford, 5–24.
- ISAAKIDOU, V. 2011: Gardening with cows: hoe and plough in prehistoric Europe. In: Hadjikoumis, A., Robinson, E. N., Viner, S. (Eds.): *The Dynamics of Neolithisation in Europe*. Oxbow, Oxford, 90–112.
- JONES, G. 2005: Garden cultivation of staple crops and its implications for settlement location and continuity, *World Archaeology* 37, 164–176.
- JONES, G., CHARLES, M., BOGAARD, A., HODGSON, J. 2010: Crops and weeds: the role of weed functional types in the identification of crop husbandry methods, *Journal of Archaeological Science* 37, 70–77.
- JONES, H., CIVÁŇ, P., COCKRAM, J., LEIGH, F. J., SMITH, L. M. J., JONES, M. K., CHARLES, M. P., MOLINA-CANO, J.-L., POWELL, W., JONES, G., BROWN, T. A. 2011: Evolutionary history of barley cultivation in Europe revealed by genetic analysis of modern landraces, *BMC Evolutionary Biology* 11, 320.
- JONES, G., CHARLES, M. P., BOGAARD, A., HODGSON, J., PALMER, C. 2005: The functional ecology of present-day arable weed floras and its applicability for the identification of past crop husbandry, *Vegetation History and Archaeobotany* 14, 493–504.
- JONES, H., LEIGH, F. J., MACKAY, I., BOWER, M. A., SMITH, L. M. J., CHARLES, M. P., JONES, G., JONES, M. K., BROWN, T. A., POWELL, W. 2008: Population based resequencing reveals that the flowering time adaptation of cultivated barleys originated east of the Fertile Crescent, *Molecular Biology and Evolution* 25, 2211–2219.
- LISTER, D. L., THAW, S., BOWER, M. A., JONES, M. CHARLES, M. JONES, G., SMITH, L. M. J., HOWE, C. J., BROWN T. A., JONES, M. K. 2009: Latitudinal variation in a photoperiod response gene in European

- barley: insight into the spread of agriculture from historic specimens, *Journal of Archaeological Science* 36, 1092–1098.
- MAINLAND, I., HALSTEAD, P. 2005: The diet and management of domestic sheep and goats at Neolithic Makriyalos. In: Davies, J., Fabis, M., Mainland, I., Richards, M., Thomas, R. (Eds.): *Diet and Health in Past Animal Populations: Current Research and Future Directions*. Oxbow, Oxford, 104–120.
- MINNITI, C. 2010: Economia e alimentazione nel Lazio medievale: nuovi dati dalle evidenze archeozoologiche, *Archeologia Medievale* 36, 273–283.
- MINNITI, C., PEYRONEL, L., 2005: Symbolic or Functional Astragals from Tell Mardikh-Ebla (Siria), *Archaeofauna* 14, 7–26.
- RUSS, H., JONES, A. K. G. 2011: Fish remains in cave deposits; how did they get there? *Cave and Karst Science* 38(3), 117–120.
- RUSS, H. 2010. The Eurasian eagle owl (*Bubo bubo*): a fish bone accumulator on Pleistocene cave sites? *Journal of Taphonomy* 8(4), 281–290.
- RUSS, H., JONES, A. K. G. 2009: Late Upper Palaeolithic fishing in the Fucino Basin, central Italy, a detailed analysis of the remains from Grotta di Pozzo, *Environmental Archaeology* 14(2), 151–158.
- TWISS, K., BOGAARD, A., CHARLES, M., HENECKE, J., RUSSELL, N., MARTIN, L., JONES, G. 2009: Plants and animals together: interpreting organic remains from Building 52 at Çatalhöyük, *Current Anthropology* 83, 649–668.
- VALENZUELA, S., BAYLAC, M., CUCCHI, T., VIGNE, J.-D. 2011: House mouse dispersal in Spain: a geometric morphometrics appraisal, *Biological Journal of Linnean Society* 102, 483–497.
- VALENZUELA, S., POITEVIN, F., CORNETTE, R., BOURNERY, A., NADAL, J., VIGNE, J.-D. 2009: Evolving ecosystems: ecological data from an Iron Age small mammal accumulation at Alorda Park (Catalonia, Spain), *Journal of Archaeological Science* 36, 1248–1255.
- VICKERS, K., PANAGIOTAKOPULU, E. 2011: Insects in an abandoned landscape: Late Holocene palaeoentomological investigations at Sandhavn, Southern Greenland, *Environmental Archaeology* 16, 49–57.
- VICKERS, K., ERLÉNDSÖN, E., CHURCH, M., EDWARDS, K., BENDING, J. 2011: 1000 years of environmental change and human impact at Stóra-Mörk, southern Iceland – a multiproxy study of a dynamic and vulnerable landscape, *The Holocene* 21, 979–995.
- VINER, S., EVANS, J., ALBARELLA, U., PARKER PEARSON, M. 2010: Cattle mobility in prehistoric Britain: strontium isotope analysis of cattle teeth from Durrington Walls (Wiltshire, Britain), *Journal of Archaeological Science* 37, 2812–20.
- YALDEN, D., ALBARELLA, U. 2008: *The History of British Birds*. Oxford University Press, Oxford.

